VERANDA:

an interdisciplinary journal of
Art and Architecture

Cover Art

Aashita Relan is an architect and illustrator from New Delhi. Her artwork and other creative pursuits are inspired by her architectural education and practice, and largely focus on creating new perspectives by drawing parallels between the rich traditions of India and contemporary global pop culture.

Concept

Any built environment consists of an array of elements varying from the macro scale to the micro. Combining urban planning, architecture, interior design and landscape, it helps in the creation of relationships between users and the space that they inhibit. This artwork depicts a built form of distinctively Indian architectural vocabulary, caught in a rhythm with its surrounding flora and fauna; a synchronised dwelling, where human beings and nature are equal partners in the atmosphere without any dominance of one over the other.

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Dean's Note

I am elated to see the compilation of PhD colloqium conducted in Sushant University. It was an exceptional interactive forum where Ph.D research in architecture, planning and design was presented. Peer and senior academic input and criticism enriched the discussion and provided participants with the oppurtunity to narrow down their opinions on their research stance.

I would like to congragtulate the Veranda team of Schoool of Art & Architecture, Sushant University for creating this significant publication as an e-journal for a wider reach of knowledge.

Col. Virendra Kumar Malik S
Executive Editor, Dean
School of Art and Architecture
Sushant University, Gurgaon,India

An Indo-Portuguese word dating back to the 18th Century, Veranda resonates in Hindi and Urdu with baraṇḍā 'roofed gallery', Marathi varāḍ, varāḍā 'parapet', and echoes back to Sanskrit varaṇḍaka 'mound of earth, rampart separating two fighting elephants'. Veranda: is the interdisciplinary journal of Art and Architecture published by School of Art and Architecture, Sushant University. A hybrid journal of texts, essays, papers, critical commentaries and reviews, it explores new writing and research on architecture where connections to urbanism, planning and pedagogy re-think text and image. Veranda: (colon) makes a case for hybridity aiming to present dialogues in architecture always about to happen. This is a journal in-flux responding to current but changing issues, in Gurgaon, India, and beyond. With a distinctive graphic identity and layout, the journal appeals to both international and Indian readers, re-assessing language, topic, theme and image. Something of the moment yet also academic, something respecting the pull of tradition and heritage but situated in the contemporary, even 'speculative globalism' of current India. Veranda: defines its own difference and appeal to language (image and text) by including the silent and uncertain issues as yet not spoken about. We place before you the Volume based on our first PhD Colloquium that celebrates research in the creative disciplines of Architecture, Planning and Design.

Dr Vibhuti Sachdev
Former Dean
School of Art and Architecture
Sushant University, Gurgaon, India

Editorial

Doctoral research in the fields of architecture, planning and design is relatively nascent, as compared to the well-established domains of the so-called 'sciences'. The common thread through the three fields that connects with the built environment is receiving more focus in terms of academic research in India over the last decade or so and getting established further through the increasing number of doctoral inquiries[1]. The fields are essentially interdisciplinary, hence finding a number of intersections across each other as well as other disciplines. This volume of the journal is an exploration of recent research enquiries into the built environment, encapsulating a number of approaches and methodologies while addressing varying scales and aspects of the same.

In examination of the city, Arathy Gopal and Parminder Kaur have built upon classifications such as smart, sustainable, historic and temple cities, while Piyush Das and Tejaswini Rai study the urban cultural landscapes of Bhubaneshwar and Nathdwara to establish an integrated methodology. The larger physical region, beyond the urban realm has been investigated by Balaji from the perspective of a spatial narrative of music. Green buildings, housing, the office and water structures emerge as typological areas of emphasis in studying the built form, as also the study of construction technology and processes.

Interdisciplinarity is seen through the connecting frame of the 'people', whether it's a community strung together due to a special need, social constructs, occupation, user group or due to spatial proximity. The aspects of access, authenticity, inclusivity, informality, feminism, liveability, perception, satisfaction and sustainability are brought forth by the authors in their contributions, pointing out to concerns in examining the relationship between the human and the built environment. In contemplating the structure for the volume, we arrived at a neutral framework that allows the reader to be free from categorising the research works in terms of binary classifications. We hope that you find many more intersections and connections that spark the spirit of inquiry in your minds!

Dr. Parul Munjal
Parshati Dutta

[1] As presented during the three day PhD Colloquium I Architecture I Planning I Design organised by School of Art and Architecture, School of Planning and Development and School of Design of Sushant University in July 2020.

Temple cities of India
Categorisation based on urban form

Arathy Gopal, Mayank Mathur and Mandeep Singh

ABSTRACT

In India, many cities have evolved historically from a temple core and attract a large number of tourists. Though there are few in-depth studies focusing on the evolution of urban form of some cities, there is a lack of understanding regarding what the major temple cities of India are and their categories based on urban form. This research is an attempt to address this gap in existing literature by identifying the major temple cities of India and categorising them broadly based on urban form. Major temples and locations of mythical beliefs which have led to urban development were initially identified. The core temples were identified from literature sources and respective state tourism reports and cities with considerable tourist influx were considered further. The major Temple cities of India were identified based on four criteria identified from theory: i) age of temple, hence those built in or after 20th century not considered, ii) cities where the urban area is detached from the sacred core not considered, iii) temples with no active rituals but attracting tourists only due to heritage or architectural value not considered and iv) relatively higher tourist influx considered. The cities were further categorised into three types of urban form and the spatial distribution was mapped. The uniqueness of the sacred urbanism of India has been restated, with a discussion on the scope for further research along these lines.

KEYWORDS
Temple city, Urban form, Religious core, Form based typology, Sacred urbanism

INTRODUCTION

Across the world, many cities have evolved historically from a religious core and continue to attract religious tourists. Religious pilgrimage is a significant motivation for tourism and the destinations include various Hindu and Buddhist sacred sites of Asia (Okonkwo & Nzeh 2009). In this context, sacred pilgrimage activities merge with a commercial culture (Terzidou, Scarles & Saunders 2017). Religious tourism has many positive effects on urban form as a 'powerful force for economic growth, job creation, cultural preservation, environmental protection and peace' (Okonkwo & Nzeh 2009). However, besides improving economic opportunities and awareness about conservation, the effects of tourism include improperly planned tourism

infrastructure and services that damage the environment, and over utilisation of resources for commercial reasons (Tisdell 1987). In the case of historic cities with religious tourism potential, a major urban issue is the pressure that mass flow of pilgrims could exert on the urban fabric of holy cities, as mass pilgrimage changes the traditional townscape in favour of transportation infrastructure, commercial development and lodging infrastructure (Maroufi & Rosina 2017). There is a risk of invoking a metamorphosis of a traditional community, where it eventually dies due to commodification of culture which needs to be mitigated if not prevented (Kasim 2011). In such cities, there is an increase in certain uses while others are moved to the periphery leading to fragmentation of urban space and polarisation of activities and high land prices drive out local population (Barrera-Fernandez, Hernandez-Escampa & Vazquez 2016). The issues include congestion, intensive use of services and spaces, noise and social unrest and potentials include generating awareness regarding conservation and help fund conservation efforts (ibid.). The major changes in urban form and issues include enlargement of the area around the shrine, particularly in the case of cities governed by theocratic government, street widening for improving vehicular and pedestrian accessibility to the shrine and isolation of shrine from city fabric due to roads along the periphery of shrine, and commercialisation and commodification[1] of the urban space (Maroufi & Rosina 2017).

In India, many cities have evolved historically from a temple core and attract religious as well as non-religious tourists. Though there are few in-depth studies focusing on the urban issues in some cities (Chadha & Onkar 2016; Mehta, Yadav & Mehta 2014; Shinde 2015; Shinde 2018; Sultan 2015), studies focusing on the generalisable effects on tourism on the urban form of Temple cities of India are absent. A major constraint in initiating such a study could be the ambiguity regarding which are the major temple cities of India and the categories based on urban form. The research addresses this gap in existing literature by identifying the major temple cities of India and categorising these broadly based on urban form. Major temples and locations of mythical beliefs which have led to urban development were initially identified. The core temples were identified from literature sources and respective state tourism reports, and those cities with considerable tourist influx were considered further. The major temple cities of India were identified based on four criteria identified from theory:

- age of temple, hence those built in or after 20th century not considered
- cities where the urban area is detached from the sacred core not considered
- temples with no active rituals but attracting tourists only due to heritage or architectural value not considered
- relatively higher tourist influx considered.

Examination of existing studies on urban form and temple cities helped in evolving the criteria. These have been elaborated further in the next section.

THEORETICAL BACKGROUND

Urban form of regions developed from temples

Urban form could be studied along different perspectives. One of the earliest attempts focusing on spatial pattern was by Rose (1967) who describes urban form as the arrangement of large functional units of a city defined by the spatial patterning of land uses. The spatial pattern of most of the Indian cities that have evolved from a temple core was determined by the location of the temple. The distribution of functions of few cities like Puri evolved incrementally (Patnaik 1994) whereas in others like Srirangam, the spatial pattern was determined in adherence to religious treatises on urban planning (Ghosh & Mago 1974).

Another definition of urban form suggested by Castell (1983), stems from the societal perspective: 'urban forms are produced by the interaction between space and society, the relationship between human consciousness, matter, energy and information'. Societal aspects play a significant role in determining the urban form of Indian cities that have evolved from a temple core. Bharne and Krusche (2012) describe the importance of temple related beliefs and religious rituals in determining the urban form in such cities. There are cases where a temple complex has evolved over time, with an incremental accretion of shrines and subsequent rituals, to become a city, as in the case of Madurai, Tamil Nadu. Varanasi and Ujjain represent cities with their own mythic identities of formalised status as 'holy', owing to the presence of a temple related belief. Most of these cities attract many religious tourists which could contribute further to changes in urban form. The motivation for religious tourists predominantly being the push factor of internal stimuli (Drule, Chis & Ciornea 2012), societal aspects play a significant role in the urban form of temple cities of India.

A more recent attempt at defining urban form states it as 'the morphological attributes of a city at all scales' (Williams, Jenks & Burton 2000). This stresses the two aspects of scale and morphology in the study of urban form. The relevance of studying the city at all scales is relevant in the context of temple cities as they present a case where the economic benefits of tourism maybe distributed over the whole city but the issues on built and natural environment may be limited to the temple core. Studying at multiple scales is hence quite relevant to the context. The other aspect emphasised is morphology which involves the study of the historical transformations in urban form. Studies focusing on morphological evolution, define it as the analysis of a city's evolution from its formative years through subsequent transformations, identifying and dissecting its various components (Moudon 1997 as cited in Ahmed, Hasan & Maniruzzaman 2014; Oliveria 2016). The temple plays a key role in the evolution of the city in its formative years. The temple could be the foci of an 'unintentional' organic growth as in the case of Puri or Amritsar. It could be built by a ruler to mark his territory and promote development in it as in the case of

Thanjavur or Thrissur. It could also be built by a ruler to initiate urban development in a new region as in the case of Thiruvananthapuram or Gangaikondacholapuram. In all these cases, the evolving urban form has been largely influenced by the location of temples, the streets for access to temple or for temple related festivals and processions, and the rituals of the temple.

Rossi (1982) defines urban form as 'the construction of the city over time including aesthetic intention and creation of better surroundings for life'. His idea of 'architecture of the city' as 'the city is a gigantic complex piece of architecture growing over time as well as urban artifacts characterised by their own history and form' integrates history, built form and its temporal variation; and the emphasis on creation of better surroundings for life, brings in the societal aspects as well. He explains two levels of analysis for the study of urban form: morphology and typology; the former being the description of the form of an 'urban artifact', and the latter as the structuring principles located in the transformation and adaptations of forms of habitation. His views emphasised more on the incremental changes or transformations over a time. It has been found that in many historic cities with religious tourism potential, the tourist influx exerts a pressure on the urban fabric changing the traditional townscape in favour of transportation infrastructure, commercial development and lodging infrastructure (Maroufi & Rosina 2017). The incremental changes over a time contribute largely to the present 'visible' urban form in Temple cities.

These definitions suggest five dimensions to be considered in studying urban form: pattern, including urban pattern and distribution of functions; society, including societal aspects; scale, implying study at multiple scales; history, evidenced as morphological evolution during formative years; and time, pertaining to transformation over time. Since the study objective involved understanding the urban form of cities which have evolved historically from a temple core, the dimension of history, that is manifested in morphological evolution during formative years, was found to be most relevant. However, the other dimensions need to be considered in identifying the major temple cities, to have a holistic understanding of what are the major categories of urban form in such cities.

Religious faith and tourism in temple cities

There are various sources that demonstrate the magnificence of religious tourism in India. 'In India, religious visitation is estimated around 170 million and to more than 2,000 sites and almost 95% of domestic travelers are religious tourists' (UNWTO 2011 and Sharpley & Sundaram 2005 cited in Shinde 2015). 'India for centuries has been a center for pilgrimage and of late, a major domestic and international destination for religiously based travel' (Koldowski & Martin 2008). Largest proportion of domestic trips in India are made up of religious pilgrimages (National Council of Applied Economic Research 2004 as cited in Koldowski and

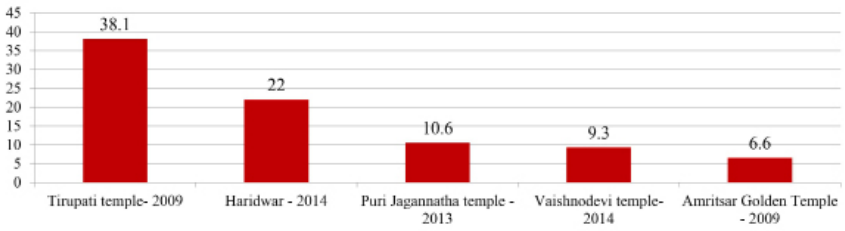

Figure 1: Visitors to major religious sites in India, 2004, in millions. Based on National Council of Applied Economic Research, 2004 as cited in Koldowski and Martin (2008) (Source: Author)

Martin 2008). 'Tirupati's annual list of pilgrims is higher than the total number of Indian travelers visiting Delhi, Mumbai, Bangalore and Kolkata put together' (ibid.). The number of visitors to the five major religious sites in India, in 2004 is charted in Figure 1.

There are very few research studies that examine the impacts on physical form and functions in detail. Vargheese and Varghees (2012) have studied the satisfaction of tourists, purpose of visit and other determinants and issues faced by tourists in Tuticorin and ranked pollution and lack of cleanliness as the major problem. Shinde (2018) presents the findings of a study on the governance and management aspects of religious tourism in two cities of Vrindavan and Shirdi as follows:

> On one hand, there is rapid urbanisation both in terms of demographic change (with an increased migrant population) and conversions from agricultural to urban land uses and speculative real estate that is supposed to serve the increased visitation. On the other, this growth is not supported by necessary infrastructure and environmental services; water supply is inadequate for the increased population, the sewage disposal system through surface drains is near collapse and solid waste is a menace.

The research establishes that by overcoming the 'institutional vacuum' in dealing with impacts at traditional pilgrimage sites, urban issues can be addressed and better measures of sustainability can be developed. It is also stated that conversion from agricultural to urban land uses was found in such cities. It can be understood from these studies that tourist influx has a considerable impact on the urban form of temple cities of India.

Since many of the temple cities have a mass tourist influx during seasonal festivals and rituals of the temple, they witness a transient or temporary urbanism. Sultan (2015) evaluates the existing tourism infrastructure, desirable impacts of tourism on local economy and the undesirable impacts on the environmental quality of Haridwar. From data collected during field study, the shortcomings of the existing accommodation and transportation facilities were assessed. It was found to be far too short to meet the demands during the 'Kumbhmela' and 'Ardh Kumbh mela' days, when the tourist influx to Haridwar reaches the maximum. The disposal of sewage into Ganga and the mass bathing of pilgrims, leads to deterioration of

river water quality which may injure health of people taking the dip in the river and also affect the health of the population downstream who use the river as a source of water for drinking and bathing. The paper elaborates on issues that include lack of infrastructural facilities to support sudden swell of pilgrim influx leading to degradation of urban environment, disruption of vehicular movement and lowering of environmental quality (Sultan 2015). The temporary urbanism during major festivals is found to initiate changes in urban form including lack of transportation, housing and infrastructural facilities to support sudden swell of pilgrim influx during festivals, temporary plotting and provision of permanent facilities for temporary influx, degradation of urban environment and lowering of environmental quality. On the positive side, it also initiate preservation and protection of buildings of historical importance (Mehta, Yadav & Mehta 2014 as cited in Chadha & Onkar 2016).

Defining typology of temple cities

A typology of urban areas developed or developing from temples in India was detailed by Vinayak Bharne and Krupali Krusche in their book on sacred urbanism in India (Bharne & Krusche 2012). The first type termed 'temple compounds and hamlets' are those in which multiple enclosures devoted to a deity, morph into complex compounds over time, accommodating multiple shrines, buildings, and residential quarters, as in the case of Badami, Karnataka. The second involves 'sacred towns', in which a large temple complexes formed through an incremental accretion of shrines, evolved over time to become centres of sizeable towns, as in the case of Madurai, Tamil Nadu. The third type termed 'exurban ensembles and acropolises' includes cities with mostly detached sacred-urban relationships, with a visually dominant temple tower seen from the distant city or temples perched atop a hill as an acropolis with visual access from city. This is seen in the case of the temples bordering the hill of Kamadgiri in Chitrakoot, Madhya Pradesh. The fourth type involves 'sacred and political centres' characterised by the bipolarity of the sacred and royal dimensions. In these cases, the city did not just grow incrementally around a temple, but were initiated or consciously built by a king due to devotion, special occasion or as a symbolic proclamation of ruling dynasty, as in the case of Thanjavur, Tamil Nadu. The fifth and final type termed mythic cities and its translation involve cities with their own mythic identities of formalised status as 'holy', owing to the presence of a temple or belief; and its translations are cities intentionally reproduced as in the case of Ujjain, Madhya Pradesh and Bishnupur, West Bengal.

However, within these five categories, there are more differences determining the evolving city form. There are cities with their core temples having no prominent deity worship or religious pilgrimage at present. For example, Konark Sun Temple in Odisha acts predominantly as a cultural tourism destination attracting predominantly secular tourists with interests in the heritage value. There are also cities that have lost their relevance as a sacred core and developing predominantly

as administrative capital rather than as a sacred destination. This is depicted in cities like Bhubaneshwar, Odisha and Thiruvananthapuram, Kerala where the temple forms serve as a cultural heritage point attracting tourists. There are cities with religious foci of evolved urban form as a point around the temple core, a line along a procession path or an area, as there are many temples or shrines of relatively equal relevance. Also, several aged temples had initiated settlement involving incremental addition of spaces over the large period, whereas relatively newer temples promote economic development with limited impact on the urban form during the formative years of the urban area.

Defining temple cities and criteria for identification

A suitable definition of 'temple cities of India' is found to be absent in existing literature. For the purpose of this research study, these are defined as 'urban areas that have evolved due to a temple or multiple temples or temple related beliefs and which continue to attract considerable tourist influx'. The four criteria for identifying the major temple cities along with the rationale are elaborated here.

- **Age of temple:** The literature review on urban form had stated the dimensions of history, seen in morphological evolution during formative years and time evidenced as transformation over time. Many temples are being built in India and they continue to transform the immediate urban precincts as in the case of Akshardham in Delhi and Attukal in Kerala. However, these cities lack an influence of the temple during the morphological evolution of the region during formative years. Hence for the purpose of the identification of major temple cities of India, those cities which had developed incrementally over a considerable period of time are more relevant.
- **Relation of urban area with the sacred core:** The literature review on urban form had stated the dimensions of pattern, as urban pattern and distribution of functions, which is relevant only when the temple is in the urban area. There are many major religious tourism destinations in India, where the temple is detached from the urban core, Tirupati temple, Vaishnodevi temple and Sabarimala temple to name a few. In all these cases, due to the local terrain and location of temple, mostly atop a hill, the region witnessing urban development is an area on the way to the temple. In these cases, when the urban area does not become the destination but is only on the way to destination, the temple has limited influence on the evolving urban pattern and distribution of patterns. Hence for the purpose of the identification of major temple cities of India, cities where the urban area is detached from the sacred core need not be considered.
- **Presence of active rituals in urban areas with core temples:** The literature review on urban form had stated the dimensions of society, or societal aspects as an important factor. The temple, with its active rituals, has a large societal impact. The relevance of the rituals in determining the urban development is also restated by Bharne and Krusche (2012). Temples like Khajuraho with no active rituals act more as a cultural tourism destination. In the same state of Odisha, Konark presents a case where the city develops as a cultural tourism

destination and Puri presents a case of large number of religious tourist influx to the core temple. The tourism to such cities and resultant urban development and changes in urban form, will continue in an upward trend as the motivation of the tourist forms part of a theological continuum. Hence, for the purpose of the identification of major temple cities of India, urban areas with core temples having no active rituals but attracting tourists only due to heritage and/or architectural value need not be considered.

- **Higher tourist influx:** The huge magnitude of religious tourism in India has already been discussed. As mentioned in the definition of temple cities also, considerable tourist influx is a determinant of the relevance of the city. Hence for the purpose of the identification of major temple cities of India, urban areas with relatively higher tourist influx needed to be considered.

METHODS

Major temples and locations of mythical beliefs which have led to urban development were identified from literature sources[2] (Deva 1995; ed. Dhaky 1998a; ed. Dhaky 1998b; Josna & Kasthurba 2015; Mitchell 1977; Subba Reddy 2009; Tom 2014) and cities with considerable tourist influx were regarded as temple cities of India as a part of the research. Based on four criteria, 42 major temple cities of India were identified from the list. The data for the four criteria were derived from respective state tourism reports and other literature and secondary sources. The major temple cities of India were further analysed for the typology of urban form. Three broad categories of urban form were identified. The location of cities was spatially mapped with distinction made between the three categories.

It was found that 102 cities in India had developed predominantly due to temples or temple related beliefs. From the initial list of 102 cities, few urban areas developed around temples were excluded based on the criterion of age of temples, which included the Akshardam Temple complex in New Delhi, Pitambara Peeth Temple in Datia and Solomon Temple in Aizawl. Each of these was built in or after 20th century. Few urban areas with detached sacred-urban spaces were excluded based on this criterion which included Katra, the location of Vaishnodevi Temple and Erumeli, the location of Sabarimala Ayyappaswamy Temple. It was noted that there were also cities that develop due to the adjacency of more than one detached temple. For example, in the case of Chitrakoot, Madhya Pradesh, the urban development is due to the temples bordering the forested hill of Kamadgiri in Uttar Pradesh as well as Maa Sharda Devi Temple atop Trikoota Hill in Maihar in Madhya Pradesh. Urban areas with core temples having no rituals and functioning as a destination of cultural heritage value were eliminated which led to cutting down many urban areas, predominantly in the states of Madhya Pradesh and Karnataka. The tourist influx numbers were collected for each city, as per the respective state tourism reports. However, comparison between cities across states was not possible due to

Figure 2: Major Temple cities of India with categorisation based on urban form. (Source: Author)

lack of the data in the same year. Hence within the state, the cities were compared and cases with relatively higher influx of tourists were considered.

Thus, from the initial list of 102 cities, a list of 42 major temple cities of India were arrived at. It was further seen that the cities showed predominantly three broad types of urban form. Type A includes temple or temples forming the core or a street from temple forming spine of developing urban form. Type B constitutes multiple temples forming multiple foci of development. Type C encompasses cities developed predominantly due to mythical beliefs and not because of temples or temple-related rituals. The spatial distribution of the major temple cities in India including the typology is shown in Figure 2.

DISCUSSION

Besides finding an underlying generalisable urban pattern, the study also demonstrated considerable differences within the three subtypes. The uniqueness of the sacred urbanism of Indian Temple cities as explained by Bharne and Krusche (2012) is restated through the study findings.

Type A include cities that have evolved from a temple forming the core as in Thanjavur, temples forming the core as in Madurai or a street from temple forming the spine of developing urban form as in the case of Puri. With cities like Amritsar in North, Veraval in West, Imphal in East and Thanjavur in South, this typology is relatively distributed uniformly across India. However, there is a greater concentration of cities in peninsular India in comparison to the northern half. The underlying urban pattern involves a radio centric development from the core or development along a major street. The street could be a processional street as in the case of Puri or access streets as in the case of Thanjavur. With relatively similar religious significance, the evolving urban area could have sprawled over a large area as in the case of Amritsar or be limited to a small area as in the case of Puri or even smaller in the case of Pushkar. There are cities like Thiruvananthapuram where the temple was built to initiate development in a new capital but over time the religious significance is lost as the city develops as an administrative capital. It is seen that though there is a generalisable urban pattern, there are considerable differences in the evolving urban form.

Type B includes cities in which multiple temples have formed multiple foci of development. For example, Kanchipuram has developed due to multiple temples with the evolving urban form influenced by Kailasanatha, Vaikuntha Perumal and Kamakshi temples. Except Guwahati and Orccha, all the cities in this typology are in the two states of Tamil Nadu and Karnataka in south India. The share of this typology in the listing is also lesser. Only seven cities out of the total 42 depict this type of evolving urban form. Within this subtype, there are cities where one temple has a relatively larger significance. For example, though developed with multiple temples forming foci of urban development, there is a relatively higher religious significance to Jambukeshwarar temple in the case of Thiruchirapilli and Adi Kumbeshwarar temple in Kumbakonam. This is unlike the development in Kanchipuram, where temples form nodes of relatively similar significance.

Type C includes cities developed predominantly due to mythical beliefs and not because of temples or temple-related rituals. This typology is totally absent in southern parts of India. The temple city of Varanasi developing with the ghats (steps leading down to the water) along river Ganga for ritualistic ablution and multiple temples including the Kasi Viswanath Temple; city of Mathura with its beliefs related to the birthplace of Lord Krishna, and the city of Allahabad with the location of Kumbhmela, present cases where the city has developed predominantly due to mythical beliefs. It is interesting to note that the tourist influx to such cities is higher in comparison to most of the cities in Type B and many cities in Type A. It is seen that though the urban pattern is determined by the religious beliefs and rituals in all cases, generalisable features of evolving urban form are limited.

CONCLUSION

Through this paper, the authors have addressed the research questions of which are the major temple cities of India and what are the categories based on urban form. The findings include a listing of 42 major temple cities of India and three broad categories of urban form. Type A includes temple or temples forming the core or a street from temple forming spine of developing urban form, Type B has multiple temples forming multiple foci of development and Type C represents cities developed predominantly due to mythical beliefs and not because of temples or temple-related rituals. Besides finding an underlying generalisable urban pattern, the study also demonstrated considerable differences in the urban form of temple cities. The uniqueness of the sacred urbanism of Indian temple cities is restated. The limitations of the study include a lack of primary survey of the cities for a deeper understanding of the urban form. The data collection was limited to literature and secondary sources of information due to the geographical spread of the cases. Besides addressing the gap in literature, the study findings would be useful for initiating further studies on understanding the change in urban form and other urban issues in such cities.

END NOTES

[1] Based on real estate speculation.
[2] Including respective state tourism reports.

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Occupant satisfaction
A measure of green building performance

Ashima Grover and T S Brar

ABSTRACT

Green building certification is a standard practice for ensuring positive performing buildings for its construction and operational phase. Throughout a buildings' lifecycle, major consumption of resources occurs in the operational phase, when occupants interact with building systems and spaces for their comfort and productivity. Building performance is largely a measure of the quantity of natural resources it consumes for its working and quality of spaces it provides for its occupants. Occupant perception and satisfaction within an environment is an implicit parameter which has a huge impact on building performance. This parameter of performance is rarely attempted for comprehension or quantification by building operators, managers and owners by conducting post-occupancy evaluation studies. This lacuna in building industry practice leads to a gap in anticipated building operational performance. Therefore, this paper is an attempt to highlight the significance of occupant satisfaction in achieving green building performance targets.

KEYWORDS

Building operational energy Performance, Occupant Satisfaction, Post Occupancy Evaluation

INTRODUCTION

Buildings play a critical role in overall environmental sustainability. Throughout the building life cycle construction, occupancy, renovation, repurposing, and demolition, they have a huge impact through land use, material use, waste generation, atmospheric emissions, water and energy consumption. Other than these mentioned effects on the environment, buildings and spaces also have effects on its occupant physical and mental health, productivity and satisfaction. In response to these, green building certification systems provide building experts with a global standardised Yard scale to measure building's impact on the environment and occupants. In large green building certification systems are based on similar domains like site sustainability, energy efficiency, water efficiency, material use, Indoor Environmental Quality (IEQ) and waste management. Within these domains of green buildings certification systems, the environmental benefit

is indisputably the prime benefits, but there are several unspoken benefits as well that are to addressed to occupant wellbeing- comfort and satisfaction majorly under IEQ section.

The green buildings industry has a deep impact on social transformation of society. It is not only to the building designers and owners, it propagates a larger role to its occupants, like understanding of design philosophy, generation of green ideologies and encouraging pro-environmental behaviours. The provision of awareness, education and training to occupants, a minor feature within the green rating systems, helps to regulate their behaviour of using systems and operating the buildings which later affects the building performance significantly (Elham *et al.* 2017).

Published literature highlights the fact that green building designs do not always operate ideally as anticipated (Al Horr *et al.* 2016). In such a scenario, strategies adopted in a green building may not always facilitate the occupant's desired comfort conditions, therefore, it is of great significance to ensure that energy-efficient systems, technologies, operations and measures do not have an undesirable impact on occupants' health, productivity, comfort and perception of indoor space, which may incite undesired adaptive behaviours of occupants later, leading to altered unpredicted building performance (Kim & Kim 2020). In this context, it is important to investigate how occupant responds and interacts with green building technologies and also finding measures to sustain high energy performance along with desired occupant satisfaction.

OCCUPANT SATISFACTION: FACTORS AND PARAMETERS

Impact of space environmental factors on occupant satisfaction

People spend almost 90% of their life in indoor environments (houses, schools, work environments, etc.) and the effects of indoor conditions on human health cannot be ignored (Fantozzi & Rocca 2020).

It is of prime importance for a fulfilling space purpose and productivity, that occupants are comfortable, healthy and satisfied. It is imperative, for occupants, that their psychological comfort and assurance at work are fulfilled through quality designs and efficient operation of space (Asmara *et al.* 2014). Satisfaction or dissatisfaction within a working or living environment space can be a subjective perceived opinion of an occupant which is also influenced by personal and contextual characteristics.

Building occupants are exposed to numerous indoor environmental factors like thermal, visual, acoustic and air quality factors (Schweiker *et al.* 2020). Various research indicates that there exists a very complex relationship between space

environmental factors and occupant perception of satisfaction. The overall interactive outcome of this determines occupants' indoor environmental perception, satisfaction leading to adaptive behaviour towards its environmental space factors. These factors can have both short and long-term impacts on the occupants (Al Horr *et al.* 2016). Out of all environmental space factors, IEQ factors determining occupant's comfort levels are of high significance. As per the building owners claim that the cost of the occupant in doing the job is substantially higher than the cost of energy, therefore, which goes contradictory if workplace designers fail to provide workers with an environment healthy, comfortable and productive through improved space environmental parameters (Asmara *et al.* 2014).

Studies on occupant perception and satisfaction

Conducting a Post Occupancy Evaluation study and surveying occupants, to understand occupant interaction patterns and evaluating satisfaction levels within a space is the most used method. There exists a varied range of published studies conducted in other countries, but hardly any on Indian green buildings. The majority of POE studies aiming to investigate occupant satisfaction in context to IEQ factors of space have investigated specific aspects such as thermal comfort, visual comfort, ventilation, stuffiness and sound privacy. Some studies indicate that along with IEQ factors, other space elements such as exposure to nature and daylight, noise and ergonomics as well as opportunities for social gathering, relaxation and exercise also impact occupant satisfaction (Kamaruzzamana *et al.* 2011).

Interdisciplinary studies on human perception, behaviour and building performance evaluation have highlighted a wide range of facts, emphasising more the influencing factors and its implications of occupant satisfaction scores. The satisfaction levels of occupants to a very great extent are influenced by the perception or image they have of their working and living environment. In comparison to green versus a conventional building, it is found that occupants are more appreciative of their green environment, even in case of discomfort. The image of enhanced performance i.e., green building certification label, has a positive impact on the user's perception, studies have revealed that the occupant satisfaction score with their workspace is much higher for a green building compared to a conventional building (Max Paul & Dear 2010).

It is also found that occupant's awareness of its building performance and system efficiency influences his perception of space psychologically. Even in the cases where all IEQ parameters of spaces are equally performing, a green certification label on a building can have a positive impact, influencing occupant perception leading to scoring higher on occupant satisfaction compared to a non-green building (Holmgren *et al.* 2017). This positive image influence on the occupant perception was also investigated in a study (Khoshbakht *et al.* 2018), highlighting that occupants of a green building even if they are experiencing discomfort in certain IEQ parameter, tends to forgive the discomforting conditions due to the

overall positive image of building performance. However, an experimental study (Geng *et al.* 2017) conducted to find the relationship between various IEQ factors and their related impact of occupant perception highlights that in some scenarios the unsatisfactory performance in any one of the factors not only affected associated comfort levels of that factor but also had a comparative and relative impact on the perception of other IEQ factors indirectly leading to lower satisfaction scores. This study also highlighted the fact that the occupant's expectations from the environment in terms of comfort and satisfaction is higher in better performing spaces or green labelled buildings.

An analytical study to investigate the impact of interior design space layout on occupant energy behaviour, where space was studied by dividing into destination, circulation and energy consumption spots, highlights the significance of space design and how it influences the choices of activities and potential behaviour (Delzendeh & Song 2017). A detailed literature review of relation between IEQ and occupant satisfaction is published where experts imply that top-rated green buildings with high IEQ scores that have implemented measures to achieve improved IEQ conditions within the spaces have a positive influence on the satisfaction and perceived productivity of occupants (Kim & Kim 2020).

In contradiction with the above facts, a study where 65 LEED-certified and 79 conventional buildings were surveyed in the US, to investigate the performance and occupant satisfaction levels, the outcomes revealed that green building and conventional building have equivalent occupant satisfaction scores with the IEQ factors, building, interior and workspace design, highlighting the fact that there is no substantial influence of LEED certification on occupant satisfaction (Altomonte & Schiavon 2013). A similar study conducted to investigate occupant satisfaction in UK BREEAM certified office buildings, showed similar results that certification does not have a substantial effect on occupant satisfaction (Altomonte *et al.*, 2016). The above studies highlight the fact that any building or space, that maintains a positive optimal balance with its efficient operations, human-centric space designs and ethical working social norms, like encouraging positive and constructive interactions, and reducing negative and relegating distractions, could help in maintaining desirable effects on occupant's satisfaction and perceived productivity (Goçer *et al.* 2019).

The results from POE study on 77 Australian open-plan offices, emphasises a strong link of space physical configuration space design with occupants' perceived productivity and satisfaction levels. Evaluating several features of a building design and operations like aesthetic quality of space and building, comfort conditions from environmental parameters- visual, thermal, IEQ and acoustics, personal controls, outside views and connections to spaces, privacy, security, maintenance and individual space configuration. This study highlights the fact that a good physical configuration design with maintained building operations, positive

occupant working condition and experience, and regular working hours have a high association with the overall image of a workspace building for users (Göçer *et al.* 2019). However, it is difficult to directly determine what environmental factors of space have a major role in inducing satisfaction or dissatisfaction to a user.

Parameters affecting occupants' satisfaction

The reviewed literature supports that the overall space can affect its users through its performance or its experience and perception. A study to measure user satisfaction broadly classifies a method within two main clusters such as performance-based building user satisfaction measurements and perception-based building user satisfaction measurements (Shafaghat *et al.* 2016).

- Performance-based IEQ parameters: These include thermal comfort, that is temperature and humidity levels; visual comfort, that is daylight and artificial light levels; acoustic comfort or noise control, and indoor air quality, that is odour, CO_2 levels, pollutants, ventilation and air exchange rate.
- Perception-based space design parameters: These include aesthetic value, outside visual connections, furniture and partition layouts, colour and material, privacy, cleanliness or maintenance and building or space system controls.

The satisfaction of building occupants is affected by all of the above parameters of space. Space constitutes tangible and intangible factors which form a relationship with the occupant. To understand the overall process and linkages, it is necessary to evaluate all the above mentioned parameters of a space that interacts with the occupant and help to develop the perceived satisfaction. These space environmental parameters should form the core of all enquiries aiming towards occupant satisfaction.

RELATION BETWEEN OCCUPANT SATISFACTION, ADAPTIVE BEHAVIOUR AND BUILDING PERFORMANCE

The assessment of occupants' perceptions and satisfaction can provide valuable information about building performance (Kamaruzzamana *et al.* 2011). The performance of occupants should be aligned with the building performance to achieve the desired results of sustainability. There should exist a fine balance between energy and resource efficiency in a green building to provide a satisfactory and productive space for the occupants. For this, it is imperative to understand the engagement of occupants in the buildings. Occupant interaction and adaptive behaviour within the building is strongly influenced by occupant satisfaction and perception which influences the building operations involving energy use and cost of operations thus forming a closed-loop (LBNL & Tsinghua University 2017). Technology and occupant adaptive behaviour together holds the potential to achieve high performing buildings and spaces. Space operational cost and energy consumed are greatly affected when occupants perform various actions to

satisfy their physical, environmental, psychological or physiological requirements with indoor comfort conditions like adjusting thermostat settings to be warmer or cooler, opening windows for ventilation, turning on lights, pulling down the window blinds and moving around, among many other actions that significantly affect building operations (Belafi *et al.* 2018).

As experts claim that Occupant Adaptive behaviour is the measure of user satisfaction and has the potential to improve building and space energy performance (Shafaghat *et al.* 2016). However, Green building certification systems have not yet recognised a clear association between user satisfaction with adaptive behaviour and energy efficiency. Within a green building code, the potential to enhance the Indoor Environmental Quality (IEQ) is substantial. It is implied that a higher-ranked green building is high performing as well, where occupant comfort conditions and comfort-related behaviour are aligned (Brown & Cole 2009). A study conducted with this theory (Keyvanfar *et al.* 2014) provides evidence that the occupants' adaptive behaviour formed due to discomfort or dissatisfaction, contributes to high operation energy use. This implies building occupants when not satisfied with the building operational features or systems and they may adapt the building indoor environment design according to their satisfaction level with individual interventions, which causes higher energy consumption.

A review paper (Sujanova *et al.* 2019) published based on an analysis of more than 300 scientific publications between 1960 and 2019, covering topics concerning IEQ, energy efficiency, occupant comfort, health, sustainability and adaptability of the built environment, highlights the necessity of a human-centric design of the built environment, where the efficiency of technology can be measured only if it is successfully implemented and used by the building occupants.

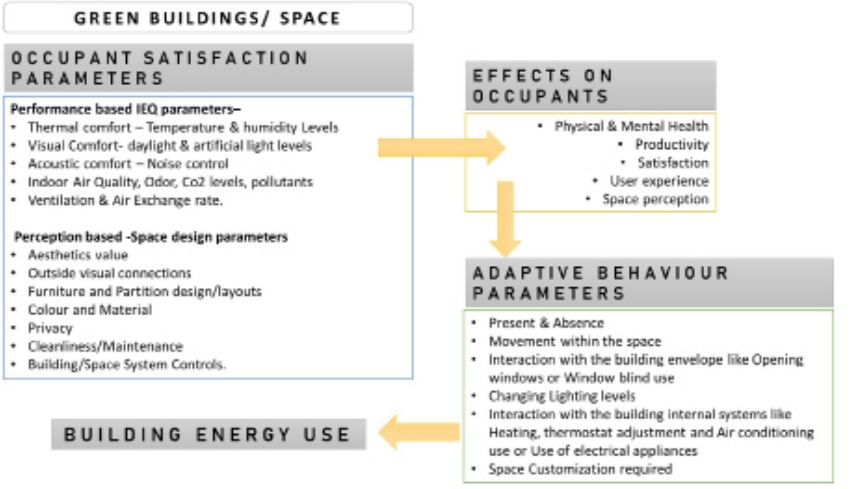

Figure 1: Illustrates the association between occupant satisfaction, adaptive behaviour and building performance. (Source: Author)

METHODS AND APPROACH

All over the globe, experts are attempting to arrive at an accurate methodology to integrate occupant satisfaction and behaviour modelling into pre and post-construction building energy efficiency approaches. Methods like surveying, surveillance and simulations have been used by experts in various studies to evaluate the same. For POE investigations Occupant Survey- electronic or handouts with walkthroughs, interviews and field measurements are widely used.

To evaluate occupants' perception and satisfaction levels, longitudinal surveys are the most commonly used method due to their relatively low cost of implementation and ease of communication (Berquista *et al.* 2019). A literature review recently published by (Li *et al.* 2018) shows that the occupant long term survey helps quantify subjective opinions through the series of questions with scaled answers or responses and then benchmarks the outcomes. These types of longitudinal surveys are suitable for consistent building occupants who are exposed to the same spatial conditions daily, over the long term (Berquista *et al.* 2019).

UC Berkeley published a literature review on established survey methodologies identifying 10 surveys that evaluate occupant comfort, perception and satisfaction on space IEQ parameters (Clara & Stefano 2011). Seven of the ten surveys were used for specific research projects and have fallen into disuse. This review highlights that the two most extensively used survey methods for long term assessments are the Center for the Built Environment (CBE) survey and the Building Use Studies Occupant Survey (BUS). Another survey tool recently developed and widely in practice is The Building Occupants Survey System Australia (BOSSA). It is an Australian-developed POE instrument for office buildings (Candido *et al.* 2012). All these survey methods are based on a similar base ground of assessing the results from occupants and their engagement with the built environment, although they differ in their approach, features and structure of the questionnaire. All the three survey methods are closed-ended with multiple choice answers, requiring participants to choose each possible answer, independent of the others, on the continuum of responses, provided by Likert scale. They all have been established, verified and kept consistent over many years, thus enabling reliable benchmarking. The BUS questionnaire has been developed in the UK and used worldwide, the CBE questionnaire is developed and implemented in the USA, whereas BOSSA has most of its implementation in Australia.

The mentioned survey methods are well designed to investigate occupant satisfaction scores, primarily dealing with IEQ factors and space design. They are widely implemented in various other countries but when tested for application on the Indian office buildings, the questions and structure need modifications as per the climatic context, regional context, working pattern and social norms followed in Indian workspaces. Also, the structure of these survey methods does not focus

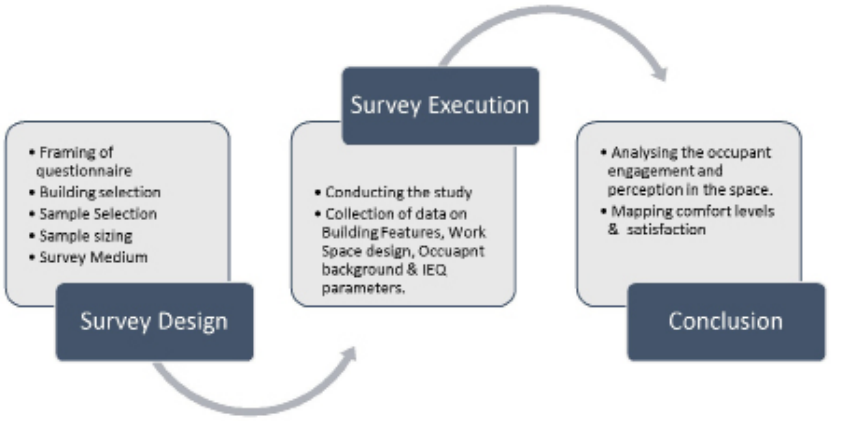

Figure 2: Illustrates the process of conducting a survey. (Source: Author)

largely on adaptive behaviour linked with discomfort experienced in the specific environmental or non-environmental space parameter. These lacuna accentuate the need for developing an advanced method tool structured specifically to the Indian workspace context.

CONCLUSION

The consumption of resources like energy, water and daylight, are the primary parameters of efficiency in green buildings but there exists a strong relationship between occupant perception, satisfaction levels, adaptive behaviour and building performance levels, which is still overlooked in current green building practice. The occupant centric discussion presented in the paper with the building systems and the space environment has large implications on building performance that need to be acknowledged by all stakeholders of the building industry and considered throughout the building life cycle.

The foreign existing established quantification- survey methods highlighted in the paper are well verified to comprehend the occupant perception and satisfaction levels of the space but this is still open looped as this method does not close the connection of occupant dissatisfaction to the mapping of occupant adaptive behaviours, and then methodically leading its connection to the building overall performance. There exists a need for an advanced tool or method that can investigate the complete link of satisfaction, adaptive behaviour of occupants that can be adopted as a solution to test the performance of Indian buildings.

In the current practice of green buildings, professionals have yet not acknowledged that the occupant satisfaction can be a measure to test the building performance but it holds a large potential for improving efficiency levels leading to the overall sustainability and mitigating adverse effects of building sectors on planetary problems like climate change.

NOTE

This research paper is developed from a part literature review of the author's PhD thesis work.

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Spatial Narrative of Carnatic Music in Kaveri Basin

Balaji Venkatachary

ABSTRACT

Carnatic and Hindustani are the two major art music traditions practiced in India. Carnatic music had its origin in the tradition of Vedic chanting. Study of ancient treatises show that it went on to acquire a complex form between 500 BCE to 500 CE in the form of Tamil Pann (melodic mode of ancient Tamils) music. These compositions were secular in content, and were quite uniquely attributed to landscape features for creating an imagery and mood for the songs. Tamil Bhakti (devotional) movement around 700 CE brought in a revolution in the musical form by introducing devotional compositions and complex rhythm. During this period, a group of Tamil saint poets glorified sacred centers and landscape features in their musical works. On the other hand, musicians were offered significant roles in temple services and eventually the practice of temple music was institutionalised. Around 1400 to 1700 CE Carnatic music received royal patronage in the courts of Tanjavur, Mysore and Travancore. Thus, one could say Carnatic music has journeyed through sacred landscapes, temples and royal courts to arrive at its current form. Today, Carnatic music plays a historical as well as modern role in temples and concert halls. This paper focuses on the spaces associated with Carnatic music in the Kaveri basin. It is argued that Carnatic music is a contextual and place-centric phenomena with the aid of four case studies including a temple town (Nangur), a living palace (Amba Vilas), a memorial site (Thiruvaiyyaru) and a concert hall.

KEYWORDS

Carnatic music, Kaveri basin, musical spaces, Bhakti movement

INTRODUCTION

India is a land where a host of musical traditions are found to thrive and it boasts of a huge repertoire of several genres and families of music, from regional indigenous music to classical traditions spanning across the nation. Music is an inherent part of Indian culture and Indian culture appears to be strongly rooted to its regional geography or place. Music in India seems to be diverse yet sharing common features and characteristics and appears to engage very actively with its community and the environs. While certain forms of music are prevalent within a community, certain

others are of national inheritance. Certain forms are ritualised and have really been owned and guarded staunchly by the inheritors, while the others have penetrated into a purely artistic realm for enjoyment and explorations and is allowed to be owned by anybody who explores it. Landscapes and Music in India seems to be interwoven with each other (B Venkatachary *et al.* 2018). One such example is lyrical compositions of Toda, a tribal group from the Nilgiri mountains of Tamil Nadu that includes descriptions of nature and landscapes. Musical festivals such as Tansen Samaroh in Gwalior and Thyagaraja Aradhana in Thiruvaiyyar, to mention a few, are set in a landscape to create the artistic ambiance carrying a historical meaning of its association.

Ragamala[1] paintings are another prominent example of how classical Indian music was always associated with imagery of deities, personalities, landscapes, time of the day and seasons. In these paintings each raga is depicted by a colour, mood, a story of a *nayaka* (hero) and *nayika* (heroine), with the carefully chosen motifs and shades indicating the season and the time of day in which a *raga* (Indian musical modes) is prescribed to be sung. Most of these paintings are also codified with iconography of specific deities associated with the *raga*, for instance, Shiva, a Hindu deity appears in Ragamala paintings attributed to the raga Bhairav or Bhairavi, Devi for raga Sri and so on. Along with the *raga*s, each folio of Ragamala paintings are generally known to depict the *raginis*, the wives of respective *raga*s, their sons called Ragaputra numbering around five to six for each couple of Raga-Ragini and sometimes even the daughters known as Ragaputri (Jain 2002).

Another perspective to look at the spatial relationship of music is to examine the musical performances in the physical place of enactment. For example, ritual music of temples of Tamil Nadu and Kerala have a set of protocols as to who is allowed to perform, in which part of the space and in which season. Similarly, the performers and the audience in a concert hall know what protocols to exhibit in that space and time during the concert. The study shows that even architectural elements and iconography show a correlation to the music it is associated with. For example, the saint composers of Tamil Bhakti or devotional movement era are depicted on the gopuram (temple towers) and shrines of the temples that were sanctified through their compositions. Although the above indicated spatial expressions of Indian music are understood at large, few studies seem to have explored it systematically. For the purpose of this paper, one form of music, that is Carnatic, is chosen and its association with various spaces in varying occasions are explored and presented.

SPATIAL NARRATIVES OF CARNATIC MUSIC

Art music is a term used by musicologists to represent a tradition of music that has a developed structure and theory (Siron 2002) or in most cases accompanied by a written tradition (Arnold 1983). It is also referred to as classical music or canonic

music (Nettl 1995). Hindustani and Carnatic traditions constitute the two major classifications of Indian art music or more popularly known as Indian classical music. Historically, though both the traditions share the same origin, and over time, due to various regional influences, they have evolved into two branches developing their own characteristics and repertoire. Hindustani form is largely seen in the northern and western parts of the country including some parts of south India, while Carnatic is predominantly the manner of the south. Some fundamental differences between both the traditions can be easily noticed in the language of the compositions, structure of presentation, instruments used and technicalities like the *gamak*s (ornamental patterns in Indian music) (Krishna 2013). However, this is just a comparison on the surface. Elaborating on the nuances of the forms of music is beyond the scope of this paper.

From the study of Lakshanagranthas that are ancient theoretical and descriptive texts on Indian music, it is clearly understood that while fundamental theory of Indian music in either form is the same, Carnatic musical tradition is largely influenced by Tamil Pann music and draws from the same both musical content as well as poetic imagery.

To understand the development of Carnatic music in India, it is useful to trace the journey of the music through seven salient phases.

- Vedic music and Shiksha literature
- Natya Shastra, Brihaddeshi and other Lakshanagranthas[2]
- Tamil Pann music referenced in Sangam literature
- Puranas or Epics such as Bhagavata Purana, Ramayana etc.
- Bhakti movement reflected as temple music and dance
- Court music
- Modern and contemporary in concert format for public

The first and foremost evidence of any organised music in India is found in the practice of Vedic chanting. In public memory it is always recalled that Indian art/ classical music had its origins in Samaveda, one of the four major Veda texts (Venkatasubramanian 2010). Samaveda records the way in which the chants have to be recited and it uses pentatonic and heptatonic scales for the first time in Indian musical scene. Three most important Shiksha literature from the Vedic period namely Naradiya Shiksha, Paniniya Shiksha and Yagnavalkya Shikshas shows the earliest development of musical notes and scales in India, detailed instructions for pitch, modulation and pronunciation for musical renditions of hymns. This corpus of literature also shows the presence of complex musical instruments such as harps and lutes in ancient India.

One of the unique aspects of Indian classical music is that it was treated very scientifically and theoretical treatises were produced starting from second century CE to around 20th century CE. These works were largely written in Sanskrit language

and some in Telugu, Tamil and Malayalam. These works came to influence the practice of classical music in India and vice versa. Sometimes the treatises recorded and documented existing regional practices, while on the other hand elaborately described theoretical possibilities that could be explored. These texts also assimilated the philosophical and sacred beliefs associated with music from various dimensions. Along with the technicalities of music, we also find prescriptions of time and season to render raga, deities and iconographic imagery associated with music and so on. Perhaps in the old treatises such as Natya Shastra, Brihaddesi and Dattilam we find one of the earliest references to Indian music being associated with sacred and religious sentiments. The influence of such an idea is evident in how Carnatic music was nurtured as temple music tradition long after.

Parallelly, since around the second century BCE southern Indian region, called Tamilakam (today's Tamil Nadu including some parts of Andhra, Kerala and Karnataka) saw an indigenous musical innovation called Pann music. Reference to Pann music and how the concept of Ragas in Carnatic music were influenced by the concepts of Pann is well documented in fifth century CE treatises Brihaddesi and Sangita Ratnakara of 13th century CE. Although, Pann music was initially a secular music as described in ancient Tamil Sangam (ancient assemblies of Tamil scholars) epics such as Silappadikaram, soon it seems to have embodied the sacred ideas from pan Indian philosophy of music and amalgamation resulted in the form Carnatic music is presented today.

Ninth century CE saw the emergence of the institutions that popularised singing of Tamil sacred hymns. This was essentially due to Bhakti movement in Tamil Nadu. Scholars attribute this phenomenon to the first three out of the four Samayacharyas (religious revivalists) (Champakalakshmi 2011). Alvars who were Vaishnavite saint composers (12 in number) and Nayanmars who were Shivite composers (63 in number), roughly between seventh to 12th century CE undertook the feat of composing numerous devotional and sacred poems that were set to the tunes of Pann music and popularised. Not only did they compose music with a devotional bent but also associated places and landscapes in their poetry to divine mythology, sacred interventions, described physical sites as divine abodes and a whole cultural reconstruction of sacred landscape was attempted through the use of music in their verses. Alvars sanctified 108 Vaishnavite centres through their musical work called Divya Prabandham,106 of which are physical locations on earth spread across India and beyond. Two of them are from the mythological heavens. Similarly, Nayanmars sanctified around 275 sacred centres in India and Sri Lanka. Most of these sites are distributed in heavy concentration in the Kaveri river delta. This unique socio-musical phenomenon was so influential that we see consecration of a huge number of temples in such sites that were revered in their musical verses.

Royal and aristocratic patronage poured in to support and develop these centers of Bhakti. Due to the growing religious activities, singing of the sacred hymns such

Figure 1: Image of Nayanmar Appar carrying a younger Nayanmar Thirugnana Sambandar on a palanquin as found in Amirthakadaieesh-warar temple. (Source: By Portvp shared under the license CC BY-SA 3.0)

as Pasuram, a Tamil Vaishnavite hymn and Tevaram, a Tamil Shivite hymn in temples also gained popularity and reached its peak during 13th century CE. Not only were Bhakti compositions vocally rendered, but there were also dance and instrumental ensembles called 'Periya melam' and 'Chinna melam'. Players of the Nadaswaram a south Indian wind instrument followed a strict regime of which raga was to be played on a specific occasion, which processional route to take for playing a piece and so on. After the decline of this practice during the later Chola and Pandya rulers, Vijayanagara rulers took interest in the revival of the temple singing tradition by around 15th and 16th century CE (Kuppuswami 1992). The iconographical depictions documented from the study area shows the images of saint composers and stories embedded into the songs. These traditions were rigorous and temple dancers and musicians became a community in itself who were supported by the temple and kings as an institution by offering a regular payroll, land grants and other infrastructure to the artists. Inscriptions indicating such establishment of large scale are found in Thillai Nataraja temple in Chidambaram and Brihadeeswara temple in Tanjavur.

While larger institutions of dance and music were prevalent in the region, local traditions like Namasankeertana and Bhagavata Mela by around 17th and 18th century CE started emerging and found its popularity amongst the masses (Indumati 2018). These traditions were using the familiar Carnatic music, but added the elements of storytelling from Puranas, simple chanting of the names of God, theatrical presentations etc. that appealed to the mass. Some important influences for these acts came from Andhra Pradesh and Maharashtra.

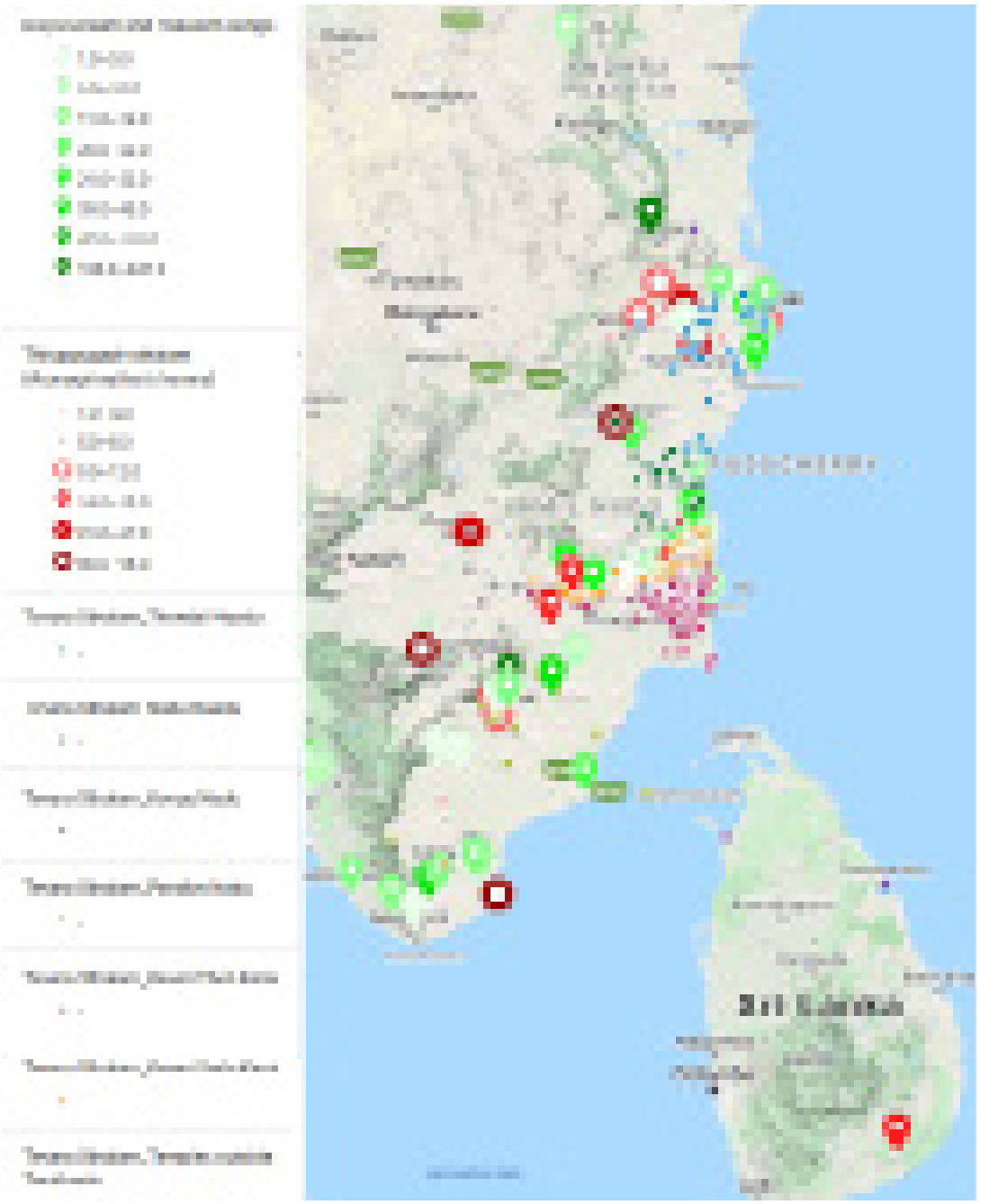

Figure 2: Historic places glorified in Tamil Pann music. The map shows places associated with Tamil Pann music predating Carnatic music in South India. It includes places of bhakti centres mentioned in Tervaram, Divya Prabandham and Thirupugazh. It also shows places associated with the composers such as Azhwars, Nayanmars and others. (Source: Author)

Soon after the British rule in India abolished the practice of dance and music in temple premises, the huge community of artists and supporting groups of people suffered a period of tension (Subramanian 2006). The context of Carnatic music takes a sharp turn at this point in time. Royal families and courts began supporting these artists and the patronage in royal court was the only means of their survival. Nevertheless, the purpose of music has now changed from being a sacred ritual to being the prestige of the court. Not only did Carnatic music have to revive itself in terms of quality, but it also had to relook at the aspects of presentation, language etc. Now the music was being presented to an audience of the aristocrats and diplomats in the *darbar* (court) halls of palaces unlike a ritualised presentation of which the public was a part. Aesthetic innovations were undertaken for Carnatic music and its presentation. A special mention is due to the Marathas from the courts of Tanjavur, Wadiyars of Mysore and royal family of Travancore who massively patronised Carnatic music and thus paved a way to its phenomenal growth during the 17th and 18th century CE.

The gradual movement of elites to cities, particularly Madras due to commercial attraction and the changing political landscape in the 18th and 19th century CE, Carnatic music took to the concert halls of Chennai. This time around the music had to completely transform itself into shorter entertaining presentation formats. For the first time ever, Carnatic music was being hosted onto a proscenium or a stage that would overlook the audience hoping for appreciation and patronage. Today concert halls are found dotted all over Chennai, particularly visited in millions during the December-January music season called 'Margazhi Utsavam'. *Sangita sabha*s (concert halls) are a popular typology today also found in other cities such as Mysore, Bangalore, Trivandrum, Trichy, Coimbatore and so on.

Though it seems like the narrative of Carnatic music is a story of moving identities, remnants of all these various facets of the music are still evident and relevant today in their own context and in various capacities. The following section explores four case studies that bring out the four different spatial narratives of Carnatic music that demonstrate how the same form of music brings out different colours in varying spatial settings.

CASE STUDIES

The case studies described here are chosen from Kaveri basin amongst 25 other case studies studied in depth. Four sites discussed here are representative of four different interactions of Carnatic music in varying contexts of space-time. Nangur or Tirunangur is a site revered in the compositions of the most prominent of Vaishnava Bhakti saint composer Tirumangai Alvar. Due to Tirumangai Alvar's sanctification of the site, it gains a prominent place in Vaishnava landscape of the south. So today, people from this place celebrate the composer as a deity and his songs have

become the connecting thread between the group of 11 temples in the region. Case study of Amba Vilas shows how Carnatic music acquires a new form within the realm of a palace. In the example of *tyagaraja samadhi* (memorial commemorating the dead), one is able to see how a burial site of one of the greatest musician composer of Carnatic world turns into a field of festival with the renditions of his compositions by thousands of visitors during the occasion of his death anniversary. The last example is that of a typical Carnatic sabha or a concert hall meant for hosting Indian classical music for a public audience. This is the modern typology designed and built specifically to accommodate acoustic needs of performance with a raised proscenium and seated spectators' space. This kind of space is quite different from the rest of the examples where music played a role amongst other activities to define the character of the place, while sabhas are built for classical music performance alone.

Nangur

The cluster of eleven Vishnu temples poetically described and sanctified with beautiful music by Tirumangai Alvar, one of the 12 Alvars (Baliga 1957) define the sacred network of Nangur in Nagapattinam district of Tamil Nadu. The eleven temples are part of the larger Vaishnava sacred landscape of 108 Divya Desams. The oldest of them have been dated to the reign of the Medieval Chola king Parantaka I, which is roughly about the 10th century CE. Tirumangai Alvar in his verses describes the town as 'radiant' place where the sound of conches and Vedic chants never seem to cease. He describes the town to have been set amidst the beautiful landscape made up of Ashoka or *Saraca asoca*, Punnai or *Alexandrian laurel* and Serundi trees. He sings about the peacocks dancing in large numbers, lakes filled with swans and blue water lilies, bees humming sweet tunes and sipping nectar from the Jasmine and Shenbagam or *Magnolia champaca* flowers.

Thirumangai Alvar from around 8th century CE is the last in the order of the 12 Alvar saints of south India, who are known for their association with Vaishnava tradition. Around 4,000 verses are known today to have been composed by all the Alvars. Amongst all the Alvars Tirumangai is considered to be the most learned and to have contributed the most superior compositions in terms of the usage of language and the musical quality (Pillai 1994). A traditional account recounts that he transformed from being a robber into a devoted saintly poet and musician. This episode from his life is annually reenacted in the Vedu Pari festival. His most important work is Periya Tirumoli, composed of 1084 hymns. The others are: Tirunedunthandakam (30 verses), Tirukuruthandakam (20 verses), Tiruvelukkutirukkai, a single long poem of 47 lines; Siriya Tirumadal (155 lines) and Periya Tirumadal (297 lines) (Chari 1997).

A festival called 'Tirumangai Alvar Mangalasasana utsavam' in the Tamil month of Thai (Jan–Feb) showcases a spectacular event called Garudasevai in which the procession idols of the deities from the 11 sacred shrines of Nangur are brought on Garuda (a bird from Indian mythology) mounts in the region. An image of

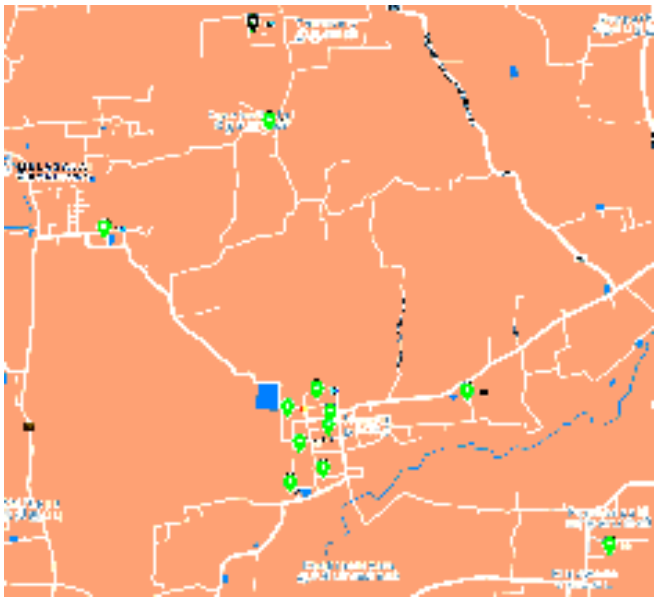

Figure 3: Map showing the sacred centres sanctified by the verses of Tirumangai Alvar in Nangur. (Source: Author)

Tirumangai Alvar on a Hamsa Vahana (swan vehicle) with his consort Sri Kumudavalli Naachiyar are taken in a palanquin through paddy fields. His verses are musically rendered at each of these 11 temples. The paasurams (poems) dedicated to each of the 11 Divyadesams are chanted in the respective shrines (Senthil 2008). Another related event is the Vedu Pari utsavam held on the streets of Veda Raja Puram, a remote village nearby. This is known to be the birthplace of Tirumangai Alvar. Over 5,000 devotees gather to witness the event where the late night episode of Tirumangai Alvar turning into a saint composer from being a robber with the blessings of Lord Vishnu is reenacted and the whole mythological landscape is re-created along with the renditions of his verses. After midnight the village sets into a mood of celebration. A procession of lamps called 'Pandha kaatchi' is witnessed in the streets and one finds the street ringing with Prabandham (Tamil composition of 4000 verses by Alvars) chanted by the devotees. The festival is concluded at five in the morning when Tirumangai Alvar is blessed by the Lord and he performs Vaiyali (the dance of joy) in the priestly neighbourhood called Agraharam near the Tirunagari temple. It is not only during these festivals, but music becomes a way of life in all the eleven temples every day. Mallari (unique composition for wind instrument) is played in nadhaswaram at specific rituals such as feeding and bathing the Lord. When the Lord is taken outside the sanctum in a defined circuit, music composed in certain ragas are only played as if to indicate the folks of the town that Lord is taking his daily rounds in the town and those who wish to visit may do so.

Amba Vilas palace

The Amba Vilas palace can be described as having been located in the geographical center of Mysore, and faces eastward to the Chamundi Hills.. The axis defined

between the hills and the palace is so strong that it cannot be visualised in isolation. Chamundi hills houses the temple of Goddess Chamundi who is the royal deity. This relationship is always kept alive as a living landscape by the royal family. One example of this can be witnessed during the Mysore Dasara celebrations where the procession with over thousands of people, animals and chariots start from Chamundi hills, go through the axis connecting the palace, stop at the palace and move into the city. Amongst the seven palaces of Mysore, the most prominent and beautiful one is the Amba Vilas palace within the Old fort. This palace is popularly referred to as 'Mysore palace'. After an incidence of fire that completely burnt down the old wooden palace in 1896, the current structure was reconstructed between 1897 and 1912, by British Indian architect Henry Irwin.

According to the Mysore Gazetteer the regime of Krishnaraja Wadiyar IV, between 1902 to 1940, was a golden age as it saw a revival of Carnatic music. His patronage to classical music is a well-known fact. He supported some of the eminent composers and musicians of his time including Ariyakudi Ramanuja Iyengar, Fiaz Khan, Bidaram Krishnappa, Muthiah Bhagavathar, Veene Sheshanna to mention a few. Ustad Fiaz Khan of the Agra Gharana was honoured with the title of Aftab-e-Mausiqui by the maharaja. The last king of Mysore, Jayachamarajendra Wadiyar, was a prolific composer of Carnatic music whose compositions are performed in the annual Dasara music concerts even today in honour of his contributions to the development of Carnatic music. Though patronage to music was pouring out from the latest of the Wadiyar rulers, some of the earlier rulers are also remembered for their contributions to Carnatic music. King Chikka Devaraya wrote a musical treatise called 'Geetagopala'. In the 18th century CE, Krishnaraja III authored 'Sri Tattvanidhi' which has a section on music. Veena (Indian chordophone instrument) players were supported by the royal family with great passion and a unique form

Figure 4: Private concert in Amba Vilas palace Darbar hall. (Source: Public Domain)

of Veena, known today as the Mysore Veena, was developed and specialised with the support of Wadiyars.

For the last 15 years the annual Dasara concerts are held in the front yard of the palace. Until 1990's, the event was held in Darbar hall of the palace, but was moved into an open yard owing to the structural concerns as the crowds coming in each year to witness the grand event increases exponentially. The concerts today are held in the open ground with a backdrop of the magnificent front facade of the palace, setting up the context and reminding the spectators of the continuing traditions of royal patronage to music and other arts. It is perhaps the biggest open-air classical music concert venue the country has witnessed. The great stalwarts of Indian classical music have performed here and it is considered to be a great honour to receive the opportunity to perform in this royal venue.

Tyagaraja Samadhi, Tiruvaiyyaru

Tiruvaiyaru is a panchayat town on the banks of the river Kaveri in Tanjavur district in Tamil Nadu. Tiruvaiyaru takes the center-place in the map of Carnatic music due to its association with prolific Carnatic musician and composers (called Vakgeyakaras) Thyagaraja, Muthuswami Dikshitar and Shyama Sastri, who are popularly known as the Trinity of Carnatic music. Tiruvaiyaru literally meaning 'five rivers' refers to those that surround the city - Arisilaaru, Vennaaru, Vettaaru, Kudamuruttiyaaru and Kaviriyaaru. Tyagaraja was highly influential in the development of India's classical music tradition. Tyagaraja composed numerous compositions blooming with the aesthetic of devotion to Lord Rama (a Hindu deity). These compositions are mostly in Telugu language. Tyagaraja's Pancharatna Kritis, literally 'five gems of Carnatic compositions' are world renowned for their technical excellence and emotional expressions.

Tyagaraja was a contemporary of four major rulers of the late 18th century to mid-19th century Maratha dynasty — Tulaja II, Amarasimha, Serfoji II and Sivaji II. In spite of having invitations to serve in the royal court, he is said to have regarded music only as his personal expression used to serve the divine. Musicologists regard Tyagaraja as a musician of expressions, rather than for his technical expertise over Carnatic music. One of the unique characteristics of Tyagaraja's compositions is the poetry he uses in his songs, where he imagines himself to be engaging personally with the Lord and thus captures the most nuanced expression possible in his compositions. He spent most of his life time in Tiruvaiyaru unlike the other two of the trinities from Tiruvaiyyaru. In addition to nearly 700 compositions in Kriti format, Tyagaraja composed two musical plays in Telugu - the Prahalada Bhakti Vijayam and the Nauka Charitam.

Tyagaraja is recorded to have willingly put his life to rest on the banks of the River Kaveri, where a samadhi (memorial) is erected and it is at this spot that one of the magnificent music festivals of the country is held annually. The festival known as

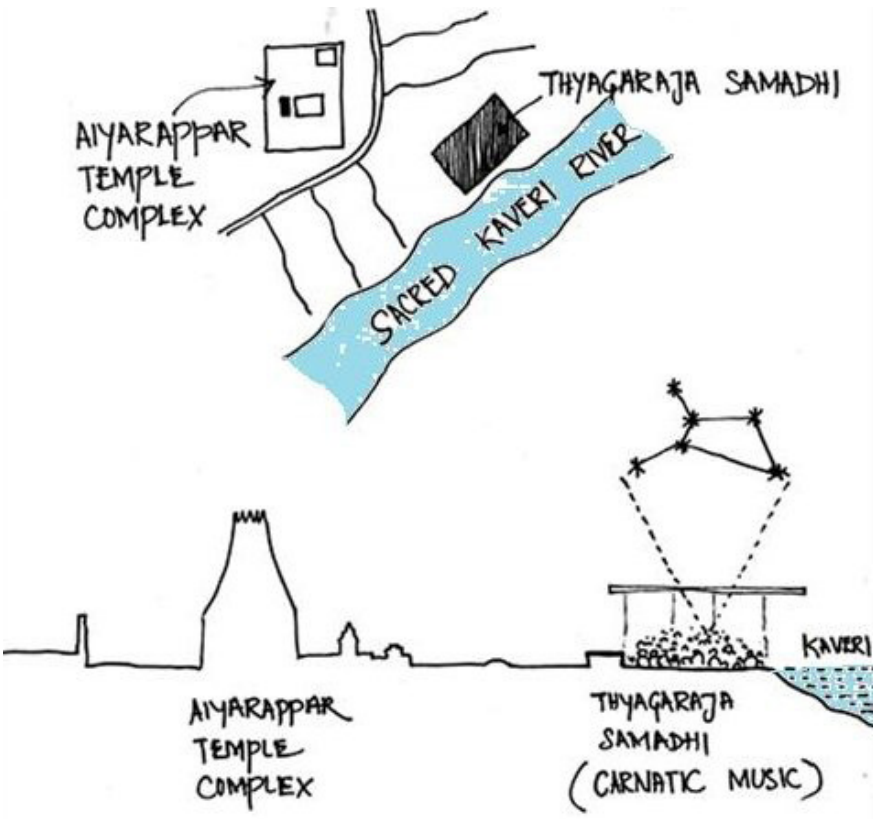

Figure 5: Tyagaraja Samadhi at Tiruvaiyyaru. (Source: Author)

'Tyagaraja Aradhana' is held in January on the day of Pushya Bahula Panchami (the fifth day of the waning moon in the Hindu lunar month of Pushya) when the saint had attained samadhi (died). Most of the leading exponents of Carnatic music come to perform here on this day annually. It is interesting to note that a huge pandal (temporary shed) is prepared in front of the memorial site for this occasion and the celebrity exponents of Carnatic music all sit along with the public under the shed on ground and the whole crowd of around thousand people sing and play their instruments in unison as if they have rehearsed together.

The five major compositions of Pancharatna Kritis are rendered by this mass of people and artists. These compositions are sung in memory of Tyagaraja as an offering to him at this place and time. So, a standard concert format of the audience facing the musicians is not the norm of this place. Hundreds of Carnatic musicians from all around the world flock to Tyagaraja memorial on this week long festival and offer a performance as a spiritual service on each day without expecting any emolument from the organisers.

The *aradhana* (worship) in its present form has evolved over a period of hundred years and is at present organised by Sri Thyagabrahma Mahotsava Sabha. After Tyagaraja died in 1847, his mortal remains were buried on the banks of the river Kaveri and a small memorial was built at the site. The memorial soon fell into neglect and had become quite dilapidated by 1903, when two of the last surviving students and eminent musicians Umayalpuram Krishna Bhagavatar and Sundara Bhagavatar renovated the memorial and started a musical commemoration since 1905 along with Tillaisthanam Narasimha Bhagavatar and Tillaisthanam Panju Bhagavatar. Soon it was divided into two events known as Periya Katchi and Chinna Katchi. Neither groups allowed women or Nadaswaram players to perform. Bangalore Nagarathnammal, a temple performer consecrated a temple for Thyagaraja near the samadhi and started her own performance where she involved marginalised artistes. In 1940, SY Krishnaswami, ICS, convinced the groups to unite and it was in 1941 that the Aradhana as it is known today was first conducted. Harikesanallur Muthiah Bhagavatar selected the five pancharatnas as being best suited for group rendering, so that a common homage by all musicians became possible.

Nadabrahma concert hall, Mysore

Next to Tanjavur and Travancore provinces, the princely state of Mysore became the bowl of patronage for cultural activities, especially for Carnatic music over several centuries. As soon as the republic of Indian states were re-organised in independent India, the "Royal Asthan (Musical assembly)" lost its official status in 1956. Sangita Bhushana M.A.Narasimhachar along with his friends Sri S.B.Rama Rao and K.V.Anantharamaiah, an advocate and the then Vice President of Mysore

Figure 6: Carnatic Violin concert at Nadabrahma Sabha by Vidwan Mysore Nagaraj and Dr. Manjunath. (Source: Author)

Municipality came together to establish an institution to continue patronage to music. The outcome of such a vision was Sri Nadabrahma Sangita Sabha.

The Sabha attained a respectable position in the society over the next 50 years. Once the crowd started flocking to the hall, there arose a need to make a complete premises with all infrastructure. Every year, at least 10 renowned Carnatic musicians performed here. With the initiation of Sri. K.V.Anantharamaiah the sabha in its present form was constructed around 1989 and is capable of accommodating about 400 people. The performance hall was named after Mysore K.Vasudevacharya who was a great composer from Mysore. The sabha has seen magnificent growth and support since then not only in terms of support from artists and patrons, but also had evolved with its infrastructural developments such as improved acoustics, better seats, revamped sound system, fully furnished greenrooms and improved generators. A balcony with 200 seats was built around a decade back. The Hall of fame showcases the photographs of accomplished musicians from both Carnatic and Hindustani tradition. Today, the sabha is a major cultural centre in the state having around 35 events featuring several hundred concerts a year. It does not only limit itself to arranging concerts, but has also taken up initiative in conducting youth festivals to feature young talent in classical music. It also organises workshops on music and hosts several festivals commemorating the memory of doyens of Carnatic music.

CONCLUSION

In the present context of fast moving urban life, though there is a huge group of connoisseurs or lay public who appreciate Carnatic music in short concerts or by playing the records, the space-time relationship that Carnatic music shares is least understood. This paper makes an attempt to demonstrate the various ways in which Carnatic music may present itself in a specific context or place. Today, Chennai has turned into a mega hub of Carnatic music and has in a way begun to monopolise the art world of this form of music. Artists, patrons and supporting human resources are all getting concentrated in a particular city or two and restrict themselves to the commercial formats of Carnatic music. Parallelly, a sharp decline of temple tradition can be witnessed due to loss of patronage. Variety in Carnatic music might be lost forever if it spatially homogenises.

This issue is not only true of Carnatic music. One may use the same perspective to look at various intangible traditions across the world and understand the value of place and time in keeping the performing traditions alive. UNESCO's 'Representative List of the Intangible Cultural Heritage of Humanity' identifies several intangible traditions across the world including music. Though it speaks about the artistic practice, people involved and the importance of preserving them, it seldom considers the physical setting as an important criterion for true expression of a

traditional performing art. Similarly, the Creative Cities Network programme of UNESCO looks at the city as a canvas for the arts to thrive, but does not seem to understand the behaviour of artistic tradition in varying contexts of place and time.

Through this paper the author has argued that qualitative studies must be undertaken to understand the relationship between music and its setting to be able to keep the traditions thriving. The spatial narrative of music should not remain the story of the past leaving behind lifeless, museum like places. But with continuing efforts and support, these places of musical significance will continue to be thriving landscapes of music.

END NOTES

[1] Indian miniature art depicting various Indian musical modes. Ragamala paintings were created in schools of Indian art, between the 16th and 17th centuries, and are known as Pahari Ragamala, Rajasthan or Rajput Ragamala, Deccan Ragamala, and Mughal Ragamala.

[2] Codification of Indian music by lakshanakaras or theo-reticians such as Bharata, Matanga, Dattila and others)

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Amirthakadaieeshwarar temple relief depicting Appar bearing ThiruGnaanaSambandar's palanquin 2010, licensed by portvp under the CC BY-SA 3.0 Unported license, viewed January 09, 2020, <https://upload.wikimedia.org/wikipedia/commons/3/31/Thirukkadaiyur_Gopuram_Appar.JPG>.

A concert in progress at the Mysore Palace 2007, licensed under Public Domain, viewed January 09, 2020, <https://upload.wikimedia.org/wikipedia/commons/1/17/Concert_Mysorepalace.jpg>.

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Theorising waste generation phenomenon and management in Indian construction sector

Dharati Sote-Wankhade and Vasudha Gokhale

ABSTRACT

This research aimed to examine the status quo of construction waste management in India in order to explore parameters design. Procurement and construction aspects are responsible for large scale generation of construction waste, in addition to human psychological parameters, theoretically and empirically. It is critical for doctoral research to include the process of theorising and theory development from the extant knowledge as well as from empirical data. This part of research is aimed to establish a theoretical base, iterations of which provide theoretical coherence for articulating research design methodology in the respective field of inquiry. Waste generation in construction industry has been looked at from the industrial ecological perspective while relevance of the concept of circular economy has been explored as the theoretical base for this research. The construction industry is labour-intensive where effectiveness of waste management practices is dependent on the willingness, attitudes and behaviour of operatives. The study looks into relevance of these in dictating the behaviour and attitude of stakeholders from the perspective of waste management. The theoretical underpinning provided is aimed to provide structure to the doctoral work with adequate epistemological and ontological stance and methodological coherence.

KEYWORDS
Waste, human behaviour, theory, circular economy, construction industry

INTRODUCTION

Population explosion and improved life style of people in urban areas, with fast adoption of convenience behaviour like 'use and throw concept', converts virgin materials into wastes (Agarwal, Chaudhary & Singh 2015). Laziness, ignorance and carelessness in activities of people leads to high waste generation (Srun & Kurisu 2019). The attitude towards waste management due to lack of knowledge, concern, obligation to environment, locus of control, self-efficacy is unacceptable as it threatens human survival by affecting the environment and human health (*ibid*.). Waste generated due to human activities is in large quantity and in various forms, in which Construction and Demolition (C&D) waste has a large share (TERI 2014).

This research is motivated with an initial observation of huge quantity of waste on Indian construction sites. Low environmental awareness of stakeholders, irrational use of resources, thoughtless practices and ignorance result in generation of large quantity of waste (Dania, Kehinde & Bala 2007).

Waste generation and management is a complex phenomenon that needs to be looked at from a theoretical perspective in doctoral research. Abstract and theoretical factors need to be explored and examined with respect to determining choice of analyses, background material, theories and research techniques (Love 2002). Theorising is the process that leads to theory. Theory is built, theorising is the process of building. Theorisation involves finding a 'lens' or perspective from which the research problem should be viewed. For this there is a need to see the works of major theorists or theories in a holistic way for theoretical and conceptual construction for a problem in hand. The first step is to identify the problem and elaborate on theoretical and conceptual issues related to area of concern that calls the pre-study or initial literature browsing. In this process of research, early theorising occurred by observing the topic intensely and it helped in discovering, further enabling development and explanation. The journey started with understanding the term 'waste', how it is generated and its impact, with focus on construction waste.

Waste is matter or material discarded after completion of process or unwanted by-product and not needed by owner, producer or processor. It is matter for which no use can be found by the organisation or system that produces it, being abandoned by their owners, and symbol of inefficiency. All the components of solid waste if converted or treated scientifically, there is no waste as such in the world (Agarwal, Chaudhary & Singh 2015). All materials are useful in one-way or other because it is created out of some material. It can say that waste is nothing but useful material at wrong place and man's ignorance considers certain things as waste and certain other thing as useful (Desa, Kadir & Yusooff 2011; Pongrácz 2004).

Population density, economic status, level of commercial activity, culture and city or region (Kumar *et al*. 2017) affect rate of per capita waste generation (Ahmed 2016; Nandan *et al*. 2017). In developing country, population explosion and uncontrolled urbanisation, coupled with modern life style of people along with convenience product consumption associated with greater prosperity and careless habits has led to more acute waste generation problem (Agarwal, Chaudhary & Singh 2015; Desa, Kadir & Yusooff 2011). The fast waste generation process, coupled with final deposition, results in the environmental pollution increase and implying ecological deterioration problem (Márquez, Oh & Hidalgo-Silva 2008).

At global level, negative consequences of human activities include environmental pollution, uncontrolled deforestation and their conversion into agricultural land, destruction of the ozone layer, global warming of the planet, climate changes,

natural disasters, accumulation of various wastes, including radioactive, eradication of certain plant and animal species. Altogether, the human activity is turned itself a serious problem that threatens mankind survival by consequently impacting human health. As huge amount of waste is being produced every day, it influences the air we breathe, the food we eat and the water we drink and seriously endanger human's survival (Madaleno 2018). In urban areas, indiscriminate dumping of wastes contaminates surface and ground water supplies. This waste clogs drains, creating stagnant water for insect breeding and floods during rainy season which exposes individuals to water-borne diseases. Similarly, uncontrolled burning of waste and improper incineration contributes significantly to urban air pollution leading to overall health problems. The soil and water bodies get polluted due to greenhouse gases generated from the decomposition of organic wastes in landfills, and untreated leachate spreading diseases such as dengue fever and cholera (Alam & Ahmade 2013).

C&D waste being both produced and managed mostly by the private sector, suffers from weak enforcement provisions. In research study, authors highlighted that sometimes C&D waste is not listed as a waste category in landfill even though C&D waste is disposed of together in municipal solid waste landfill and attracts significantly less attention than other forms of waste. The major hindrances against source separation and recycling are cost involved in separation, lack of knowledge and awareness of waste recovery. Most of the C&D waste are inert materials and may not pose as great a threat as hazardous waste (Mah, Fujiwara & Ho 2018).

EXAMINING EXISTING THEORIES

Doctoral research needs to develop knowledge of various theories used in a discipline by engaging with the literature in order to have a solid theoretical grounding. Concepts and a particular combination of theories need to be combined in order to provide a tool to explain reality (Chowdhury 2019). A theoretical base needs to be context specific while addressing construction waste there is a need for an in-depth understanding of the nature of the construction industry.

In both developed and developing countries, the construction industry is commonly one of the largest in terms of investment, employment and contribution to GDP. At the same pace of development and expansion of economic activities, the adverse impact of the construction industry on the environment is significant. Major challenges of the industry are to minimise the rate of impact by minimising the consumption of resources and match it with a corresponding improvement in environmental efficiency and effectiveness associated with human activities (Uher & Lawson 1998). In case of material utilisation, there are many similarities between the construction industry and other industries. Construction is closely tied to industries which produce many of the building material products that in-return

ultimately comprise the built environment for them and humans. At the same time, this industry differs from other industries as the built environment are not factory produced with high tolerances. They are once-off products designed to relatively low tolerances by teams of architects and engineers, and assembled at the site by labour of subcontractors and craftspeople. Along with its production process, the built environment is generally not subject to extensive quality checks and testing the buildings and is not even identified with their producer. At the end of their life-cycle, the product of this industry is less likely to have their components returned to their original producers for take-back. Due to ecological illiteracy, the potential of construction industry needs to incorporate the lessons learned from both natural systems and Industrial Ecology in its materials cycles and develop a closed-loop system (Kibert, Sendzimir & Guy 2000).

Literature established the large-scale environmental impact that construction waste has. This aspect led this research to look at waste from a broader ecological perspective where the concept of industrial ecology is adopted for theoretical underpinning for this research.

Industrial ecology as a theoretical base

Humans have a habit of using resources once and dumping the waste back into the natural environment as opposed to natural ecosystems where resources pass through the system repeatedly i.e. the waste from one activity or organism becomes the natural resource for another. Industrial ecology aims towards a model industrial system to operate like a natural cycle where use of resources so as to contribute to the construction of closed loop economics by networks of initiatives that exchange waste. In this cycle, clusters are designed where the output that one industry considers to be waste can be used as a valuable input, i.e. raw material for another industry, thus reducing the extraction of natural resources, pollution and saving on waste treatment (Douglas, Goode, Houck & Maddox 2010; Kibert, Sendzimir & Guy 2000). Thus the Theory of Industrial Ecology describes how the physical flow of materials and energy flow in natural ecosystems takes place and how this can be used for developing the vision and the overall goal of industrial ecosystem to be ecologically sustainable (Korhonen 2005; Bruel *et al*. 2019). The former president of the US National Academy of Engineering, Mr. Robert White, has defined industrial ecology as 'the study of the flows of materials and energy in industrial and consumer activities, of the effects of these flows on the environment, and of the influences of economic, political, regulatory, and social factors on the flow, use, and transformation of resources' (Ayres & Ayres 2002). The waste minimisation measures are widely addressed in industrial ecology like strict avoidance of waste creation/prevention at source, application of more effective production technology, source-oriented improvement of waste quality, reuse of products and part of them, disassembly and reuse of components and internal and external recycling of production waste (Pongrácz, Phillips & Keiski 2004) with effective manner. Construction industry in the major industrial countries play

important role in socio-economic development, so it could benefit the most from employing industrial ecology model based on natural systems models. As in the case with other industrial systems, construction industry needs to be examined because its ecology and metabolism is marked by a long lifetime, with large quantities of resources expended in creation of its components, significant resources consumed over their operational lives and generation of major waste quantity in the stream (Kibert, Sendzimir & Guy 2000).

In the framework of Industrial Ecology, construction industry would be defined as 'Construction Ecology'. This terminology itself spells out how this industry could achieve sustainability, both in the segment that manufactures the products that comprise the bulk of modern buildings and in the segment that assembles these products into the actual buildings and demolishes existing buildings (*ibid*.). As defined in construction ecology, placing materials into a closed loop system is hampered by many problems since building components are often made of materials that are difficult to recycle. Most of components are rigidly tied with each other and not designed for disassembly to facilitate recycling (*ibid*.). Over in all, this industry is needs to promote the optimal use of virgin resources during production and consumption of products promoting the adoption of closed-loop patterns which represents the concept of circular economy (Bruel *et a*l. 2019). For this, construction ecology can be presented as a strategic framework that would be used as a guide for the development of building practice and circular economy can also be offered as a business model for establishing new forms of technology, organisational or industrial structures, human competence, and rules (Núñez-Cacho *et al*. 2018).

Circular economy

Over the past years, 'Circular Economy' has developed as a model that aims to increase the efficiency of resource use, through the adoption of material loop closing patterns in production systems based on the principle of industrial ecology (Freitas & Magrini 2017). After analysing 114 definitions, Julian Kirchherr defined circular economy as 'an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/ distribution and consumption processes (Kirchherr, Reike & Hekkert 2017). It operates at the micro level in products, companies, consumers, meso level in eco-industrial parks and macro level in city, region, nation and beyond, with the aim to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations' (*ibid*.).

The principles of circular economy are system thinking[1], stewardship[2], innovation[3], collaboration[4], transparency[5] and value optimisation[6] (Widmer & Prior 2019). The effective implementation of circular economy at three levels is necessary. Involvement of actors such as suppliers, producers, consumers, and designers at

micro level should be linked to cleaner production, life cycle management, and eco-design for product-oriented approach. Inter-organisational environmental management through clustered firms that trade by-products and share common services or infrastructures at meso level for waste trading system. The service or functional economy that emphasises the utilisation of services provided by products and links to other forms of dematerialisation and re-materialisation at macro level like city, regional or national level (Bruel *et al*. 2019). The circular economy is often discussed through the 3R principles represented by reduce, reuse, and recycle. The reduce principle implies using minimal inputs of energy, raw materials, and waste. The reuse principle states that products or components used again for the same purpose for which they were conceived. The recycling principle refers to any recovery operation by which waste materials are reprocessed into products, materials or substances (Ranta *et al*. 2018). Circular economy indicates changes in managerial and organisational practices of companies in a way they use energy, materials and resources more efficiently, and reduce the environmental waste contextually (Ünal, Urbinati & Chiaroni 2018).

Linking circular economy and industrial ecology in construction industry

Circular economy mainly focuses on the study of the flows of matter, energy, and information exchanged between the natural and industrial systems, while industrial ecology focuses on the study of these flows at the company level, between firms, and at a regional or higher level (Bruel *et al*. 2019).

Sustainable economic growth is possible through circular economy as it assist in finding solution for waste generation and resource scarcity effectively (Ünal, Urbinati & Chiaroni 2018). The built environment consumes almost half of the world's resources extracted every year and responsible for a massive environmental footprint. This adverse impact can be minimised by transformation from linear to circular built environment to create a sustainable and future-proof industry (WBCSD 2018). Circular strategies in existing buildings could be focused on the inner layers[7], such as renovation of installations and refurbishment of furniture. Whereas in new buildings, the emphasis should be given to designing the structure, site and skin such that a building can optimally serve one or more purposes, facilitate circularity in the inner layers and can be readily disassembled for a new lifecycle (*ibid*.).

Linear and circular built environment in building industry

Linear building assumes no limit on the availability of natural resources and is too referred to as a take-make-dispose process. In a linear built environment, materials are lost for future use. In this economy, ownership of an entire building[8] is transferred from one owner to the next who takes over responsibility for all actual and future environmental, economic and social impacts. Owners are responsible for their own actions in each stage of ownership[9] and there is limited view of the next step and related responsibilities (WBCSD 2018).

In a circular built environment, resources are used more efficiently and the economy becomes less dependent on non-renewable resources (WBCSD 2018). So, construction companies can innovate by retrieving materials left over after construction and demolition work and keeping them in cycles which could capture their value and ultimately reduce overall construction costs. The waste can be minimised and cost can be reduced by opting for renewable and recycled materials and modular construction methods (Ellen Macarthur Foundation 2016).

Industrial ecology is a strategic framework that can be used as a guide for the development of building practices which emerges from the design phase by guiding the flow of materials in and out of the built environment. This phase is a conscious explicit activity to establish new forms of technology, organisational or industrial structures, human competence, and rules acting as a starting point that allows the implementation of the circular economy in the building sector (Núñez-Cacho *et al*. 2018). The circular economy can be applied to the building design process by adopting four paths. First is to improve the current metabolic pathway of building processes and material used. The second one involves the need to implement the principles of CE in the industrial ecosystem. While the third path dematerialises building output, keeping in mind the idea of the product as a service, Cradle to Cradle, and managing resources carefully. And fourth one systematises the pattern of energy used (Núñez-Cacho *et al*. 2018).

The ecological system comprises the cultural norms and beliefs and with its influence, the industrial systems represent the framework for legislative changes to adopt circular economy concept based on recycling and sustainable production (ibid.). This has suggested ways that institutions shape the diffusion and adoption of sustainable business (Ranta *et al*. 2018). In order to interpret a sound knowledge, existing theories are needed to study and theorise the concept above. Therefore, theories from sociology are looked in, like institutional theory and theory of temporary organisation for understanding social structure, management and economics.

Institutional theory

The design of systems with inevitable human error and then blaming the humans and not system design does not change the environment or resolve the related issues (Sarhan, Pasquire & King 2014). So the economic, social and environmental issues contributing to poor decision-making should be understood to avoid similar flawed or risky decisions. In this context, institutional theory considers the processes by which structures including rules, norms, and routines become established as authoritative guidelines for social structure and behaviour (Ranta *et al*. 2018). This theory inquire into how these elements are created, diffused, adopted, and adapted over space and time; and how they fall into decline and disuse (Scott 2005). This theory has risen as a popular and powerful explanation for both individual and organisational action.

The framework of institutional theory suggests separating institutions into three pillars: regulative that is required/enforced by law, as it is the case with specific accounting standards; normative that is enforced by a shared sense of what is appropriate, for example, the expectation that elected leadership represents the interest of its constituents, and cultural-cognitive that is taken-for-granted, mental models of how work should be done, as it is the case with most routinised behaviour in organisations. These are individually distinguishable but interdependently contribute to the resilience of the social structure. These pillars reveal through their indicators the rules, norms, and beliefs that impact social behaviour and are reflected in activities, relations, and resources in a particular field, region, or community (Ranta *et al*. 2018). They are capable of affecting organisational forms independent of resource flows and technical requirements (Berthod 2016). As per institutional theory of organisations, institutions are at the core of the analysis of organisations' design and conduct as are local instantiations of wider institutions, while organisations deal with a multitude of external influences, such as cultural differences, legal requirements, conventions, and norms, and with the demands raised by a diversity of actors[10]. In this system, resulting beliefs, rules, and persisting expectations explain choices in formal structures and organisational practices[11] (Berthod 2016). How these aspects are addressed in structure and organisation of building industry is matter of concern which needs to be explored empirically. It has been found that the components of institutional theory could help in establishing the analytical framework for this work.

Theory of temporary organisation

Mainstream organisation theory is based upon the assumption that organisations are or should be permanent while theories on temporary organisational settings are much less prevalent but they are important to supplement traditional project management wisdom (Lundin & Söderholm 1995). Temporary organisations are those that are characterised by a predefined limited time of interactions between members and have become common in many industries today. These organisations offer capabilities that permanent organisations lack, for example regarding efficiency; high levels of creativity and innovation; and dynamic capabilities. In addition, they are flexible, ad-hoc and that it involves the possibility to adapt to the opportunities and challenges of a turbulent environment (Hallin & Maaninen-Olsson 2018). So time, task, team and transition are the foundation for understanding the temporary organisations (Lundin & Söderholm 1995).

Time in temporary organisations is a linear section of a continuous time-flow that is cut out so predictable and plannable. Temporary organisations are created for working and completing of specific task. The interpersonal relations are focused by team the way they made to function through commitment-building, and how they interrelate with the surrounding environment through processes of legitimisation. Temporary organisations are formed with basic aim of transition, before success can be proclaimed (*ibid*.). Organisations and their employees play an important role on

constructing or destructing the environment in which they operate. In this context, reducing the negative impact and promoting positive impact of organisations on the environment is possible through understanding and promoting environmental behaviour of employee, such as recycling, waste management, reduction in energy consumption or any other behaviour that consciously seeks to minimise the negative impact of one's actions on the environment (Vinojini & Arulrajah 2017).

This research considers building project sites as temporary organisation where time, task, team and transition are component parts. How the theoretical features of temporary organisation represented by efficiency, creativity, innovation, dynamic capabilities manifested need to be examined contextually. Waste generation is phenomenon which is directly related to human behaviour. The behavioural and environmental theories that have a bearing on waste generation phenomena and human behaviour are discussed in the next section.

Theories related to human behaviour and waste generation

These theories are developed to explain, predict, and enhance the understanding of human behaviour in context of waste generation phenomena. The theories that are reviewed in this paper include; pro-environmental behaviour, responsible environmental behaviour, the value-belief-norm theory of environmentalism, norm-activation theory, diffusion of innovation theory, reasoned/responsible action theory and planned behaviour theory. Along with this Knowledge-Attitude-Behaviour (KAB) model is also reviewed to reveal that as and when there is an increase in the awareness and knowledge waste; there is a positive change in the attitude towards waste generation, segregation and disposal which leads to modification in the behaviour which is essential for the benefit of a larger society.

Pro-Environmental Behaviours

Pro-environmental behaviours are defined as 'any actions that can protect the environment as a whole and/or a specific ecosystem from the destructive effects of human activities' (Ghazali *et al.* 2019). The pro-environmental behaviour is initiated from an individual's intention and described as one's act to change the environment back to normal. It is a special type of behaviour of human like energy protection, mobility and transportation, waste avoidance, consumerism, recycling, and more social behaviours toward environmental protection (Vinojini & Arulrajah 2017). In pro-environmental behaviour, employees take initiative to engage in environmentally friendly behaviour to complete their required task and even more moves beyond the field of their required work tasks (*ibid*.). There are many internal and external factors that impact the pro-environmental behaviour of employee in the workplace.

Internal factors that influence pro-environmental behaviour of employee are social factors, and affective factors. The social factors include social norms and personal norms and affective factors include the attitude of employees towards the pro-

environmental behaviour.

- Social Factors: Norms are acceptable standards of behaviour within a group that are shared by the group's or organisational members. They may help to understand why people diverge from acting in their own self-interest. Personal norms and social norms are included in social factors. Tendency to act pro-environmentally is personal norms which can be general or specific. These norms are attached to the self-concept and experiences as feelings of a moral obligation to perform a certain behaviour irrespective of social expectations as they are driven by internal processes instead of external one. The accepted standards of behaviour of social groups are social norms as well they are unwritten rules about how to behave. They are perceived to be enforceable through reward or punishment and based on fear of social permission. Social norms are further distinguished between descriptive and injunctive norms. Descriptive norms are to provide information about what appears to be the most appropriate behaviour based on the perception of what other people usually do while injunctive norms reflect beliefs about how one wants to act based on expectations of what other people would morally approve or disapprove of (Vinojini & Arulrajah 2017).
- Affective factors: Attitude towards pro-environmental behaviour or environmental attitudes are perceived as preconditions for achieving environmental behaviour and they are fundamentally important, widely discussed, frequently measured but poorly understood. Behaviour of humans is determined by their attitudes which further investigates a variety of constructs such as beliefs, values, intention, and concern. For more understanding of these constructs' theories are also developed by sociologists like value-based theory for environmental attitudes which includes self-value and the value of all life. Similarly Theory of Planned Behaviour is expected a positive relationship with pro-environmental behaviour of employee (*ibid*.).

Performance of pro-environmental behaviour depends on the required conditions and infrastructure that are available, such as opportunities for recycling in the workplace and have the possibility to buy sustainable products etc. The external factors mainly include the situational factors, leadership behaviour and leadership support.

- Situational factors: Pro-environmental behaviour situational factors mean an individual's circumstances at a given time, represented by access to or knowledge and experience of waste management and environmental protection.
- Leadership behaviour: Top management controls organisation and its activities as well as employees of the organisations. So, leadership affects the effectiveness of environmental management and is considered as an important external factor from the perspective of employees in an organisation.
- Leadership support: In any organisation, the impact of exemplary pro-environmental behaviour by leaders and heads of departments has to be

distinguished for employees to act pro-environmentally. For greening of organisation, leaders' environmental descriptive norms, leadership and pro-environmental behaviour played an important role. The leaders influence their employees in the workplace by sharing values, inspirational motivation, intellectual stimulation, and establishing a relationship with their employees (Vinojini & Arulrajah 2017; Srun & Kurisu 2019; Eshet, Ayalon & Shechter 2006).

The pro-environmental behaviour is determined by relationship of socioeconomic, psychological and few more supplementary individual, social and institutional factors. It is commonly supposed to be environmentally friendly human behaviour and is a broad set of environmentally responsible activities. In order to promote responsible environmental behaviour effectively, it is essential to enhance understanding of the factors associated with individuals engaging in environmentally supportive behaviour for sustainable future.

Responsible Environmental Behaviour(REB) model suggests variables that predict environmental behaviour of humans:

- Knowledge of issue: People must possess knowledge of environmental issues cognition with their causes and consequences. This variable has also termed as Environmental Awareness means 'knowing of the impact of human behaviour on the environment' and it is coordinated with declaration of Awareness of Consequences (AC) in Norm-Activation Theory (NAT). Awareness of consequences is defined as 'how well one individual is aware of the negative consequences of environmental disasters'.
- Knowledge of action strategies: People with knowledge of issues have to know action accordingly to behavioural conduct in order to mitigate the bad consequences from environmental issues. The action factor which explains 'how much skilful and knowledgeable to carry out the preservation behaviour'.
- Attitude, locus of control and personal responsibility (personal factors): Personal factors explicates that 'desire to act' drives people more likely to practice responsible environmental behaviour.
- Verbal Commitment: Verbal commitment is an expression of intention to act on in response to environmental issues and it is willingness of person for environmental behaviour (Mei *et al.* 2017).

NAT model explains about the activation of personal norms which means 'expectations that people hold for themselves' and it is an important process in determining altruistic behaviour. In this model it is also explained that personal norms are created through the internalisation of social norms. AC, Ascription of Responsibility (AR), and personal norms are three variables of a norm-activation model (Srun & Kurisu 2019). Value-Belief-Norm (VBN) theory of environmentalism links value theory, norm-activation theory and New Environmental Paradigm (NEP) perspective through a chain of five variables leading to behaviour (Stren 2000):

- personal values, especially altruistic ones

- awareness of adverse consequences
- ascription of responsibility to self
- beliefs about general conditions in the biophysical environment
- personal norms for pro-environmental action

The VBN theory explains the influence of human values on behaviour in an environmentalist context and suggests relationships between values, beliefs, norms, and behaviours in a causal chain.

Value refers to 'a guiding principle for any behaviour based on desirable trans-situational goals, which vary by relative importance'. The components of value are altruistic values, bio-spheric values, egoistic values, and openness to change values.

- Altruistic value: a collective value concerning other people and living species
- Bio-spheric value: emphasises the biosphere, the environment, and the ecosystem
- Egoistic value: self-interest in regard to society including wealth, authority, and being influential
- Openness to change value: stimulation and self-direction based on the motivation of independent thought and action, which conflicts with the motivation of fulfilling others' expectations

Belief refers to one's thoughts about the natural environment and human behaviour. The components of are awareness of consequences and ascription of responsibility.

- Awareness of consequences refers to the belief that environmental circumstances will either improve (to the benefit of all) or threaten other people, species or the biosphere.
- Ascription of responsibility is a belief that an individual's actions can either prevent or promote potentially undesirable consequences.

Norms refers to personal norms that leads individual to hold enduring beliefs and ideals that are essential to preserving the environment (Ghazali *et al*. 2019). Many researchers have used VBN theory to predict pro-environmental behaviour, but few have suggested that social norms are also an important to such behaviour.

So VBN is extended by adding social norms to examine their effects on pro-environmental behaviour. It can say that, personal norms have a positive influence on social norms if an individual's personal benefits are in accord with societal benefits (Ghazali *et al*. 2019; Dursun, Kabadayı & Tuger 2017).

Innovations are communicated through certain channels over time among the members of a social system by process of diffusion. Personal or collective or authoritative decision follows five-step process for diffusing the innovation as where like to diffuse.

- Knowledge, where a person becomes aware of an innovation and has some

idea of how it functions,
- Persuasion, where a person forms a favourable or unfavourable attitude toward the innovation,
- Decision, where a person engages in activities that lead to a choice to adopt or reject the innovation,
- Implementation, where a person puts an innovation into use,
- Confirmation, where a person evaluates the results of an innovation-decision already made (Orr 2003).

In innovation process construction is sometime deemed to be similar to manufacturing, still this industry is very different in characteristics and its production processes. The unique characteristics of construction industry are location-dispersed sites, high project cost, complexity of products and processes, high failure risks, limited number of repetitions in production, and immobility of final products. The temporary nature of project team creates short term relationship in team members, which affect the sharing and retention of knowledge and information of innovations. Thus, this industry has impelled the researchers to identify new variables that influence the diffusion process. In construction industry, the researcher need to focus issues like procurement practice, cyclical market, project-based relationship, high social responsibilities, and a government regulated industry in their studies (Songip *et al*. 2013).

The Theory of Reasoned Action (TRA) proposes that 'behaviour' is determined by 'intention,' which is in turn determined by 'attitude toward the behaviour' and 'subjective norms'. In this theory, attitude refers to the degree that people value the behaviour positively or negatively and subjective norms are the perceived social pressure, whether to engage in the behaviour or not, from closed person or group of persons. This theory applies only when the behaviour is under volitional control, that is, people's behaviour is determined solely by their intention (Srun & Kurisu 2019). The theory stipulates that the intention of acting has a direct effect on behaviour, and that it can be predicted by attitudes which are shaped by subjective norms and beliefs, and situational factors influence these variables' relative importance. This theory provides a foundation for the understanding that, despite having good intentions, people may not act in favour of the environment due to their lack of confidence or they feel they lack control above the behaviour. On the basis of different experiences and different normative beliefs, people may form different beliefs on the consequences of performing a behaviour. These beliefs, in turn determine attitudes and subjective norms which then determine intention and the corresponding behaviour (Akintunde 2017).

In the Theory of Planned Behaviour (TPB), a revision of the controversial TRA, is introduced one more predictor, Perceived Behavioural Control (PBC), which determines intention and behaviour and represents how much the target behaviour can be controlled by an actor himself/herself. This theory has become the most

popular to predict people's behaviours and it has been widely applied to waste-related behaviours such as recycling and prevention (Srun & Kurisu 2019).

In TPB pro-environmental behaviour is directly determined by considering the intention to act and objective situational factor. The intention is the interplay of cognitive variables which include; knowledge of action strategies and issues, action skills as well as personality variables such as locus of control, attitudes and personal responsibility. In this theory, links among influences on behaviour and their effects are captured at the conceptual level by one of the components of the model or relationships in the model. This theory provides further describes into the connection between knowledge, attitude, behavioural intention and actual behaviour as they influence waste management practices. In the model knowledge is nothing but 'attitudes which are a function of beliefs'; and beliefs refer to knowledge about a specific behaviour (Akintunde 2017).

Knowledge-Attitude-Behaviour

The Anowledge-Attitude-Behaviour (KAB) approach assumes that behavioural changes are brought about by increasing public knowledge about an issue via positive attitudes toward the environment. The causal relationships between these dimensions can be described as:

- Environmental knowledge produces positive environmental attitude;
- Environmental attitude influences environmental behaviour; and
- Environmental knowledge directly influences environmental behaviour.

Personal experiences or from education itself inputs such as skills, beliefs, values and expertise are enhanced and this is referred as knowledge. Knowledge sharing is the activity of exchanging what one knows with other people such as peers, kin, colleagues or any intended individuals (Kuang, Davidson & Yao 2012).

Environmental knowledge is defined as 'general knowledge of facts, concepts, and relationships concerning the natural environment and its major ecosystems'. It helps in the recognition of issues related to the environment and note the source from which environmental attitudes are cultivated. Individuals with a high level of environmental knowledge would be expected to know what should be done to resolve environmental problems and understand the benefits of responsible behaviour (Ito 2017).

Construction industry is labour-intensive and the attitudes and behaviours of those involved in this industry influence its growth and performance. This shows that behavioural impediments significantly influence waste levels.

It is also seen that the extent to which reduction, reuse and recycling of waste can be achieved depends on motivational influences on the behaviour of construction workers (Begum *et al.* 2009). Waste management behaviour is improved by workers'

knowledge, attitude and awareness of environmental benefits (Bakshan *et al*. 2017). In terms of the formation of attitudes, five steps can be listed as part of the process:

- Knowledge of the correct procedures and the ability to carry them out.
- Knowledge of the reasons behind the correct procedures and practices.
- Examples set by managers, sometimes called the 'culture' of the organisation.
- The reinforcement of important messages.
- Support attitudes through the procedures and reward systems of the organisation. (Kulatunga *et al*. 2006)

Persons who hold collective beliefs, affect, and have behavioural intentions regarding environmentally related activities or issues are affirmed as having an environmental attitude. This involves the psychological tendency, with cognitive, affective, and behavioural elements, to favour or disfavour some environmental behaviours. Environmental attitudes consist of environmental awareness and concern. Environmental awareness is defined as 'a measure of one's ability to understand the nature of environmental processes and problems, his or her degree of concern for environmental quality, and the extent to which one is committed to environmental behaviour in daily life'. Environmental concern refers to 'the degree to which people are aware of problems regarding the environment and support efforts to solve them and/or indicate a willingness to contribute personally to their solution'. As attitudes include behavioural as well as affective aspects, individuals with strong pro-environmental attitudes are more likely to engage in pro-environmental behaviour (Ito 2017).

In construction industry, human components involved in activities initiating from the beginning to completion of a project. Most of the causes of waste generation are directly or indirectly affected by the attitudes and perceptions of the personnel involved in the construction industry. Thus, attitudes of managers play important role in determining people's behaviour and provide an insight into their motivating values and beliefs (Kulatunga *et al*. 2006).

Environmental behaviours are 'environmentally friendly behaviours that can contribute to reduction of current environmental burdens'. Environmental behaviours dictate conscious actions performed by an individual to lessen the negative impact of human activities on the environment and to enhance the quality of the environment (Ito 2017).

THEORISING WASTE MANAGEMENT

Various environmental, social and psychological theories looked for theoretical underpinning for this inquiry. The concept of industrial ecology is found relevant to this research as it emphasises on the benefits of recycling residual waste materials and by-products through the development of complex inter-linkages and promotes

resource minimisation and the adoption of cleaner technologies. The possibility identified to use the two concepts borrowed from industrial ecological theory which states that the waste and by-products from a group are shared as resources and the optimisation of materials flows by increasing resource productivity or dematerialisation.

The theoretical background of 'circular economy' and the importance of its application realised in light of research objectives. Analysis indicated that the critical components of the circular economy need due consideration that include industrial symbiosis, renewable materials, shared economy, 'product as a service', a close relation between producer and consumer, reuse, recycling and up cycling and sustainable consumption and production. The waste generation and management could be looked in light of the principles of CE that include systems thinking, stewardship, innovation, collaboration, and transparency and value optimisation. These aspects could help to establish a conceptual framework leading towards research design that includes a methodological and analytical framework. Considering waste is created due to human error cannot help to lead towards effective methods of reduction or prevention as failures are to be attributed to the system. It is found that human behaviour is always influenced by the environment in which it takes place, that is, broader organisational system or institutional environment. Reflecting on this it is found important to analyse the work environment in constructional sites in light of institutional and temporary organisational theory. Literature indicated the need to look into human behavioural theories as behavioural aspects of people dictate waste generation. Theory of pro-environmental behaviour, responsible environmental behaviour, the value-belief-norm theory of environmentalism, norm-activation theory, diffusion of innovation theory, reasoned/responsible action theory and planned behaviour theory are identified for theoretical grounding of this work.

CONCLUSION

This paper considered several theories that intersected with the epistemological stance and broadened the way of thinking about the concepts in the study. The details about existing theories their importance and relevance in the context of research objectives were presented. The multiple theories provided varying perspectives on the issue at hand. The theoretical underpinning is aimed to build an argument, establish the context of the problem and explain the findings. It also helps in justifying the research questions, the problem, the significance of the study, and works as a way to help determine the research design and the analysis plan. It has been realised that information gathered for a PhD inquiry needs to always be interpreted through a theoretical framework in order to offer a clear explanation of findings and conclusions. This paper presents the theoretical framework for this inquiry where industrial ecology theory is conceptualised as the base of circular

economy in construction sector. It has been considered that waste is generated because of ecological transition which occurs whenever the ecological environment is altered as the result of a change in role, setting of environmental parameters and human action both.

Cultural norms and beliefs influence the waste generation and management practices as a whole. It is hypothesised that enriched through industrial ecology theory, a new framework will prove useful for management of construction waste by paying attention to designs, flows of the building process, energies used and outputs generated. It has been found that waste management has generally followed a linear approach in which materials are sourced, used and finally disposed of as waste which has negative externalities that include rising carbon emissions, increased pressures on landfill and widespread ecosystem pollution. The need is realised to move away from the linear model to system where waste is prevented and negative externalities are designed out and are held in repetitive loops, maintaining them at their highest possible intrinsic value. The identified theoretical framework is supposed to support and build the methodological framework as well as guide throughout the research journey.

END NOTES:

[1] Holistic approach of organisation for decision and activities that interact within the system.
[2] Management of direct and indirect impact of their decision and activities within the system.
[3] Innovate ideas to create value by enabling the sustainable management of resources through the design of processes, products/services and business models.
[4] Internally and externally through formal and/or informal arrangements to create mutual value.
[5] Openness for effects due to decision and activity for more circular and sustainable mode of operation and communicate for same.
[6] All products, components and materials at their highest value and utility at all times.
[7] Services, space plan and stuff.
[8] Its construction, content, surroundings, etc.
[9] Planning, design construction, use and demolition.
[10] Suppliers, customers, regulatory agencies, NGOs, or trade unions.
[11] Such as ISO norms, information technologies, CSR standards, or the divisional form.

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Issue of authenticity in current practice of crafts in Rajasthan

Harminder Singh

Prior to India's Independence in 1947, Rajasthan, literally 'The Land of Kings', consisted of more than 20 princely states, and was known as the last bastion of royal affluence and feudal pageantry. Tales still abound of the bravery of the Rajput warriors who ruled this area, of internecine struggles between the many royal houses, and of their resistance to invading forces. But during the Mughal Period, under the reign of Emperor Akbar, a truce was established between the Rajputs and their non-Rajput neighbours, thus ushering in an era of political stability which in turn occasioned lavish and consistent court patronage to the arts, crafts and architecture. To enrich these practices, many princely states encouraged craftspeople to settle in the major cities in Rajasthan, and engage with their industry throughout the year, or as per seasonal need. Cities like Jaipur, Jodhpur, Udaipur, Bikaner, and Kota came to be known for their unique traditions of many indigenous crafts that also gave each city its distinct vernacular style.

In the old city of Jaipur, crafts' settlements of sizes big and small were introduced by the ruler, where after many generations of practice, the crafting communities adapted their skills to local needs to produce objects of everyday use. But over time, with the change of user needs and manufacturing processes, many traditional craftsmen have adopted altogether new machine assisted designs, industrially produced to process raw material, and resulting in completely new product ranges that only imitate the traditional meenakari on gold and silver, block printing on cotton fabric, and lime carving work. In this context, there is a need to broaden the understanding of authenticity in craft products deeply embedded in the cultural fabric of different regions of Rajasthan.

Figure 1: Lime carving work (Source: Author)

Figure 2: Cement carving work (Source: Author)

Authenticity may include a craft's uniqueness, workmanship, aesthetics, cultural and historical integrity, genuineness, manufacturing process, and raw material.

In the first image of the signage of a shop, the topmost section of the design has a geometric pattern used uniformly across the city of Jaipur to bring a homogenised style of carving in lime work design. Comparatively, the second image imitates the geometric pattern of the lime carving in cement on the outer boundary wall of the Jaipur City Palace.

Again, in the third image, the cup and saucer are made of silver with traditional meenakari executed on the surface, following a process of hand carving followed by enamelling. But in the fourth image, the wall sconce is made of wood, covered in white metal sheet, and then applied with epoxy resin colour, thus displaying the meenakari craft in an imitated form.

Figure 3: Glass property meenakari (Source: Author)

Figure 4: Meenakari work with epoxy resin colour (Source: Author)

Figure 5: Block Print Photographed by Sanjay Chippa

Figure 6: Screen print. Photographed by Sanjay Chippa

Figure 5 shows a cotton fabric, traditionally block printed with Phadad design (Hath Thappa Chapai), done by hand, using colours extracted from natural material. Once again, figure 6 is an imitation of the Hath Thappa Chapai, with the Phadad design having been screen printed on cotton fabric using Procion dyes extracted from chemicals.

In this context, the research aims to establish a process to assess and evaluate the authenticity of handcrafted everyday objects. It also aims to establish the parameters and criteria for this assessment, which is tentatively expected to include tools, raw material, process, visual style, pattern, ecosystem, geographical indications, design, and community.

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Challenges of equitable water distribution system planning
Case of a middle-class neighbourhood, Mehrauli

Kopal Chaube Dutta

ABSTRACT

As the state controls and provides water services, a common assumption is that there is a clear demarcation between what is legal and what is not, and that the formal and informal channels are easy to identify. However, upon closer examination it is observed that there are multiple sites, especially where water supply is scarce, where the two coexist and a dichotomy is misleading. This paper looks at the water distribution system in Mehrauli and captures people's perspectives on water scarcity and their coping strategies. Through a focused study of a municipal ward, it brings out a nuanced understanding of the ways in which informality in the water sector in Mehrauli breaks the stereotypes associated with the role of the middle class in access to water. Much has been written about the ways in which the urban middle class appropriates resources from the poor but this paper explores how this non- subaltern class competes with its own kind to ensure a steady availability of water. It tries to highlight the challenges this process creates for planning a functioning and equitable distribution system by focusing on piped water supply in Mehrauli. It is important to note that Mehrauli, spread across nine wards, is a historic settlement and one of the seven cities of Delhi. From among these wards, this study site is that of a middle-class urban establishment and does not include jhuggi jhopri clusters and slums. The residents of this site are duly serviced by piped water supply provided and managed by the Delhi Jal Board, and also a site where informality and/ or illegality has creeped in as the only way to ensure that the taps established by the formal system do not run dry.

KEYWORDS
Water, Delhi Jal Board, informality, illegality, class, qualitative work

INTRODUCTION

There is a substantial body of literature that unpacks what post-colonial states actually do and how they work in practice. Ethnographic and qualitative works have understood the post-colonial state as a multi-layered entity with porous boundaries (Ranganathan 2014), in contrast with the conceptions of the traditional western political scholarship that visualised the state as a distinct and coherent

organisational system, standing apart from other organisational systems like the civil society. The monolithic state is a cultural construct. The identity of a state as a possessor of vertical hierarchy and encompassing all other institutional forms should be seen as an effect of power rather than a pre-ordained condition (Ferguson & Gupta 2002; Mitchell 2006).

In order to understand the functioning of water distribution in Mehrauli, this monolithic state needs to be understood as an amalgamation of several sovereign local governments, local *'dabangs'* (strongmen), political party workers, brokers etc. I found Lund's concept of 'public authority' useful because he defines public authority as an 'amalgamated result of the exercise of power by a variety of local institutions…conjugated with the idea of the state' (Lund 2006). Thus, public authority is a mix of interactions among lower level bureaucrats, party workers and informal sovereign[1]. During my field work I found this lens particularly helpful in understanding the politics of water availability, especially because each ward had at least one different narrative on why water is scarce therein, and how they cope with it.

Mehrauli: An introduction

Mehrauli is one of the seven historic cities that constitute the contemporary city of Delhi. It has a rich past and was once known for water bodies, but is now better known for the Qutb Minar than for water conservation. It is located on the southern Ridge, the tail-end of the Aravali hills, with *hauzs* (large artificial ponds) and *baolis* (step wells) forming an ancient and intricate network of monuments around the village (Jacob 2014). Several of these water sources in Mehrauli have now fallen into disuse, including Gandhak Ki Baoli, a sulphur spring built by Iltutmish, the Dargah Qutub Sahib Tank, and Rajon Ki Baoli made a few centuries later during the Lodhi reign. At present, the Hauz-i-Shamsi is the largest and oldest surviving tank in Mehrauli. *Hauzs* are a peculiar urban water structure that were introduced in India with the advent of Islam, and Hauz-i-Shamsi was built by Sultan Shamsuddin Iltutmish in 1230 CE, probably much larger than it is now. Its catchment, to the north, west and south, has been almost completely encroached by locals with their houses (Jacob 2014). However, the *hauz* remains quite full from rainfall, even as natural flows into it are blocked and has been restored by the Indian National Trust for Art and Cultural Heritage (INTACH).

Mehrauli Tehsil[2] falls under the south district of Delhi, and as per the 2011 census has a population of 1,10,635. For administrative efficacy, it is divided into eight wards. The Islamic Colony is located in Ward 1 while Ward 3 has a large population of scheduled castes (Gihar 2003), Christian Colony is to the north east, and Brahaman mohalla and Teachers' Colony are to the north west and west respectively. To the south are Khandsa Colony, Brijwasi Colony and Ghosiyan Colony. The eastern part of the area has now been developed with luxurious apartments that are governed by Resident Welfare Association. Overall, Mehrauli has been urbanised in a

Figure 1: Rajon ki Baoli (Source: Author)

Figure 2: Gandhak ki baoli (Source: Author)

haphazard and unplanned manner, and has a dense mixed land use of residential and commercial amidst traditional residential buildings. Several old buildings have given way to apartments like Paradise Apartment, Green View, Mini Qutab View Apartments, and Hill Top Apartment. A few unauthorised colonies like Gadwal Colony, Islam Colony, Nut Colony, and Church Colony have also come up here.

Mehrauli also falls under the South Delhi Lok Sabha constituency since 2008 and currently, Ramesh Bidhuri is the Member of Parliament (MP) In Delhi, state elections saw the emergence of Aam Admi Party candidate Naresh Yadav, who won from Mehrauli. Yoganand Shastri, former Member of the Legislative Assembly (MLA)

from Congress also belonged to the same place. The area defined through Google map is the area I have chosen to work on.

This boundary is what is understood as Mehrauli whereas the SDMC includes urban villages in Mehrauli, and the election commission includes adjoining areas of Lado Sarai, Vasant Kunj and Jawaharlal Nehru University in the perimeter of Mehrauli constituency. The Delhi Jal Board (DJB) however works with the SDMC's definition of Mehrauli, but also includes Vasant Kunj in the Mehrauli constituency.

Table 1: Demographic details of Mehrauli (Source: Census, 2011)

Total Population	110635
Male	63594
Female	47041
Sex Ratio (Per 1000) (National Average-940)	740
Average Literacy	84.41

Mehrauli was once known for its water harvesting systems, but today its residents are battling for water. As of today, it receives 29 litres per capita per day of water from the DJB, which is the least in Delhi. Mehrauli Township has been divided into 75 odd pockets for water supply by DJB that are being supplied water by operative sluice valves. Therefore, the frequency of the filtered water supply to pockets is claimed by the DJB to be on alternate days for one hour. However, during the preliminary field visits, the residents informed that water is available now once in every three to four days as against once a week from earlier times. The timings as well as supply are erratic, although each ward has a schedule for water supply. Another important fact about the place is that the supply is variable across the geography of the area. For instance, Ward 8 reported drinking water problems, whereas residents of societies ,especially in the eastern part, do not face similar shortages. In case of severe shortage DJB tankers fulfils the requirement. The area is also dotted with private bore wells, and although residents are not allowed to access both piped water and bore well together, the primary visit revealed that

Figure 3: Gandhak ki baoli (Source: Google maps)

Figure 4: Dried lake inside Sanjay Van (Source: Author)

Figure 5: Drainage Structure enroute Rajon ki Baoli (Source: Author)

there are houses which have both. Mehrauli also has a high number of unauthorised water connections *(Zee News, Nov. 30, 2013)*.

Reportedly, the Sheila Dikshit government had approved ₹1.5 billion for revamping the water supply system. It provided for construction of five underground reservoirs and their pumping stations with a total storage capacity of around 19 million litres of water. Besides, the project also envisaged the replacement of old pipes over a total length of 33 kilometres and provision of about 35,000 water connections, fixed with new water meters *(The Hindu, Oct. 3, 2012)*. This work was to be done on a contract by a private firm. As of 13 August, 2014 the projects of water management

based on Public Private Partnership (PPP) model for improvement of water supply have been awarded to M/s MVV Water Utility Pvt. Ltd for Mehrauli and Vasant Vihar project areas as per Unstarred question no. †3750 to the Ministry of Home Affairs, Rajya Sabha. The water availability as of now continues to be erratic and uneven.

METHOD

The field work was done over 2016-2017 and deployed a mixed method approach. Quantitative field work was done in Ward 4 to determine whether access[3] to institutional water supply is dependent on wealth and assets. Household surveys were conducted to understand the class composition as well as inter and intra class variation. The collected data on availability of water, coping mechanism, water storage facilities and assets. With the help of the assets, a wealth ranking was conducted. For this purpose, a basic model of the asset in every segment and determining its market value was chosen. The value was assigned to each article and the sum total of the values of all the assets was calculated to determine the net asset value of an individual household.

Sample size was 25% of the population of the chosen block. Voter list was chosen as the universe in the absence of any other credible source of listing of households. Since there were no squatters, slums or Jhuggi Jhopris within Ward 4, the voter list was a fair representation of the population. The unit chosen was a household block. For example, if there were four floors in a block then only one household from that address was chosen. This was done to study water access through piped supply and all the floors were assumed to be supplied by the same line. A survey questionnaire which had structured questions on water availability, consumption, socio economic indicators and one semi structured question on water scarcity was used.

- The qualitative data collection aimed at in-depth understanding of the site in general and issues of access to water, water scarcity, privatisation of water and coping mechanisms in particular. Data was collected through
- Semi structured interview guide: There are eight wards[4] in the Mehrauli area and 120-150 respondents in each block were interviewed following the principles of theoretical sampling and applying the method of divergence and saturation. Snowballing technique is used to identify respondents.
- The key informant interview is conducted through a semi structured interview schedule.
- Focused group discussion: one in each ward.

Limitation of the study- as for 'METHOD'

Mehrauli has three territorial identities, one is defined by the Municipal Corporation of Delhi, second by the election commission and the third identified in the Google map. So, delimiting the territory, given multiple definitions of the geography by different administrative authorities was a huge challenge.

Non-availability/scarce availability of valid data on household consumption of water of the sampled households was another challenge. To add to the limitations the Jal Board was inaccessible in the absence of any acquaintance within the system. Hence, the information obtained from them was limited.

SITUATION OF WATER SUPPLY IN MEHRAULI

Ways of accessing water[5] in many urban settlements is as complex as the mish-mash of water pipes that we notice in Mehrauli, a densely populated area in the southern part of Delhi. Typically, in an urban area, water distribution is contingent upon the type of housing planned, unauthorized, slums and JJ clusters. Clear guidelines on the mode and quantum of water to be made available to them are laid out for each of these settlements by the Jal Board. However, ground realities are fuzzy, and even in planned[6] neighbourhoods water availability[7] is subject to multiple factors : political, economic, technical, spatial and topographical. Matt Birkinshaw aptly puts that the quantum of water supply by the Jal Board in Delhi is negotiated by the actors through formal and informal negotiations (Birkinshaw 2017). Lack of piped water or insufficient water supply by the DJB leads to augmentation by informal/ illegal channels. This is not surprising because water is an inalienable resource. Due to 'informal sovereigns' such arrangements are rather easy, given the fact that the state continues to act as a monolith impermeable to the needs and demands of the common masses.

In the literature on urban water provisioning in developing country, access is premised on geography (Zerah 2000), type of settlement- slum, JJ cluster (Maria 2009), and/ or power (Ribot & Peluso 2003), but largely it is assumed that in localities which are authorised and are serviced by piped connection, the water supply is independent of class and power dynamics, and problems arise due to techno- administrative issues coupled with topography.

Mehrauli however presents a very unique picture. It is serviced by the DJB but receives less than required water. The areas along the eastern margins (Ward 1, Ward 8 and parts of Ward 7, are the ones experiencing bustling commercial activity as well as construction of multi storied builder flats that generally house the upper-middle class population. Although entire Mehrauli is dotted with builder flats, they vary in terms of amenities, location, approach road and hence rent and price. The important understanding about water provisioning and access developed after field work is as under

- There is no uniform pattern in water supply and it varies even within the same ward.
- Water in the tap comes twice weekly for two hours each, i.e. a total of four hours in a week.
- Majority of respondents' houses had meters, but these were either invalid or

logged average bills. Hence a large part of Mehrauli can be said to have non-metered connection[8].

- The areas adjoining the 'main' DJB pipelines are the ones that get water every day, for more than 6-8 hours daily owing to illegal connection.
- A large part of Mehrauli runs on illegal water connection. Such a connection is easier to get as compared to a borewell.
- There are illegal borewells dug in the houses.
- Water tankers do not seem to be a popular choice for battling water scarcity primarily due to the narrow width of Mehrauli's alleyways, prohibitive costs and free water appropriation by neighbours.
- Builder floors have become the norm and are now constructed in every ward to cater to all classes- from lower to upper middle class. Most builder floors have more connection than permitted.
- In many wards such as Ward 1,2,5,8 people have two types of water supply: *khara* (saline) and *meetha* (sweet). *Khara* water is usually pumped from an existing tube-well or well whereas *meetha* water is the treated water supplied by DJB.
- In Ward 6 and the area around Shamsi Talab no treated water supply from DJB was reported, and the population depends upon the borewell only which is also operated by DJB.
- The ground water is brackish and very high in silica. People depend upon treated water from DJB for drinking purposes because the filters and RO system face problems of silica deposition and require frequent repair and replacement.
- Availability of money alone is not a deciding factor in ensuring access and availability of water through taps, but caste and political influence are also important factors in ensuring access to water.

Since the scope of the paper is limited, the focus of research Ward 4 instead of all nine wards. Rationale for choosing Ward 4 are as follows

- It is centrally located and does not have the advantage of proximity to the broad road and the main pipe line, except for the few houses that are situated at the entrance of ward when approached through the Kaluram Complex. This ensured that residents depended upon piped connection and were affected by the lack of water when the supply failed. Those who stayed in the proximity of main pipe line had generally drawn connections from it, so even if the distribution of water to wards was less or none, they managed to obtain water from the mains and hence did not face water scarcity until the situation was so bad that there were no water in the mains, a situation that is a rare occurrence.
- It is one of the oldest settlements where the average duration of residence in the sample is 40 years. Majority of the houses were owned and a few were rented.
- A former MP and former councilor have their residences here. Their presence helped in understanding the politics of water in the ward.
- It is located near the booster pumping station of the Jal Board. Its presence

helped in understanding about whether and how much the location of the source of water plays a role in water supply and scarcity.

KEY FINDINGS

Relationship between wealth and water availability

Calculated correlation between wealth and water availability as well as between wealth and illegal water supply by correlating water available three days a week and wealth because any house receiving water three days a week does so through illegal connection. Following results were obtained:

- There is negative correlation between availability of water every day and wealth
- There is a positive but weak correlation between water twice a week and wealth
- There is a positive but weak correlation between presence of borewell and availability of water daily
- There is a positive correlation between availability of water every day and ownership of house
- Out of 23 households that have availability of water everyday 16 are owned by upper caste nine Jatts, five Baniyas and two Brahmins. Christians and Muslims have one each and others have five.

It was evident from the household survey that in Ward 4 water availability was not dependent upon asset and therefore class. The correlation between water daily and wealth is -0.129360322. Similarly, correlation between water three days and wealth is -0.12018025. This signifies the correlation between wealth and illegal connection is weak and negative.

The focused group discussions and in-depth personal interviews brought out following points:

- The only viable source of sweet and potable water in the Ward is the Jal Board supply.
- Jal Board water is available once every three to four days in winter, and once in four to six days in summer.
- Water in the tap runs for one to two hours in winters, and for one to one and a half hours in summers.
- In some areas situated at an elevation respondents reported that water pressure is poor, and the condition worsens in summers.
- The main reason attributed for lack of water was illegal connection by people, especially by those who are situated at a lower elevation.
- Ward 4 is one of the older habitations but it was noticed that most houses looked as if they had been constructed in the recent past. There was only one haveli that stood anachronistically among the cluster of modern structures. There were few more houses which were old and in shambles as if reminiscing the past but they were far outnumbered by the new ones. The implication

of this change is that the new houses have multiple connections. The water connection depends upon the number of owners. Earlier there were either single or double story houses with a single owner but the flat system has changed this pattern of ownership. Hence the number of legal connections have gone up even as the overall supply of water has not increased proportionately. This has led to further increase in illegal connections in households.

- During scarcity, people buy drinking water. Bisleri 20 litres costs Rs 50 and 'local' Bisleri costs Rs 20. The choice between 'Bisleri' and locally bottled drinking water is guided by the quantum of consumption as well as paying capacity of the people.
- Proximity to the booster pumping station is an asset during water scarcity. People capitalise their interpersonal relation with valve man, and Jal Board staff to fill water canters from the pumping station.
- Tankers were not a very popular option because of two main reasons - a) it is an expensive option, and not everyone can afford it on a regular basis; b) even when a tanker arrives, its owner or the person who bought tanker water cannot prevent other people from filling in their buckets.
- The valve man plays an important role. Some respondents reported that they bribe the valve man to 'open' the valve for their 'gully'. This was however not widely reported. The valve men were not approachable at all and could not speak to them in detail.

Coping strategy: Other sources or extra connection

Looking at the asset values of respondents who receive water daily as well as three times a week. It was found that an extra/illegal connection as a coping strategy is not specific to any particular income/asset group. The study did not find any class specific mechanism to cope up with water scarcity.

This study suggest that in a middle class neighbourhood, which receives its water supply from the Jal Board, money and therefore class dynamics alone do not play a decisive role in navigating water scarcity. It found out that there is a combination of factors like political affiliations, caste dynamics, religious vote bank politics which ensure water availability within a household. There is a need to use the term water availability as distinct from water access to show that water supplied by Jal Board to Mehrauli is grossly inadequate[9] and people have to take recourse to different methods to ensure water availability. Water access on the other hand would mean access to Jal Board connection because every household that interviewed had piped water supply.

DISCUSSION

Informality and illegality are usually associated with the poor (Coit 2001). Informal and illegal actions are not reserved for the poor alone but can also be used by

those with the means to exploit the resources. Sometimes it is the only recourse available to fulfill basic needs like water. This phenomenon came to light during my field interactions with people in different wards of Mehrauli.

In the context of the water sector, informality and illegality are often used interchangeably, but they are in reality somewhat different. Illegality emerges from vulnerability caused due to non-recognition by law whereas informality might be completely legal. So, whereas the low socio-economic stratum is more likely to use illegal methods the more affluent have in their disposition both, the illegal and the informal. Therefore, understanding of what factors aid it is very complex. In Mehrauli different wards have different coping mechanisms which are dependent on the demography, topography and the physical nature of water.

The demography of Ward 4 is varied but mostly upper caste and the average asset value of the sample population was Rs 259947.5 with 77% of them owning the house. 100% of the sample had legal Jal Board connection. It is thus safe to assume that it is an average middle class neighbourhood. Observed that within the same ward and despite being connected to the same water supply system, not all houses received the same quantum of water. It is important to note here that the entire Mehrauli is supplied water through three nodal points. So, barring a few, most wards receive supply from one nodal point. So ideally all households in that supply line should get equal water, but this does not happen. Some of the reasons people reported for this discrepancy were:

- Topography: some parts of the ward are situated at a height. It is perceived that due to this the pressure of water falls.

  'Hamara ghar unchai par hai so paani ka pressure nahi banta, upar se log motor laga kar paani kheench lete hai. To paani ki badi samasya hai bhai" (Resident 1, Ward 4)

- Population pressure: each household is entitled to only as many connections as there are owners. Earlier houses were either single storied or double storied at best[9] but now the occupancy has increased. Houses have become multi-storied but the connection has not been multiplied. Legal connection is very difficult to obtain now.

  'Mere hisab se pani ki problem Mehrauli mei kabi solve nahi hogi kyonki log hi itne hai ki ki kuch nahi kar sakte. Joh family 2 rehti thi ek makan mei waha aaj 18 family rehti hai, phele jab hum 1969 mei aae the tab yaha kue se pani supply hoti thi, toh 2 bar din mei pani aata tha Mehrauli mei, pehle itni khpat nahi hoti thi na ab kya hai ki log bad gae, flat aage toh jab poplulation bade ga utna pani ki demand bhi badegi' (Resident 2, Ward 4)

- Illegal connection: since water consumption has increased and new connections are extremely difficult people resort to illegal connections to fulfil their needs

  'connection milta hi kahan hai flat valon ko. Mushkil se flaton me sirf 2 connection milte hain. bolte hain koi connection hi nahi lene deta hai ghar se, toh fir kya kare? Kiraay pe khareed lete hain paani unhe milta nahi hai. Jabki voh paise dena chahte hain, voh Jal Board se parchi kata de , sab kuch kara de, tab tak 50-60000 ka estimate

ban jata hai. 10 floor se upar nahi hona chahiye. problem pooora Mehrauli mei hai. humko connection nahi milega.' (Resident 3, Ward 4)

In order to understand how do they cope with these challenges I found that people deploy a range of mechanisms as coping like:

- Illegal connections: this was the most common coping strategy. Only 37% of the sample population did not have an 'extra' connection whereas 73% had multiple connections.

  'ab kya karein? Borewell to illegal ho gaya hai. Usme kharcha bhi hai. Police se lekar Jal Board tak sabhi ko khilana padta hai. Upar se padosi shikayat alag kar dete hai. So hum plumber bulate hai aur line mei connection thonk dete hai' (Resident 4, Ward 4)

  The connections are done on the subsidiary line as well as the main pipeline. The one on the main pipeline provides water daily 24x7 but is very expensive and also depends upon the location of the household. The more common practice is to get additional connections from the subsidiary pipeline.
- Buying water for drinking and filling containers from public places like *Mandir*, local *piau* and *Dargah*.
- Bribing valve man: He is the go to person in the Jal Board for any issue. However he does not oblige everyone. Only influential people or people who can pay money are able to seek favours from him. 'Valveman. Uske paas jaate hai wo batata hai ki itna paisa do to paani milega' (Resident 5, Ward 4)
- Tankers: this is not a very popular option because of two reasons: 1) it is expensive and 2) once the tanker comes the neighbours also want a share of water without sharing the bill.
- Clout of ex-councilor: many houses in Ward 4 are owned by the powerful ex-councilor from Congress. His extended family also stays in the same ward. So his influence is such that people under his patronage do not have to worry about water *'councillor ka kya hai wo to thappad maar kar bhi paani le lega' (Resident 6, Ward 4)*

CONCLUSION

Sibley (1995) writes that the production of the identity of the new middle class is linked to a politics of 'spatial purification' which builds claims of the middle class over public spaces and ultimately leads to cleansing of such spaces of the poor and working classes. This phenomenon was not very visible within the Ward 4 of Mehrauli but I witnessed a process of constant othering: 'us' vs 'them' with regard to access over water. People were continuously engaging in narratives to explain their lack of access to water. It seemed to create a sense of powerlessness among those who could not deploy means to ensure water availability in their household. It was interesting, although not surprising, to note that the 'adequacy' of water was defined very individualistically. Consequently, the perception of water scarcity was also different. People felt varying levels of deprivation based on the above factors. The vulnerabilities of the middle-class were very evident. One can argue that they

are not as worse off as the unauthorised colony inhabitants. It is true that this middle-class neighbourhood did not have disadvantages of lack of land title and daily wage earning but they are also not the vote bank parties lure for votes. Hence, they are in some sense more invisible than residents of say Sangam Vihar. In the words of one resident-

> 'pehele jo Vidhayak tha Shastri. toh rubber ki line ka project bhichaya tha. toh ye joh tank hai(baba ji ki tanki) ye isliye banaya tha kyunki paani jama hoga yahan. lekin yeh jese hi jhadoo(Aam Admi party) vala aya, jabse yyeh kaam ruk gaya hai. karodo rupay zameen ke andar hai abhi, yeh kabhi chalooo nahi hua. Bharam singh ke time sonia vihar ka paani alag jagah ke liye Divert hogaya. Yahan pehele ek councilor tha, ghadi vale party ka, fir yeh jhadoo vala ayaor joh kaam tha yeh Shastri ke time pe chala tha voh congress ka tha. Toh jab jhadoo vale aye humne poocha bhaya ye kaam kyun ruk gaya, yeh kehete hain hume paisa yahn se nahi milraha vahan se nahi mil raha. apas ki ladai , rajneetik ladai me aam janta ka nuksaan hora hai ji, poora bhrastachar hai'

Consequently, people have devised several ways of navigating the problem of lack of water through creation of several power centres. As I have already pointed out that tankers do not have a major role in this ward and in a large part of Mehrauli the respondents informed that tankers are usually called by private individuals as well as builder flats owners who collude with the tanker-walas (the DJB tanker) to fill underground tanks of the society so that all flats have 24x7 water supply.

Multiple power centres make the hydraulic public (Anand 2017) of Delhi different from Mumbai. Unlike Mumbai the management of water supply and distribution is centred in an autonomous body- Delhi Jal Board headed by the CM. The decentralised government has no role in it but they exercise influence over the Jal Board officials. The Jal Board officials are immune to pressure from the public so the public has to deploy various channels to get their work done. Thus, the hydraulic power-structure is very unique in every ward to a great extent. These specificities need to be understood if planning for an equitable water distribution system needs to be successful irrespective of whether it is done by the government or a private agency.

END NOTES

[1] According to Hansen and Stepputat (2006) informal sovereign includes local strongmen, vigilantes, political fixers and other brokers – who participate in the implementation of public goals, albeit for private gain.

[2]an administrative division

[3] access is defined as availability of water in the piped connection.

[4] Now there are 9 wards while during the fieldwork there were only 8 blocks.

[5] Water here implies potable water required for domestic consumption.

[6] read: water supply by the DJB.

[7] Planned here implies settlement which are authorised by the DDA

[8] This is in agreement to Matt Burkinshaw's observation that the quantum of Delhi's water supply is not accurately measurable. Actual supply varies depending upon formal and informal negotiation. Having a non metered connection helps this process.

[9] Source: conversation with Jal Board official

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Revitalisation of water heritage

Lohit Jain and Harveen Bhandari

Since the dawn of civilisation, water has been an essential resource that has been harnessed ingeniously to serve diverse human needs, both physical and cultural. Of special importance among these ingenious inventions are the highly efficient traditional water management systems and innovative water structures that are seen in India's hot and arid zones. While many of these structures such as Rani-ki-Vav, Chand Baori, Kusum Sarovar of Goverdhan have achieved iconic status (Chandra 2015) there are thousands of others yet, that remain unidentified. Many of these traditional water structures are now in a state of neglect (Shubhangi & Shireesh 2015; Prasad *et al* 2016). The revival and reuse of this living heritage is a necessity, and an apt revival can be a method to augment an otherwise depleting water supply, thereby helping in sustainable development along with reinforcing local cultural identity and promoting tourism (Sinha 2018).

Figure 1: Stepwell in Narnaul, Haryana. (Source: Author)

Figure 2: Stepwell in Fatehpur, Rajasthan. (Source: Author)

The architectural typologies of water structures include both the utilitarian and the ornamental, structures those designed to cater to ordinary citizens as well as those intended for royalty, ones that serve the private and ones that address collective needs of the community. They are manifestations of the vision of their patrons and the culture of the community (Hegewald 2001). While many of these structures remain active today, even in their state of neglect and deterioration, they are gradually losing their significance for their contiguous communities as well as to the policy makers at large (Bandil & Mishra 2018).

There is a need to explore possible architectural and ecological interventions that can help in revitalising these structures, reinstating their lost heritage values, and reinforcing their cultural significance. The methodology of this study will have a mixed research approach for data collection and analysis, involving architectural documentation, photo documentation, making of inventories, water quality assessment and Total Station Surveys, followed by semi-structured interviews of experts and other stakeholders.

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Smart interventions for historic cities

Parminder Kaur and Harveen Bhandari

Historic cities are places of cultural significance that enrich people's lives, often providing an immersive and inspirational sense of connection to community (Truscott & Young 2000). These cities, such as Amritsar and Varanasi, are our historical records and important for both tangible and intangible expressions of identity i.e. culture, folk music (Singh, Rana & Kumar 2020).

Due to urbanisation, migration, and globalisation, holy historic cities face tremendous pressures at present that impact citizens' quality of life (Singh *et al* 2020). In light of ongoing urban pressures, redevelopment processes of cities' cannot keep up with the current scenarios, resulting in damage to the cultural identity of these historical cities (Angelidou *et al* 2017; Ertan & Egercioglu 2016).

Figure 1: Historic city Patiala as a tangible expression of identity. (Source: Author)

Figure 2: Culture as an Intangible expression of identity. (Source: Author)

Figure 3: Tourism pressure at historic cities. (Source: Author)

Figure 4:
Damage of historic cities' cultural identity. (Source: Author)

In today's scenario, when the cities are becoming smart, there is a need for the holy historic cities too to move in the same direction by maintaining their cultural identity (Levin 2011). Implementing a smart and sustainable concept for historic cities might be difficult because of the complexity of their existing systems that require extreme efforts to be developed (Singh *et al* 2020) but we cannot keep our heritage isolated from the elements of change (Piplani & Mehta 2018). Cities are living environments that must change and adapt to the evolving needs and aspirations of their inhabitants (Piplani & Mehta 2018). Whether these cities can be successfully managed to express their cultural identity while also integrating these initiatives with new development plans is a challenge to policymakers, conservation architects, and urban planners (Singh *et al* 2020; Singh 2015).

Hence, there is a need to identify parameters that will guide the transformation of a city into a smart city in the context of existing historic environments, while also addressing the various complex issues that affect historic cities. The appropriate methodology for the research is intended to include a mix of quantitative and qualitative methods such as primary and secondary data collection, surveys, structured questionnaires and case study analysis.

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A feminist reading of history through architecture

Parshati Dutta

As chronicles are traditionally written by and about men, history has routinely marginalised women, either by excluding and silencing their voices, or by re-writing and re-interpreting their narratives from androcentric perspectives. In contemporary historiography, particularly in colonised nations, a genuine lack of authentic sources of information about women has been further problematised by the tendency of relying primarily on culturally distant and often fetishised colonial narratives to construct mainstream histories, that ultimately result in the creation of lasting gendered imaginations being accepted as fact. Even as the writing of feminist histories worldwide has begun to challenge and undo some of these practices, in the context of India, a land where historiography has predominantly been an oral tradition until the establishment of the Persianate Empires, feminist historians have only been successful in retrieving female figures 15th century onwards. Largely focused on the Mughal Empire, these narratives at present run the risk of becoming re-iterative in their common dependence on a limited body of available literary resources. Under such circumstances, this proposal seeks to investigate an area hitherto under-researched: the architectural legacy of women in history.

Figure 1: The caravanserai at Nur Mahal constructed under the patronage of Empress Nur Jahan is among the key monuments that are identified for study (Source: Author)

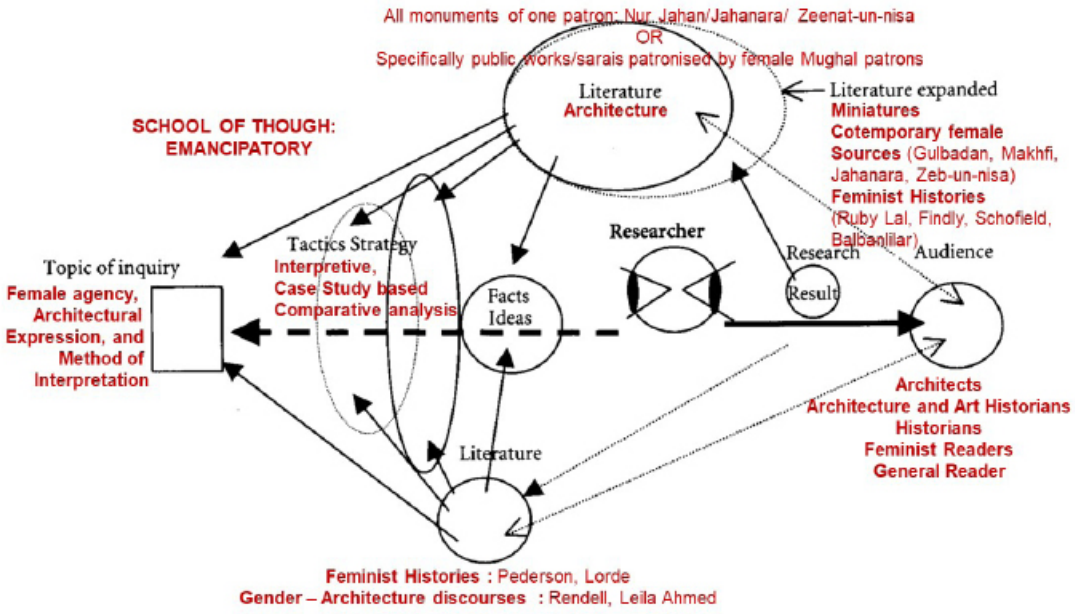

Figure 2: Methodology proposed and depicted based on Groat and Wang's (2013) diagram 3.1 from Architectural Research Methods

It is hypothesised that a detailed interpretive analysis of architecture can allow for buildings to be read as biographies, yielding credible information about their patrons. As architecture accessible to a wider audience and their interpretations, and therefore embodying most symbolic value by design, the study proposes to emphasise on the public typologies of markets, caravanserais, gardens, and public places of spiritual significance. As the success of the study is intended to be measured by the quantum of information unearthed from architectural sources beyond that already known from literary evidence about its patron, the methodology incorporates a critical comparative analysis between these two sets of data. To fulfil all preconditions, the architectural legacies of two of Mughal history's most prolific builders and well researched women are selected: those of Empresses Nur Jahan (Findly 1992; Koch 2014) and Jahanara (Bokhari 2009), one for primary study and the other to test theories derived.

Generic objectives of the study include:

- un-gendering and decolonising existing narratives of history and restore female voices
- finding, testing, and establishing a methodology for interpretation of monuments
- finding an alternative source of 'literature' in architecture

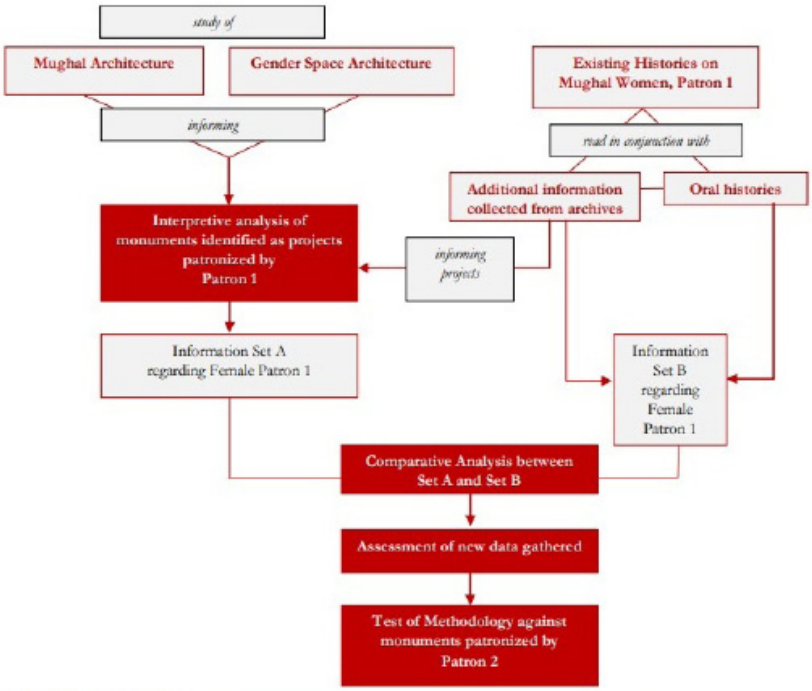

Figure 3: Flow of activities planned

Some specific objectives of the study are:

- To identify, interpret, and establish significance (if any) of structures erected by women patrons through the Mughal Period
- To understand the role of Mughal imperial women in public life through civic building

The potential significance of this research is anchored in the fact that it can enable both the understanding of socially constructed roots of suppression of women of which patriarchal histories are symptomatic and also change this thought culture. It aims to do this not only by restoring voices of Mughal women to Indian history, but by opening new frontiers of inquiry for feminist readings of history universally through the methodology developed, particularly for periods that show a paucity of primary sources of literature from women.

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Understanding architecture and planning: A case of Ekamrakshetra in Bhubaneswar

Piyush Das

Ekamrakshetra, Bhubaneswar is one of the complex sacred historic regions of eastern India. This region can be physically demarcated as the area confined by the Sikharachandi Pahar[1] in the west, River Katahjodi, a distributary to River Mahanadi in the north, River Bhargavi in the east and River Daya in the south. The region of Ekamrakshetra is particularly significant in terms of its diverse remains of cultural heritage. The documented history of this region is more than 2000 years old. Different religions such as Buddhism and Jainism have rendered various results of their cultural dynamics on this land. With the spread of different sects of Hinduism, the landscape went through many complex processes of change and adaptation. The unique sacred landscape continues till today and showcases exemplary resources of various typologies.

The available references describing the planning and architecture of Ekamrakshetra have more or less followed and used the investigative lenses of today's planning

Figure 1:
A sculpture in Vabani Sankar Temple. The study of the deities and rituals becomes essential to decipher the meanings embodied in the physical entities. (Source: Author)

Figure 2: Megheswara Temple (Source: Author)

and architectural parameters. But the construct of the landscape and its architecture was dependent on parameters which are either not understood today or have been considered irrelevant. This research aims to understand the planning and architecture of Ekamrakshetra through the investigative lenses of parameters that were used in the process, varying over time. The research objectives have been articulated as:

- understanding the evolution process and the dependent parameters of Ekamrakshetra placing in the context of various time periods and in accordance with the changing landscape.
- understanding the methods in which the built of the kshetra (area) is perceived, conceived and constructed while acknowledging the parameters used[2] in a different time.
- exploring the interaction of nature and culture in the sacred land and its impact on place-making.

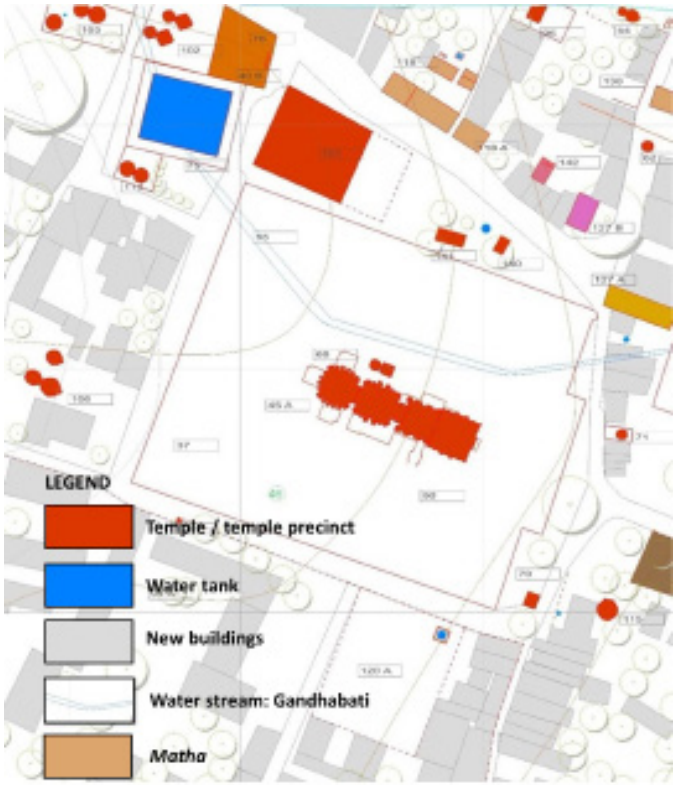

Figure 3: Map focusing on different built typologies in the immediate surroundings of Lingaraja Temple. (Source: Author)

Figure 4: Bindu Sagara is one of the significant water structures of this region which is part of almost all rituals practiced in the sacred landscape. (Source: Author)

Indian traditional knowledge of architecture and planning has always been worked in systems, where each entity connects to other aspects of the system. When we explore Indian sacred regions, the complexities are even more, where each component: built or unbuilt, gives evidence of connectivity with all aspects of a place-making. It is indeed necessary to understand these places in a manner where each entity can be described using the parameters that went behind the making of the same. This knowledge dissemination is required to move away from the narratives that have used mostly the western lenses of visual art history to describe the tangibles in a place like Ekamrakshetra. This process may offer new findings in the related discipline in terms of shared traditional knowledge of planning and architecture that may have been lost with time or rendered invisible, as we have lost the vision to understand them. The transdisciplinary methods of revisiting texts of varied related disciplines may also offer new knowledge of management of a complex place like Ekamrakshetra where the components of nature and culture have been intermingling and are still continuing.

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Research Supervisor: Vibhuti Sachdev

END NOTES

1. Part of Eastern Ghat.
2. Modified-changed

Piyush Das is an Architect with specialisation in Architectural Conservation. He has been involved in various conservation projects across the country and active in research of significant cultural landscape sites such as Mathura, Kishangarh, Bhubaneswar, Chanderi, Mehrauli, Puri, Mahanadi Delta and the Coastal belt of Odisha. Piyush has authored the books 'Memory of a Stream, Sacred Cultural Landscape of Ekamra Kshetra, Bhubaneswar' and 'Built fromthe Purana'. Currently he is an Assistant Professor at School of Art and Architecture, Sushant University.

Methodological challenges: Assessing net zero energy residential development in India

Prajakta Dalal-Kulkarni and Vasudha Gokhale

ABSTRACT

In the wake of global warming, energy efficiency measures for the residential sector in terms of guidelines and voluntary Green building rating systems are not enough to address the challenge of energy supply and Green House Gas (GHG) emission reduction targets perceived by India. This doctoral inquiry argues that the residential sector has high energy saving potential and considering the severity of climate change issue, the approach taken to build new residential building stock in India needs a paradigm shift and adopt advanced strategies like Net Zero Energy (NZE) building construction. Considering the complexity of the issue in hand the research design was critical which is discussed. A number of particular challenges are highlighted embarking on a mixed-methods study which include a number of barriers occurring specifically through the pursuit of mixed-methods research. It is understood that the combination of information stemming from diverse stages of investigation is imperative and no single method design will be useful. This study opts for mixed methods that include Delphi survey, case study, and simulation research and presents an analysis of both the approaches adopted for this study, articulating the qualitative and quantitative approaches for data collection and analysis. Design, and ontological and epistemological assumptions, are important as they justify the choice of methodology and methods of research aimed at achieving the objectives and ultimately contribute to the existing body of knowledge in the present context.

KEYWORDS

NZEB, Mixed methods, Delphi, Scenario Analysis, Simulation

INTRODUCTION

Realising the role of the building sector as one of the major contributors of GHG emissions using about 40% of global energy (Abergel, Dean & Dulac 2017)), initial studies indicate the importance of the building sector in reducing GHG emissions, which were recognised in COP21 (GABC 2016). It has been observed that India is committed to reducing the emissions intensity of its GDP by 33-35% by 2030 in its Intended Nationally Determined Contributions (INDC) submitted in the Paris Agreement on Climate Change (Union Environment Ministry 2015). Accounting for

more than 30% of the total energy consumption, the building sector is identified as an important stakeholder to achieve this target. Given the fact that the Indian residential sector consumes 75% of the total energy consumed by the building sector, and realising that despite green building initiatives in place, housing is a less frequently discussed aspects of sustainability (BEE 2018). The literature study established that currently the Indian residential sector is not covered by any energy efficiency-related regulation which is a matter of concern. Most of the residential building stock in 2030 is yet to come up in the country and needs to address the issue of energy saving (Rawal & Shukla 2014). The extensive literature review included research on themes like GHG emissions and the building sector, importance of energy efficiency in the building sector, building energy efficiency-related efforts at the global level and in India, importance of energy efficiency in Indian residential sector, various available energy codes and green building rating systems in India, net zero energy building (NZEB) approach, and its percolation in India. This background study provided a premise for identifying areas where further research is needed whereby the feasibility of NZE approach for the residential sector is proposed. The scientific premise of the research can be explained as a theoretical or practical understanding of a subject on which the hypothesis and aim of the research are based (Soniya 2018).

The research premise is shown in figure 1. It has been realised that the housing sector is emerging as one of the major sectors in India where its growth and increasing energy demand is directly related to increasing GHG emissions. GHG emissions are identified as one of the major contributors to the climate change problem. Till now there have been some efforts related to the energy efficiency of the housing sector, mainly through voluntary green building rating systems available in India and the introduction of the Residential Energy Conservation Building Code (R-ECBC). Based on available research it has been considered that these efforts are not sufficient and there is a need to go beyond these energy efficiency efforts to tackle increasing GHG emissions issues and achieve India's climate change commitments. It is hypothesised that advanced energy efficiency-related approaches in building projects such as NZEB can be a solution to it. NZEB will directly help with GHG emission reduction and climate change problems. The presence of various social, technical and economic issues identified with the implementation of this approach warrants research to assess the feasibility of NZEB in the Indian context.

Overall disciplines are mainly classified under natural science, humanities, and social science. Each of these disciplinary spectrums is related to specific epistemological outlook and methodology (Repko & Szostak 2013).

In this case, the research is related to environmental issues which are closely related to planning, designing, construction, and overall built environment. Construction is a social process, as it can be described as 'the application by people of technology developed by people to achieve goals established by people involving the

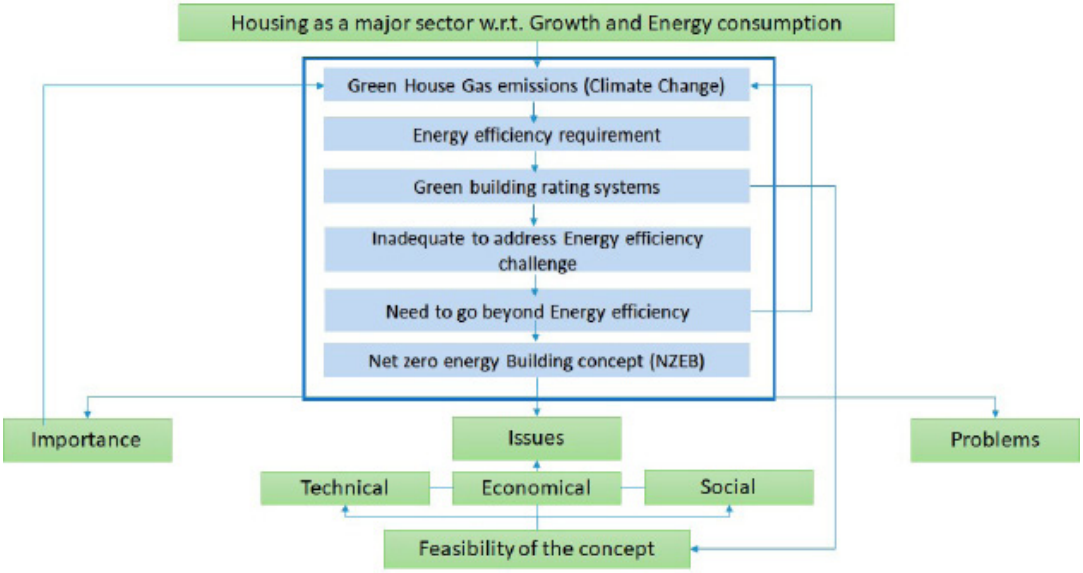

Figure 1: Research Premise. (Source: Author)

erection or retrofitting of infrastructure and buildings' (Abowitz & Toole 2010). Usually research problems related to built- environment extend across multiple disciplines and therefore, the most suitable research approach in such cases is the use of mixed methods of research which apply a combination of qualitative and quantitative research methods from various disciplines. It is observed that mixed methods are advantageous in addressing multifaceted interdisciplinary research problems in design and construction research (Day & Gunderson 2018). Mixed methods research is often recognised as the third research paradigm where equal importance is given to quantitative and qualitative approaches.

DEFINING THE RESEARCH PARADIGM

'Paradigm is a worldview that is defined by distinct elements including epistemology (how we know what we know), ontology (nature of reality) and methodology (the process of research)' (Hanson *et al.* 2005; Doyle, Brady & Byrne 2009) 'Ontology and epistemology are to research what 'footings' are to a house: they form the foundations of the whole edifice' (Grix 2004). Ontology is related to notions we make so as to rely on something that is real and logical.

The research questions dictated to include qualitative methods as they are able to address complex situations and provide profound conclusions recognising researcher's impression in constructing research findings (Sutrisna & Barrett 2007). Many scholars pursuing research in the built environment were influenced

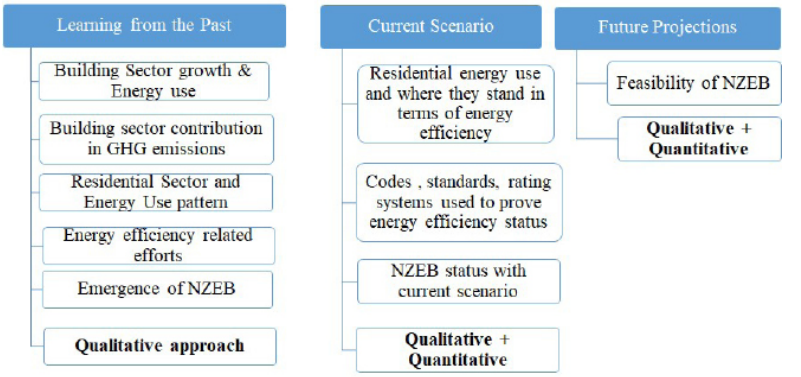

Figure 2: Examination of issue and applicable Research Paradigms. (Source: Author)

to apply qualitative techniques in their investigation and self-declaring themselves as qualitative researchers. However, several problems and challenges have been related with applying qualitative methods. The researchers may face issues in attaining aims and objectives of their research as there is a risk of unsuccessful application of qualitative methods due to problems such as facing hurdles or getting overwhelmed by the rich data collected (Sutrisna 2009).

Independence of Research Paradigms:

The examination of the issue includes three major aspects– learning from the past, analysing current scenarios, and future projections. Learnings from the past include studies related to building sector and energy use scenario, growth pattern of residential sector and its energy use, EE related efforts, need and emergence of highly energy efficient buildings like NZEB which could be examined mainly using the qualitative approach. This examination focuses on the current status of residential energy consumption and assessing possibilities and barriers of achieving NZE status with current energy consumption patterns which could be examined using qualitative and quantitative approaches. The future projections will analyse strategies and timeline required for mainstreaming NZEB residential construction. Thus a mixed method or multi method approach becomes the primary choice for this research.

Each of these followed different approaches and consequently different methods as the world view of the researcher is unmistakeably affected by main paradigm taxonomies– the positivist (quantitative) paradigm or naturalistic and constructivist (qualitative) paradigm– with which they align themselves. It is debated by conservatives that these paradigms are different and it is unlikely that they combine (Sandelowski 2000; Doyle, Brady & Byrne 2009). Conventionally, researchers have settled on a constrained decision of using either positivist approach linked with quantitative methods or the interpretative approach linked with qualitative ones (Howe 1985). Multi method approach is adopted for this research which is supposed to avoid assuming incompatibility of research paradigms as combining ontological

and epistemological stands of different paradigm approaches is impossible (Doyle, Brady & Byrne 2009).

As the positivist paradigm is based on a scientific method of investigation, outcomes are not biased due to the researcher's approach, whereas in the constructivist paradigm, research outcomes may be influenced by the researchers' values (Firestone 1987; Kivunja & Kuyini 2017). Where scholars seek to investigate the social context, constructivism research approach can be used (Schwandt 2000). Constructivism suggests that there are manifold realities and various analysis outcomes can be resulted from every research attempt. Researchers working with the constructivist worldview try to represent the reality of others through the method of in-depth descriptions of their encounters (Doyle, Brady & Byrne 2009).

CHOICE OF METHODOLOGY: MIX METHOD

The use of mixed methods started in early 1950's and has considerably evolved as a widely recognised and effective research method since (Teddlie & Tashakkori 2009). Mixed methods research is defined as 'a procedure for collecting, analysing, and "mixing" both quantitative and qualitative data during a single study, either concurrently or sequentially, to gain a better understanding of the research problem' (Creswell 2009). The basis of mixed methods is the assumption that neither quantitative nor qualitative techniques are self-sufficient (Day & Gunderson 2018). Reflecting on this, mixed methods may be defined as 'research in which the investigator collects and analyses data, integrates the findings and draws inferences using both qualitative and quantitative approaches or methods in a single study' (Tashakkori & Creswell 2007). The research is not restricted by the use of traditional approaches to data collection but is guided by a foundation of enquiry that underlies the research activity (Creswell 2009).

Researchers use both qualitative and quantitative methods in the mixed method approach but frequently they face problems of articulating them together (Tashakkori & Creswell 2007). Further, there is a discrepancy between researchers regarding what mixed methods research comprises (Sandelowski 2000; Tashakkori & Creswell 2007; Buchanan & Bryman 2007). Certain interpretations understand mixed methods as just gathering and analysis of data using both quantitative and qualitative methods while more recent literature emphasise the importance of amalgamation of the both approaches (Hanson *et al.* 2005; Buchanan & Bryman 2007). Few researchers suggest that mixed method research is still developing, and so its definition will change with the time and the debate related to its nature should be kept open (Tashakkori & Creswell 2007; Johnson & Onwuegbuzie 2007)

Key considerations in planning and undertaking mixed methods

Using a mixed method is not just gathering data for research using both qualitative

and quantitative techniques. Methodological framework of mixed methods needs to address various concerns during its application in research. Halcomb and Hickman (2015) have proposed eight important concerns of design and implementation of mixed research. The considerations are discussed in the following segment.

1. Examine the rationale for using mixed methods: The choice of using a mixed method to address research problems ought to be founded on the value that mixing qualitative and quantitative approach has over using a single method.
2. Explore the philosophical approach: Creswell and Plano Clark (2011) suggests four varied philosophical approaches for mixed methods, namely, a) single worldview (Critical realism) b) multiple worldview c) multiple worldview with sequential mixed methods [For example,a sequential mixed methods study which commences with interviews followed by an online survey would commence the study with a naturalistic (qualitative) perspective and then move towards a positivist (quantitative) worldview] and d) worldviews based on the shared beliefs with a scholarly community (Creswell *et al.* 2011).
3. Understand the various mixed method designs: Varied types of mixed methods planning approaches can be found in the literature. It is crucial for the researcher to recognise the basis and consequences of these approaches before pursuing research.
4. Assess the skills required: Broader ranges of research skills are required by the researcher and also by a supervising panel to support mixed method research projects.
5. Review project management considerations: Mixed methods project design needs to cautiously consider various aspects such as sequencing qualitative and quantitative data collection, time management, and preparation of complex datasheets to cater to both types of data etc.
6. Plan and justify the integration of qualitative and quantitative aspects: Very few guidelines on how to mix data in mixed methods are available in literature. Creswell (2013) suggests three distinct techniques of mixing within the mixed methods literature, namely, integration, connection, or embedding.
7. Ensure that rigor is demonstrated: Like any other research it is necessary for the researcher to be rigorous in their approach to the research and demonstrate consistency & accuracy in the research.
8. Disseminate mixed methods research proudly: One of the crucial tasks in mixed methods is work distribution. Two models of dissemination have been proposed in the literature for both publications and mixed methods theses (Halcomb & Andrews 2009).

These methods are explained in detail in the following section of philosophical stance. A researcher can adopt these models to resolve disseminance related challenges.

The philosophical stance

Mixed methods research is directed by theoretical presumptions that allow combining

qualitative and qualitative methods during the course of the research development (Hanson *et al.* 2005; Doyle, Brady & Byrne 2009). Johnson and Onwuegbuzie (2007) argues that 'The field of mixed methods research will move beyond quantitative versus qualitative arguments and will instead focus on recognising the usefulness of both paradigms and identifying how these approaches can be used together in a single study to maximize the strengths and minimise the weaknesses of each other'. Taking a non-traditionalist stand of using mixed methods offers the best opportunity to researcher with regards to responding to their particular research problems (Johnson & Onwuegbuzie 2007).

Maxcy (2003) recommends that pragmatic researchers' "unique contribution is to open up inquiry to all possibilities while tying that search to practical ends". Morgan (2007) underpins this and sights a pragmatic approach as a new guiding paradigm that can act "as a basis for supporting work that combines qualitative and quantitative methods and as a way to redirect our attention to methodological rather than metaphysical concerns" (Doyle, Brady & Byrne, 2009).

Distribution of work is a major and commonly faced challenge of mixed method researchers (Głogowska 2011). Segregated models and integrated models are the main work distribution models suggested in the publications and mixed method literature to resolve the challenge of work dissemination (Halcomb & Andrews 2009). As the name suggests, in a segregated model qualitative and quantitative parameters of study are kept separate and explained in separate chapters. But in an integrated model, qualitative and quantitative methods are interlinked in sequential chapters of research, each focusing on parts of the research question (Halcomb & Hickman 2015).

Further, many mixed method research outlines are developed to help researchers in improving research quality.

BENEFITS OF MIX METHOD

By utilising multiple techniques to contemplate the same issue, we can identify repetitive patterns or predictable connections among research variables, findings

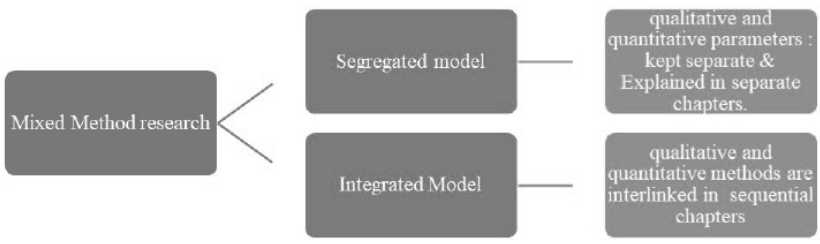

Figure 3: Mixed Method Research. (Source: Author)

that are free of one specific information source or kind of estimation and its characteristic shortcomings. Triangulation of methods is the simplest form of a mixed method approach while, the use of multiple methods of data collection, mixing qualitative and quantitative approaches in a mixed method design, is a broader form of triangulation. Blending qualitative and quantitative techniques enables us to merge research styles whose qualities and shortcomings are counteracted. Neuman (2000) submitted that, if the methods chosen only partially overlap in style, a study using more than one method, applied either sequentially or simultaneously, will provide richer, more comprehensive data. The construction researches aligned with social sciences can mainly be benefited using a mixed method research design (Abowitz & Toole 2010). Thus this research chose to use a mix method to analyse identified issues.

A research methodology theorises the choice of tools, techniques, and other processes of inquiry which seek to produce or verify knowledge. Thus methodology manifests the specific epistemology of the chosen research strategy. Scholarly research methods typically include a systematic process of producing or gathering data that is rigorous in the sense that the data can be verified. This research looks at the building industry, particularly the housing sector from a futuristic approach and needs appropriate methodology in the present context. For this concept of futures research was found suitable as it was evolved as a way of examining the alternative futures and identifying the most probable. Forecasting is designed to help decision making and planning in the present.

FUTURISTIC RESEARCH METHODS

The goal of future research is to "help inform perceptions, alternatives and choices about the future" (Amara 1991). It helps us to get choices or inclinations for the future, likely improvements, and to articulate and progress in the direction of an ideal future (Bell 1993).

The starting point of future research can be discovered extending back to the 1950's and 60's. The advantage of such research had soon been acknowledged and the tools spread rapidly to the private and government areas. In the early-1990s, 39 top forecasting specialists and 123 expert reviewers were engaged with recognising and grouping scientific knowledge on forecasting and prepared 139 principles based on the summary of research (Armstrong & Green 2018). Additionally, in 2015, simplicity and conservatism were identified as two more predominant principles in two summary papers on forecasting techniques (Armstrong, Green & Graefe 2015). Forecasts enable individuals in light of the fact that their utilisation can change factors presently to adjust the future.

After analysing various methods and its pros and cons, it is found that the use of

Consensus methods like Delphi, simulation and scenario analysis can guide this research which includes complex issues involving long range dynamic processes in uncertain contexts by accommodating and comparing different perspectives. Each method is explained briefly in the following sections.

The Delphi technique

The Delphi technique is "an iterative and sequential, multistage, flexible, group-communication process for forecasting and decision-making purposes to derive informed quantitative anonymous agreement and consensus among a panel of experts in the field on a particular issue or problem through qualitative assessment of evidence, there by minimising the liabilities of individual expert decision "(Nelms & Porter 1985). Delphi is mainly used by planners and forecasters as it is one of the well-recognised judgement based qualitative methods. The method is named after the Greek prophet at Delphi who was famous for future predictions. Currently this technique is the most popular qualitative, organised, and indirect interaction forecasting technique (Woudenberg 1991). Delphi was first created by Olaf Helmer and Norman Dalkey for forecasting military problems. The technique became well known when it was applied ten years after the fact to huge scale technological prediction and corporate design (Helmer 1983). The Delphi has continued to turn into the subject of various books and journal articles (Meade & Armstrong 1986). It is appealing to managers since it is anonymous and straightforward. Also, it is generally cheap as the specialists don't have to meet. It has a favourable position over forecasting markets in that reasons are provided for the predictions (Armstrong, Green & Graefe 2015; Armstrong & Green 2018).

Delphi is probably the most valuable technique to use when the various specialists have distinctive data pertinent to the issue or different interpretations of the idea of the situation (Cuzán & Armstrong 2005). The use of Delphi is extensively seen in US, eastern and Western Europe and Japan. It appears that hardly any techniques have caught the researchers and forecasters attention the manner in which Delphi has (Lang 2000). It was observed in one of the researches about the Delphi method that it was more accurate than 'expert opinion surveys' for 12 of 16 studies. Further observations stated that between these 24 comparisons, Delphi improved accuracy in 71% and harmed it in 12% (Wright & Rowe 2001; Armstrong & Green 2018) Various advantages of the Delphi techniques were observed such as geographically dispersed panel experts could take part together as they did not need to meet physically, anonymity and confidentiality of expert reactions which reduces factor of influence on responses, no peer pressure on experts, limited time required for respondents to complete surveys, structured communication process, flexibility and inexpensive process. Some of the drawbacks of this method are that no guidelines are available for deciding consensus, sample size and sampling techniques, time commitment required from participants, time delays between rounds in the data collection process, drop outs etc.

The following steps are involved in the Delphi process:

- Choose a Facilitator: Researcher him/herself or a neutral person who is familiar with research and data collection.
- Identify Experts: Representatives from all relevant domains- practice, teaching, and research having relevant knowledge and experience of a particular topic can be invited as experts.
- Problem definition: Precise and comprehensive definition of an the problem needs to be provided to experts beforehand, outlining the aim, likely time commitment, and processes.
- Round of Questions: Number of rounds can be decided based on required outcome. The experts answer questionnaires in two or more rounds. After each round, a facilitator provides an anonymous summary of the experts' forecasts from the previous round as well as the reasons they provided for their judgments. Thus, experts are encouraged to revise their earlier answers in light of the replies of other members of their panel. It is recommended to have more than three rounds of questioning to reach a closer consensus.
- Findings from questionnaire rounds: After the round of questions, experts will have reached a consensus and researchers will have a view of likelihood of future events and what impact they may have.

In this research, feasibility needs to be explored from a technical, economic, and social perspective. Further, the research involves various stakeholders like developers, architects, and policy makers among others. Delphi survey analysis can unfold the issues, concerns regarding feasibility of NZE in the current scenario, and give a view of likelihood of future events and what impact they may have. Delphi survey will be followed by use of scenario analysis concept for examining sampled housing units.

Scenario analysis

Scenario analysis is a process of analysing possible future events by considering alternative possible outcomes (sometimes called "alternative worlds"). Therefore, scenario analysis, which is one of the fundamental types of projection, doesn't attempt to show one definite image of the future. Rather, it introduces various alternate future improvements. Thus, an extent of conceivable future results is recognizable along with ways to achieve outcomes. Opposite to forecasts, the Scenario analysis does not depend on extrapolation of the past or past patterns. It doesn't depend on verifiable information and doesn't expect past perceptions to stay effective in future. Rather, it attempts to think about potential advancements and turning points, which may just be associated with the past. So, several situations are generated in a scenario analysis to show conceivable future results. Every situation typically consolidates optimistic, pessimistic, and more and less likely advancements. However, all parts of scenarios ought to be conceivable. Experience has indicated that around three scenarios are generally sufficient for further argument and selection. More scenarios increase threats of making the analysis excessively complex (Armstrong & Green 2018).

A scenario is a "story" illustrating visions of possible future or aspects of possible future. It is maybe the most significant foresight or future investigations technique. Scenarios are not expectations about the future, rather they are like recreations of potential futures. They are utilised both as an experimental method or decision making tool, to feature the discontinuities from the present and to expose the available choices and their potential results (Lindorfer & Velo 2016). One of the uses of scenarios is to help decision-makers acquire knowledge and understanding to anticipate the context in which they have to act. The scenarios need to be reasonable, reliable, and offer future perceptions (Hannah & Gabner 2008). Scenario analysis will help generate orientation regarding future developments of NZEB development in the residential sector through an observation of certain relevant key factors. The next step is simulation study that allows visualisation or prediction of the complex relationship between the built environment, natural environment, and users.

The dictionary defines a simulation study as "the representation of the behaviour or characteristics of one system through the use of another system, especially a computer program designed for the purpose." In simple words, simulation can be understood as a process through which one can study and analyse the real world scenario by creating a virtual world where synthetic elements of the virtual world accurately represent the real world. In the case of architectural research, simulation is extensively used to evaluate ideas in a time and cost effective way before investing in larger efforts to implement those ideas. Simulation has the potential to provide tremendous insight into how complex systems will perform throughout their life cycle. Instead of relying on common sense, simulation permits architects to quantify the entire host of design solutions till they get one final satisfactory design solution. Perhaps one of the most powerful facets of simulation is the ability to integrate the knowledge of thousands of researchers- from heat and mass transfer to material and human behaviour- into a single toolbox at the convenience of designers (Attar *et al.* 2014). In architectural research simulation study can be used to simulate various situations, for example, material testing, firefighting, wing pressure analysis, climate analysis, services integration, and analysis of the effect of natural hazards like an earthquake on buildings or city (Groat & Wang 2013). The analysis indicated that this method could be used to simulate various situations in context of housing typologies and their energy consumption pattern and the potential of achieving NZE status.

CONCLUSION

Research in environmental architecture is a diverse and complex phenomenon which includes various disciplinary fields ranging from architecture and planning, building technology, environmental sciences, and ecology to social sciences, and environmental psychology. In order to describe, explore and understand

these aspects associated in phenomena under inquiry it has become imperative to use different research methodologies. The current perception of the doctoral process which is defined as an act of conducting and designing original research with in-depth understanding techniques for research and advanced academic enquiry contributing substantially to the knowledge altogether pointing to the demonstration of mastery of research methodology in conducting research on the highest level. Although research methodologies are recognised as means to conduct research, it has been argued that the relative preference of each research methodology depends on philosophical issues related to the question of ontology (the nature of reality) and epistemology (the nature of knowledge) which is an important ingredient in PhD research. For conducting systematic investigation or inquiry whereby data are collected, analysed, and interpreted in a defined way in order to understand, describe, predict, or control an architectural, environmental, constructional, social, or psychological phenomenon, there is a need to choose an apt research paradigm. The role of the paradigm which is paramount to the choice of methodology needs to be realised.

This research explained various challenges that were encountered in selecting methodology in context of the research in hand, that is an assessment of need, applicability and barriers of construction of NZE residential development in India The research established research premise and need of adoption of advanced strategies such as NZEB in residential sector in India. The complex nature of the research problem of assessment of feasibility of NZEB in Indian context and appropriateness of use of mixed method research design to address it is explained. It is followed by the analysis of both the approaches adopted for this study articulating the qualitative and quantitative approaches for data collection and analysis. The choice of Delphi, case study, and simulation analysis methods to address the research problem and their sequential use in the research process is explained. The study discussed the research design, the ontological and epistemological assumptions which are important in as they justify the choice of methodology, and methods of research aimed at achieving the objectives and ultimately contribute to the existing body of knowledge in the present context.

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Study of affordable housing models in developing countries

The case of Kerala

Preetha Ravi Sree

ABSTRACT

Cities are believed to be places where ambitions and aspirations of life are realised. The general perception is that cities provide contentment and happiness and increase the prospects of individual and collective well-being. However, slums have become the primary living environment for people, especially those belonging to the lower economic strata, as it provides the most affordable housing for them. However, this source of housing delivery lacks proper services, planning and is deficient. Though every country has a different approach towards social housing, so far none of these approaches have been able to create a great impact in slowing down either the rate of slum growth or its eradication.

International policy makers advocate that these housing issues could be addressed through the economic growth of the countries and individual governments' capacity to enforce regulatory framework for the use of land that will provide an opportunity to implement different forms of interventions to support housing for lower income households. This economic growth model has resulted in rapid urbanisation, leading to overcrowding, creating a situation that has led to the wearing of face masks and bringing traffic to a standstill in most fast-growing urban centres, such as Beijing and Delhi. Evidence on delivery models of affordable housing worldwide has been examined here, with a primary focus on Asian countries or developing economies. This offers a pragmatic approach towards the delivery of affordable housing through inclusion of livability considerations for the urban poor.

Keywords: affordability, slum studies, housing policies, formal and informal housing market

INTRODUCTION

The challenge to provide affordable housing, especially to poor households, is a problem faced by all countries today. Slums and squatters have become the primary living environments for people, especially those belonging to the lower economic strata. Their growth rate is twice that of the formal housing sector. Though every country has adopted various strategies and approaches towards

social and affordable housing, so far none of these approaches have been able to create a significant impact in slowing down the slum growth rate, and certainly not eradication. The existing housing projects for the poor are not lucrative enough for them to opt for it over the informal housing market, that is slums and squatters. This is evidenced by the census 2011 report, highlighting that approximately 11.09 million houses are lying vacant in the face of a total housing shortage of 18.78 million dwelling units.

Many factors are responsible for this. According to Harsh Mander, Director of the Centre for Equity Studies, 'Those who really need these homes cannot afford them, and those who can afford them don't want them' (Chandran 2018). As per Anuj Puri, Chairman of Anarock Property Consultants (ibid.): A significant number of them are in areas which lack the necessary support infrastructure- most importantly transport. One way to ensure these homes are occupied is to rapidly deploy the support infrastructure in these areas. These homes will deteriorate if they lie unoccupied much longer.

The above factors are mainly due to the paternalistic planning approaches. Both the eminent urbanist and activist Jane Jacobs (1992)as well as the economist and educator Milton Friedman (2002) highlighted this fact in the 1960s. Even today, there has not been a significant shift from this paternalistic approach. International policy makers advocate for housing issues to be addressed through the economic growth of the countries, with individual governments' capacity to enforce regulatory framework for the use of land being used to provide an opportunity for the implementation of different forms of interventions to support housing for lower income households. This economic growth model has resulted in rapid urbanisation, leading to overcrowding and congestion and the housing situation could be classified as 'more housing of a lower standard' or 'less housing of a higher standard'.

The struggle to identify innovative approaches that could consider the community as the core actor while utilising public resources that are appropriate to the specific issues and local context is ongoing. In its stead, we are counterproductively focused on economic growth that only promotes supply-oriented interventions instead of a demand-driven approach.

To highlight this issue, a detailed study has been undertaken on various affordable and social housing programmes at both the national and the international level. The aim of this research is to understand current housing practices worldwide, document the learnings, identify the gaps, and finally, to conclude by offering a pragmatic approach towards the delivery of affordable housing through the inclusion of livability considerations for the urban poor.
A worldwide study conducted by the McKinsey Global Institute in 2014 identified that unlocking land at the right location, reducing construction costs, increasing

operations and maintenance efficiency, and reducing financing cost for buyers and developers were the main factors responsible in bringing down the overall cost of the housing project and making housing affordable to all (Woetzel *et al*. 2014). However, these are primarily market-led measures. Conversely, the delivery mechanism followed around the world is one of below mentioned models:

- **The consumer-led model:** It is the most common way for families to obtain housing in most countries. The consumer may hire a builder to construct their homes or collectively build their homes with the available resources and have little knowledge on the navigation of the opaque and fragmented construction industry.
- **The incentivised private development model:** In this system, the private developers receive financial and non-financial incentives from the government to build affordable housing. These are then purchased by the government and are then either sold to the citizens or operated as rental property.
- **The public-private partnership model:** In this model, both the government and the private sector are active partners. Here the government's role is far beyond being a passive, regulatory body. Private developers may be given public land for development and the finished units are sold or rented directly to the homeowners by the private developer or by the government agencies.
- **The public sector delivery model:** This model is focused towards people on the bottom of the housing ladder/pyramid. Government agencies may hire private sector contractors to build upon public land, although the government agencies retain the control and ownership of the project. The agency is solely responsible to sell or rent the property to the beneficiaries selected by them.

To understand the above-mentioned delivery models in depth, a review of a range of case studies from across the world has been undertaken, followed by a comparative analysis, referring to a wide range of cultures, scales, systems, experiences and responses to the affordable housing challenge. This will help in identifying the delivery mechanism and challenges faced by various countries and will lead us to the gap in these systems. One approach towards housing is to provide decent and affordable housing to the whole population. Countries like Denmark, Netherlands, Singapore and Sweden follow this system. Alternatively, countries like Canada, Malaysia, United States and most European nations follow an approach wherein housing is provided to the weaker sections of society, who are often excluded from the housing distribution system. China and India, the two most populous countries in the world, have had completely different approaches so far. To further this understanding, a detailed study of three countries with developing economies, namely Brazil, China and India have been taken up, charting the changes that they have undergone over time with respect to housing.

SCENARIO IN DEVELOPING COUNTRIES

Brazil, China and India are included in the list of most-populated nations. These nations have witnessed high levels of urbanisation due to rapid economic growth in a short span of time and consequently faced substantial housing problems. Each of these nations has adopted different housing and development paradigms due to the varied political ideologies and the institutional evolution over the period in the housing sectors (Tiwari & Rao 2016)

In the case of Brazil, urbanisation can be seen having led to segmented cities overfilled with unplanned settlements: favelas. In the 1950's, Brazilian politics resisted urbanisation, with the government fearing that rural migration would overwhelm the cities if they facilitated it. However, this did not deter people from migrating, as economic benefits were high in the cities. Subsequently, the government was unable to control the population explosion, leading to haphazard expansion of the cities. From the year 2000, Brazil started social innovative schemes, such as providing lower-income groups with subsidised housing, in order to improve the living condition of the poor (Maclennan *et al*. 2014; Tiwari & Rao 2016). China, on the other hand, moved from their anti-urban stand in 1966-76 to a pro-urban stand from the year 1978 onwards after switching to market-based economic policies. They controlled the negative effects of the high rate of urbanisation with a controlled migration system and the implementation of a 'one child policy'. The challenge with China's development model is that their urban economics depends on entrepreneurial bureaucrats and developers, and therefore, the social and environmental agenda remains ignored (ibid.).

In India, with a majority of agrarian voters, the government was hesitant towards urbanisation. India, in comparison to the other countries, has a slower rate of urbanisation and is less developed on that front. However, it is not able to harness the economic growth potential that has been associated with urbanisation. In India, more than pull, it is the push factor: the non-performance in the agriculture sector and lack of employment opportunities in non-urban centres that have been responsible for the rural-to-urban migration. The current approach towards urbanisation is leading to patchy development at the neighbourhood and regional level, thereby segregating the society into the haves and the have nots (ibid.).

A Summary on Brazil's Urban Housing

Brazil moved from rental housing in the 1940s, accounting for 75% of households, to a culture of home-ownership, accounting for 73% of the total housing stock as of 2010. The shift happened due to the country's multiple regime and governance changes, as well as due to policies made by the military government starting in 1964. Housing moved from centralised state intervention to market supply from 1940 to 2000. Between 1964 and 1985, during the military regime, social housing was centralised: it was carried out by the National Housing Bank. Statistically, the most

successful attempt to provide housing in Brazil was indeed during this era, through the promotion of mass housing production (Souza & Zetter 2017). However, once the country became democratic in 1985, decentralisation of housing policy and production happened. The government's role in the housing sector became limited through the 90's, the production of most of the housing moved to the private sector, and the housing policies throughout this period neglected the productive potential of the informal housing supply. This led to a huge increase in the number of informal and self-built settlements (Arellano *et al*. 2016). Since markets were not providing land for housing at affordable prices, the poor could access the urban land through measures such as land invasions and plot subdivisions that became a pattern typical of Latin America.

In the mid 1990's, more than 70% were detached houses of brick, stone, wood or concrete. There were 10%rural dwellings of wood or clay, with less than 5% being semi-private units called 'quarters', while less than 10% were apartments (Dowal 2006-08). The re-emergence of a consistent and centralised urban policy happened in early 2000s with the creation of the Ministry of Cities that was responsible for the urban development policy and sectoral policies for housing, sanitation and urban transportation. This led to Brazil's largest social housing programme in 2009 (Arellano *et al*. 2016), the Minha Casa Minha Vida Programa (MCMV) or My House, my Life programme.

The concept behind this programme was to provide to the people belonging to the economically weaker section with subsidised housing. The programme was financed by the largest government-owned public bank in Latin America that provides affiliated developers with construction financing and low-income homeowners with preferential mortgages. Since the policies during this period too were market-oriented, the impact on low-income urban dwellers continued to be negative. This became evident from the MCMV programme implementation. Instead of focusing on the target population, their needs, and the quality of the housing, the programme served mainly as an economic stimulus, generating employment in the labour-intensive construction industry. The locations identified for the implementation are often the peripheries of the city, creating poor transport facilities, infrastructure, and other amenities.

Most housing developments in Brazil are aimed for the rich, provided by the private market, while the government's housing support for the poor is mainly through the Public-Private Partnership model. This has created a massive deficit of affordable housing with approximately 30% of Brazil's population living in overcrowded slums called favelas (Teoalida 2017). Despite the housing shortage, Brazil has a large number of vacant housing. The number of empty buildings is nearly equivalent to the units needed to eliminate the housing shortage (Dowal 2006-08).

Summary on China's Urban Housing

China moved from socialist work units in 1953 to gated communities and migrant enclaves in 2010 due to two major revolutions that happened between this period. In the 50's, there was no rural-urban divide or difference in traditional housing. Housing units were mostly single-storied structures, extending to only two stories at the most. Local materials were used, and they were privately owned.

By 1950, housing in urban areas started moving away from the traditional system and became part of Socialist Welfare scheme. About 53% of housing came under work units, 29% under municipalities, and 28% were privately owned. Again, a shift came during 1980's, wherein the policies favoured privatisation and a pragmatic shift from housing as a welfare service to a commodity happened, shifting public rental to private ownership and independent-State investment to shared costs by State, employers and more importantly, individual households (Wang n.d.).

From 1990, further privatisation happened, especially in work units, wherein the sitting tenants were made to buy the housing units, special saving systems like the housing provident fund were introduced, the commercialisation of maintenance and management happened and the government provided support for affordable housing. During this period, 70% of housing was affordable and the remaining 30% was equally divided between social rental housing and commercial housing. Soon the commercial property developers emerged as the main housing providers in cities and towns, and once again, China witnessed a major transformation, from over 80% public rental in 1981 to over 80% homeownership by 2010. Today, most urban families live in purpose-built housing: also known as flats or apartments (Zhao & Bourassa 2010). Housing was no longer linked with employment, and independent housing estates became the norm of living in cities. These created different standards in different estates where access was dependent on affordability and brought in new set of problems like:

- Price inflation and instability
- Affordability problems for the young and migrants
- Inequality, social segregation, increasing gap between the rich and the poor
- Sustainability and environmental costs, urban sprawl and land shortage

The migrant population are the major sufferers as they exert high labour, receive low wages and are excluded from social and welfare services, to end up living in urban villages. In 2011, there has been a policy change through the 12th five-year plan, wherein China aims for a 'comfortable society' by 2020 that involves protection of 'Basic Housing Rights of all people'. Municipal governments were made responsible for helping and assisting poor and low-income families to acquire and live in reasonable quality housing, regardless of whether their financial power allows them to do so (Wang n.d.). Today, two major schemes existing in China are:

- commercial housing with a control of the sale price
- public rental housing for migrant workers

Still the housing demand in cities with thriving economies is substantial, as 50% of the Chinese population lives in urban areas due to migration and expansion. Due to disparity in income, most of the housing stock in cities with thriving economies are bought by rich families as an investment, while considerable housing stocks in villages and newer developments are lying empty. About one in five homes in China is abandoned.

China also has a huge number of 'ghost cities' or modern developments that have failed to attract residents. Ordos Kangbashi is a city developed to house 3,00,000 people with residential skyscrapers, museums, libraries and schools, in a record time of 10 years, but only 70,000 people moved into the city. Eventually, they too moved out and the city stopped building and today it's the world's biggest ghost town with most of the buildings completely empty (Diamond 2018; Urie & Olito 2021). A study on understanding residents' satisfaction with urban livability in China (Zhana, *et al*. 2018) using the geographical detector model revealed that most of the respondents are moderately satisfied with Urban Livability standards in China. Respondents were more satisfied with respect to public facilities, natural and socio-cultural environment but were dissatisfied with respect to urban security, environmental health, convenient transportation and socioeconomic attributes that include location, housing, education, family size and hukou that means registered residency status.

Summary on India's Urban Housing

Traditionally, Indians have lived in a joint family system. Many occupants of the house and their interpersonal relationships demanded clearly distinguished spaces for different activities. There were private and public zones in the house with the courtyard as its nucleus (Patwardhan 2017). In the past, people constructed their own houses with mutual help or using local masons and locally available materials. Traditional buildings also have the provision for incremental growth or change without losing their identity. Various forms, facades and typologies evolved during the earlier periods demonstrated a strong regional influence, a product of social, cultural and climatic needs. Elements like internal courtyards are also common in most parts of India, with inward-looking rooms, built mainly for privacy while also keeping the house cool, and reducing incoming dust and noise. India's rich architecture can be seen in the self-built vernacular architecture, but today, the growth of population and poverty is visible in the self-built squatter settlements of urban centres, where conditions are deplorable.

Shelter in India has grown out of sociocultural needs, for example, the projecting balconies with meshwork were designed to provide privacy for womenfolk, alongside security, shade, fresh air, and protection from dust. Post-independence, the housing programmes were heavily dominated by the state/ public sector for as long as two decades. The first housing initiative by the government after Partition was proposed for the resettlement of millions of homeless refugees through

Figure 1: Private affordable housing in Kerala, (Author 2019)

planning colonies and townships in various states in the country. Along with this came governmental housing projects for Government employees, as well as housing for industry and plantation workers. The private sector had a very limited role to play in housing for lower income groups, although their participation and investment in housing for middle and higher income groups was significant (Tiwari & Rao 2016). There was no official housing policy until 1988 and housing programmes were disjointed and fragmented. The beneficiaries were mainly dock and plantation workers, and industrial and governmental employees. Housing was considered as more of a welfare job than an economic growth contributor.

During the 70's to the 80's, many new schemes were introduced, like the environmental improvement of slum schemes and site and service schemes. It was during this period that housing finance institutions like HUDCO and HDFC were established. In 1987, the National Housing Board was set up and a comprehensive housing policy named National Housing Policy was formulated in 1988. The decade of liberalisation in the 90's saw the realignment of power distribution between central, state, and local government take place. The management of urban services, protection of weaker sections, and various government schemes like urban poverty alleviation and slum upgradation, were transferred to local bodies. From 2000 onwards, the economy moved into the globalisation and privatisation period, which is largely privately led, service sector-oriented and city-driven (Tiwari & Rao 2016; Hingorani 2011; Wadhwa 2009).

A transformation took place over this period, from public housing to public-private affordable housing and from rental to ownership models. In India, the rental act had a counterproductive impact. The intent behind the rent control act was to safeguard the tenants' right and it ignored the supply, the owners and their challenges and needs. The rents were based on the market value of the property

at the time of purchase. Due to this, many owners removed their houses from the rental market and the maintenance of the rental-housing ceased to exist, as maintaining the property did not contribute to the rental yield.

Findings

While reviewing literature on affordable housing, it was observed that worldwide there were many housing programmes implemented by different governments to match the housing demands of its citizens but the gap between the demand and supply only widened. Some of the common observation from all the three case studies are:

- There was a lack of continuity and interconnectedness among the various programmes due to the change in the government or political scenario. This led to difficulty in forecasting the uncertain challenges of policies, programmes and projects and taking timely and appropriate actions.
- These studies also highlight the fact that the beneficiaries were excluded from the whole process of planning, designing and execution of housing for them due to which the desired output were not met.

The above case studies expose the mismatch between the user expectation and what is delivered in terms of quality. Through these studies it was realised that liveability or quality of life and meeting the user expectation, is one of the many characteristics of a housing project that scores high on affordability. It is important to understand the user group and their expectations from a housing project because income-based or size-based affordability criteria does not correctly assess the willingness of a poor household to be part of formal housing market.

PRIMARY STUDY

Considering, the importance of evaluating the impact of the housing schemes allotted to the beneficiaries and to know the relevance of livability dimension in a settlement, a detailed study was done on two government housing resettlement

Figure 2: Government affordable housing projects in Kerala, 2000 onwards (Source: Author)

Figure 3: Karimadom Colony, Redevelopment Project in Kerala (Source: Author)

and redevelopment projects from Kerala. Figure 1 showcases the typical native urban housing typology and the housing images in Figure 2 are two of the best government projects, one resettlement project and one redevelopment, that have addressed the socio-cultural-economical needs of the people successfully. These projects have won many awards and referred by other government agencies.

The redevelopment housing project, Karimadom colony from Thiruvanthapuram, was recognised as one of the most successful housing project and used as a

showcase project by the Kerala Government. The main stakeholders for this project were Kudumbashree, a neighbourhood group, the state nodal agency for BSUP and the implementing agency COSTFORD. The Kudumbashree neighbourhood group won three prestigious national awards for their contribution in the delivering a pro-poor housing agenda at Karimadom colony and the implementing agency COSTFORD won the national HUDCO Design Award for 2013 for Karimadom redevelopment project (Chatterjee 2013). This settlement is situated in the heart of Thiruvananthapuram city which easily meets the livelihood needs of people.

In 2006, this slum was taken up for redevelopment with an aim to provide housing to 560 existing household with interactive community spaces and amenities like a health centre, Anganwadi and study centre for young children and a work centre for women. The dense fabric of huts on the low-lying ground were converted into four storeyed walk-up apartment blocks. For two-thirds of the population till date. The redeveloped of fourth phase has not started. 360 units have been built in three phases between 2008 to 2020.

The resettlement project, Kalladimukham housing colony is part of the slum eradication project of Trivandrum Corporation started in year 2015. The project was under the Basic Services to the Urban Poor (BSUP) scheme; was designed and constructed by COSTFORD at a costs Rs. 250 million. The aim of this project was to fulfil the home dreams of 320 backward families spread across the nearby wards adjoining Kalladimukham. It is considered as a new way of living for a class of people who often make do with just the sympathy of society, the 'landless and the homeless'. This project is away from the city centre and built on a semi marshy land that is about 200 metres from Karamana River.

Glimpse to Kalladimukham Colony: Location, Apartment block, Unit interior

To document the quality of life of the community Jan Gehl's method of mapping outdoor activities and Nabeel Hamid's survey checklist to gain awareness of local concerns relative to housing, services and utilities were used. Based on the physical observations and survey it was realised that people from Karimadom colony were able to carry out all their outdoor activities quite comfortably. There were lot of interaction among people in the public spaces. The streets and roads were always active with movements. However, the same is not true for Kalladimukham the optional and social activities were quite limited and less frequent. The public spaces were mostly used by youngster during playtimes and the streets were used for carrying out the necessary activities.

Therefore, if we apply Jan Gehl theory of good interaction between public space and public life improves the wellbeing of the person, we can say quality of life at Karimadom is better than Kalladimukham colony. The major enablement factors for Karimadom colony responsible in achieving a higher livability index are:

Figure 4: Kalladimukham Colony, Redevelopment Project in Kerala (Source: Author)

Figure 5: Kalladimukham living room interior (Source: Author)

- Locational advantages: All amenities in the vicinity, transportation related choices
- Employment opportunities: Multiple options in the informal sector, railway station, temple and market
- In-situ development: Old settlement who were not displaced
- Strong neighbourhood groups: Women empowerment and participation
- Sense of security and belonging: low density, better infrastructure and active community participation
- Housing unit design: The in-built facilities like attached bathroom and kitchen with storage shelf also regular electrical and water supply
- Good Social health: Low morbidity rate and good childcare facility
- The factors that were not conducive in Kalladimukham are:
- Resettlement: the beneficiaries were not from the same settlement but from surrounding 10 wards. The community bonding, participation in community development or related activities was not there.
- Location: public transport choices were limited.
- Sense of security and belonging: beneficiaries had a sense of security but not belongingness.

CONCLUSION

The whole study highlights the fact that although the fast pace of urbanisation and population explosion poses various challenges, they are not solely responsible for the inadequate and unaffordable housing and poor services. The constitutional, institutional, political, economic, social and cultural conditions are the key deciding factors that shape the housing sector (Tiwari *et al.* 2016). All these factors reflect on the livability condition of the people. The concept of livability represents overall quality of life and wellbeing. Therefore, to have a meaningful solution towards affordable housing one must look into the livability dimension before supplying affordable housing. A comprehensive study on the beneficiaries to measure the livability index of the settlement by identifying the various enablement factors

from the social, cultural, economic, political and institutional frameworks will help in improving pre-existing livability standards. When the livability factors, or enablement factors, are included in the affordability measures, the supply mechanism will be able to match the demand.

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Preetha Ravisree is an architect and urban planner with 19 years of practical and teaching experience both at the national and at the international level. Preetha is a trained Building Information Modelling professional. She is currently pursuing a PhD in the field of affordable housing. Her research is focused on finding out how by addressing the livability component one can improve the housing affordability of urban poor.

Social sustainability of prefabricated construction technology in India

Shubham Jain and Harveen Bhandari

India's infrastructure market is the third-largest in Asia and plays a vital role in the Indian economy (Murali & Sambath 2020). Building sectors have long been criticised not only for their low productivity, long construction time, and poor quality and safety but also for their energy consumption and environment pollution (Jiang *et al.* 2019). Prefabrication helps in sustainable construction with low waste generation, less pollution, and controlled use of resources (Yadav & Shah 2013). It ensures better insulation, accurate measurements and connections, faster execution and timely delivery, which reduces the overall energy consumption (Molavi & Barral 2016). Initial cost of using prefab is higher, skilled labour is required to ensure proper connections and transportation costs are also high. Also, many people in India perceive prefab buildings as inferior (Madhusudhan 2019).

Sustainable development has become a global imperative (Jiang *et al.* 2018). With the advantages exceeding the disadvantages, prefabricated construction can be a successful sustainable construction model in India. Prefabrication helps in sustainable construction with low waste generation, less pollution, and controlled use of resources (Yadav & Shah 2013). It ensures better insulation, accurate measurements and connections, faster execution and timely delivery, which reduces the overall energy consumption (Molavi & Barral 2016). Initial cost of using prefab is higher, skilled labour is required to ensure proper connections and transportation costs are also high. Also, many people in India perceive prefab buildings as inferior (Madhusudhan 2019).

Figure 2: Example of prefabricated construction in process. (Source: Free photograph on Pixabay)

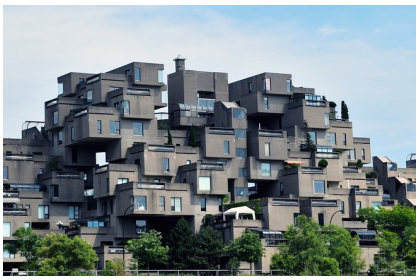

Figure 3: Habitat 67, finest example of prefabricated construction. (Source: Free photograph on Pixabay)

Sustainable development has become a global imperative (Jiang *et al.* 2018). With the advantages exceeding the disadvantages, prefabricated construction can be a successful sustainable construction model in India. Globally, prefabrication has already seen significant adoption by the construction sector. Burj Khalifa, Habitat 67 and the Sydney opera house are the few of the finest examples but prefabrication is not popular in India, even as it is a major mode of construction in most of the countries. This study, hence aims to investigate the factors which constrain the social acceptability of prefabricated construction in India, perception of the stakeholders and impact of government's policies. The research will include the investigation of present status of prefabrication construction technology in India by case study approach and detailed survey on the key subject matter.

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Office Office: the Indian point of culture

Tapasya Samal

Office design is reflective of a multitude of aspects of society: the culture of office bearers, the influence of design on lifestyle and vice versa, tools necessary for the function, furniture and other technological advancements. In this part-research, the author sets out to examine some of the existing architectural theories and scholarship surrounding the influences for design of offices during the Modern and Postmodern period in India. The gathered corpus of information began pointing towards correlation between space planning, industrial design and office culture.

The study intended to look into the cultural, socio-economic and political context for the period when architecture came to the rescue of 'Indian Identity' questions; using offices especially housing government departments as a typological case. Its principal objectives include:

- Gaining insight into the evolution of the Indian Office: space planning, furniture design, infrastructure and technology.
- Understanding the cultural evolution as depicted through various media: mass media, films, print media and biographies.


Everybody is very keen about the advantages of going open plan, especially if they are not actually going to have to brave the wide-open spaces themselves. MARCELLE BERNSTEIN reports on what life is really like for 1,200 workers in Britain's largest open-plan offices.

WOULD YOU LET YOUR DAUGHTER WORK IN AN OPEN PLAN?

Figure 1: Objections to Open Plan Office Design. (Source: Gyford 2008)

Figure 2: The Indian Office (Mr. & Mrs. 55, 1955), Mumbai.
(Source: https://www.indiaforums.com/forum/topic/4675407?pn=38)

Figure 3: An office building in Pondicherry French Quarters (Source: Author)

Figure 4: Royal Insurance Building, Calcutta (1916) by Edward Thornton and PWD architect William Banks Gwyther. (Source: Author)

The research set out to explore the characteristics of office design in the proposed period of study (1890-1990's) and draw inferences regarding the 'influences and impact' of these with respect to cultural development of the country at the given time. The intent was exploration of some of the case examples in Delhi as primary cases, which has not been possible in the pandemic situation. The proposed method in the future includes comparative analysis of architectural information including drawings, photographs and design intent for some selected sample cases, deducing the cultural parallels through review of literature, cinema and any other documented evidence.

The research is broadly contained within 'Government or public office buildings' in India. However it is not limited geographically to a particular region to enable comprehensive pattern recognition across a wider pool of samples.

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Reinterpreting the Braj-Mewari cultural landscape: A case of Nathdwara

Tejaswini Rai

Nathdwara is a town in Mewar region of Rajasthan. It is famous for the haveli that houses the idol of Shrinath Ji, the seven year old 'infant' incarnation of Lord Krishna who was originally worshipped as a living form at Goverdhan Hill in Mathura district of Uttar Pradesh (Erskine 1908). The idol of the deity was shifted to Mewar in the 17th century due to the iconoclastic policy of Mughal Emperor Aurangzeb (Tod 1883).

With the arrival of the deity in Mewar, a sacred geography emerged with the components of cultural landscape of 'Braj' by the traditional knowledge systems of Brajwasi community who came along with the idol (Sinha & Silva 2017). Various intangible attributes of Braj got overlapped with the tangible attributes of Mewar creating the existing cultural landscape in the town. Hence an amalgamation of Braj and Mewari culture is clearly seen in Nathdwara. Shrinathji Ki Haveli is a temple precinct within the town that forms the core of the town. The activities and livelihoods of the local residents were inseparably connected with the precincts traditionally, including the art of Pichwai Painting that the town is known for.

Figure 1: Pichwai Painting (Source: Author)

VRINDAVAN BAGH

VRINDAVAN KUND

NAMANA CANAL

GIRIRAJ PARBAT

VRINDAVAN BEEHAD

KRISHNA KUND

369' HIGH STATUE OF BELIEF

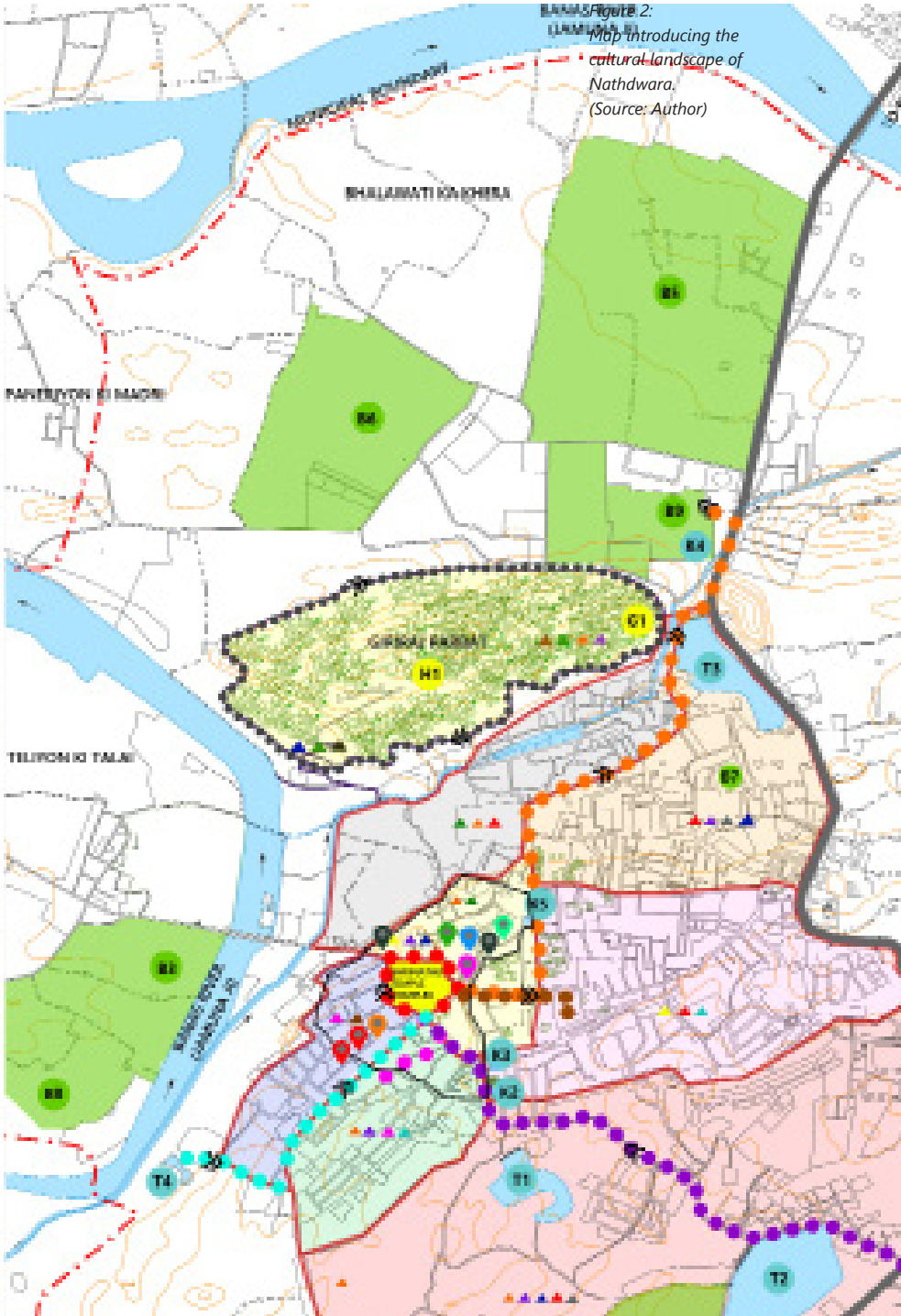

Figure 2:
Map introducing the cultural landscape of Nathdwara.
(Source: Author)

Figure 2:
Map introducing the cultural landscape of Nathdwara.
(Source: Author)

Over a period of time, the networks and subnetworks of the system have undergone changes, weakening in some ways and strengthening in others. This generates the need for examining the connections and connectors in the context of such a cultural landscape where the idea of Braj was superimposed on the local geography to create another manifestation.

Objectives laid down for the research include mapping of historic and present day association of the community with the built, natural and intangible heritage of the town, identifying the gaps in continuity of various networks associated with the 'Shrinathji Ki Haveli' temple precinct and developing an approach for reinterpreting the cultural landscape through network systems (Lynch 1960).This research intent is to approach heritage network systems as a tool for conservation of a cultural landscape in a sacred geography. It will involve the identification of gaps generated within the existing built, intangible and natural heritage networks of the town over the passage of time.

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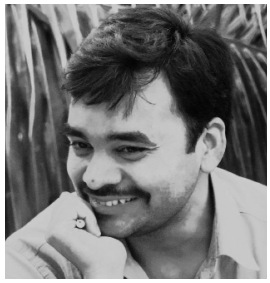

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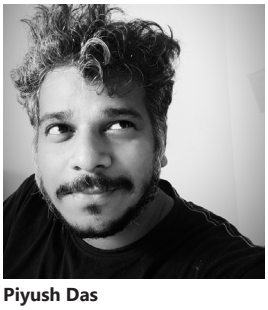

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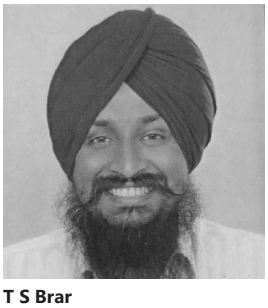

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