ISSN: 0974-5823 Vol. 7 (Special Issue 5, April-May 2022)

International Journal of Mechanical Engineering

STUDY OF COMPONENTS IN PLANNING FOR LIVEABLE URBANISM IN INDIAN CITIES

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Abstract

Infrastructure, energy consumption, healthcare, waste management, and resilience have all been impacted by the unplanned growth of metropolitan regions. Creating livable and sustainable cities is a never-ending task. The concept of liveability is based on correlations between many aspects that each ultimately make a place livable. (Agustin Granados Mateos, Torben Kulasingam, 2017). Also, sustainable and liveable neighborhoods come up with social equity, harmony, economic resilience, and environmental and social sustainability (Aromar Revi, Garima Jain, Neha Sami, 2014). It can be developed by policy and planning that stimulate, model, and assesses the impact of health in planning and transport facilities, aimed at creating liveable and sustainable cities. This report focuses on the requisite criteria through background study, primary study, and literature study to attain the "quality of life of the citizens". In addition, it also helps in understanding the city's complex system and various alternative ways that have been taken for planning and managing Indian cities. Most Indian cities aim to achieve a comprehensive approach to making the city more liveable by improving citizens' quality of life (Cities as Complex Systems: Scaling, Interaction, Networks, Dynamics and Urban Morphologies, 2009). Liveability may be accomplished through addressing the core causes of problems rather than responding to them, as well as researching how Indian towns can attain liveable urbanism using numerous indicators and best practices from cities such as Copenhagen, Bangalore, and South Korea. The research also sought to comprehend the notion of habitable urbanization in Indian cities and identified appropriate metrics for Kochi.

Key Words: **Liveable**, **Urbanism**, **Liveable Neighborhoods, Sustainable cities**

1.Introduction

Planning a liveable, sustainable city, the City of Vancouver (City of Vancouver) lists the components that are focussed on. It proposed a neighborhood where the inhabitants can work, play, and shop, where residents feel supported and could enjoy the vibrant street life. It demands prioritization of sustainable modes of transportation and high-quality urban design that contributes to an attractive, functional, memorable, and safe city that incorporates parks and open spaces, sidewalks and walkways, water bodies, trees, landscaping, and lighting into the urban fabric and Protects the beauty of the city and its surroundings while allowing for density and growth. On the contrary, such urban planning in India, the second most populated country in the world with 1.35 billion and with a population density of 382 people per Sqkm is a Himalayan task. 'Liveability' has various factors that include a community's quality of life which can be the built and natural environments, economic prosperity, social stability and equity, educational opportunity, and cultural, entertainment and recreation possibilities (Liveable Urbanism, 2019 -2020). In a nutshell, liveability is "the potential of a city to offer favorable conditions to its residents and others on the parameters of the social, natural, economic and physical environment" (Harklin, 2018).

'Urbanism' is studying the interaction of population of urban areas, with the built environment. Liveable Urbanism in city planning focuses to develop a complex system of cities and respond to urban challenges that have been recognized in rapidly transforming cities. It aims to achieve a comprehensive approach to making the city more liveable by improving citizens' quality of life. (Cities as Complex Systems: Scaling, Interaction, Networks, Dynamics and Urban Morphologies, 2009) This can be achieved by addressing the root cause of issues rather than reacting to the problems. It also needs to understand how various world cities achieved liveable urbanism by studying various literature case studies of Liveable Urbanism in cities like Copenhagen, Bangalore, and South Korea.

The Ministry of Urban Development (MOUD) has developed a group of 'Liveability Standards in Cities' to generate a Liveability Index and rate cities. The source of the Liveability Standards are the 24 features contained in the Smart City Proposals (SCPs), According to City Liveable Index, there are 79 indicators (57 Core Indicators and 22 Supporting Indicators) which have been grouped into 15 categories. (Liveability Standards in Cities, 2017). Thus Liveable city provides good living conditions for its inhabitants and makes a city attractive to the people who live there, whereas urban residents need their cities to be smart,

sustainable, and highly liveable. A liveable city promotes the well-being of its citizens, by providing a safe, inclusive, and sustainable city (Liveable Urbanism Kochi Handbook, 2019-2020). Urban liveability can promote citizens' health and wellbeing through good public transport, neighborhood walkability, access to open spaces, economic opportunities, and access to infrastructure services.In India, rapid growth in population leads to depletion in the quality of life. It's also due to shortages of amenities; mostly in busy urban areas. In India, according to UN-Habitat, the migrants from rural areas to densely populated cities are expected to increase by 66% in 2050.MOHUA (2009) recognized the need for Liveable Urbanism in Indian Cities and through AMRUT / Smart City programs aims to achieve a comprehensive approach to making the city more liveable by improving the quality of life of citizens. Also according to it, this can be achieved by addressing the root cause of issues rather than reacting to the problems. Moreover making Indian cities more sustainable and liveable, will have a positive impact to achieve a sustainable and liveable future by World Bank's statement: (2016) Liveable Urbanism improves urban spaces and services for economic growth in a better-built environment.

Research Questions

1. What is the importance of liveability and how can liveable urbanism shape a city or neighborhood?
2. Why liveable urbanism is needed in the Indian context? How can Liveable Urbanism be integrated with the Smart city mission in India?
3. What are key issues that demote liveable urbanism and what are the components that promote liveable urbanism?

2.Literature Review

Many researches have been conducted to determine the link between spatial configuration and spatial quality, as well as how they interact. Spatial quality is a complex notion that includes physical, social, economic, cultural, and environmental factors. As locations of ostensible urban culture and cultural legacy, urban squares reflect these dimensions and play a crucial role in urban identity. As a result of physical features of cities, spatial layout also influences the character of squares.

The organization of quarters in traditional Arab Islamic towns is the subject of Dabbour. L's (2021) research. He claims that these cities' structures form a worldwide unity. He brings up the concept of a physical structure that looks to match a social pattern. The city of Damascus is utilized as a model of study to define and characterize the urban structure. The claim is made that the traditional Arab Islamic city has a sub-area structure that is historically derived, but whose morphological combination is fine-tuned and modified such that the total comes to dominate and unite the parts.

Gümüş, İmran, & Erdönmez, E's study (2021) employs both qualitative and quantitative methodologies. The case study began with fifty public space quality indicators applied to two pier squares, San Marco Square in Venice and Beşiktaş Square in Istanbul. Second, using the space syntax technique, morphological analysis was done. It was explored whether or not there is a link between spatial arrangement and the characteristics that influence space quality. As a result, it has been discovered that while spatial arrangement is one of the determining variables used to measure space quality, it does not give adequate evidence on its own. The significance of this work is that it presents an analytical approach to spatial quality that encompasses both quantitative and qualitative aspects.

According to the editors, Salama. A.M. and Grierson. D. (2016), the countries of Africa, Central and Latin America, and much of Asia are collectively known as the Global South, which encompasses about 157 of the world's 184 recognized governments. They contend that the Global South is home to the majority of architectural output, city planning, place making, place management, and urban development activities, and that this will continue for the next few decades.

3.Methodology

Theoretical as well as empirical methods were adopted in this study. The theoretical part is based on a literature review on Liveability and urbanism Indicators. The literature review focused on numerous different studies, books, and articles on urban planning and design along with liveable urbanism indicators. Feedback from the respondents of Kochi also contributed certain indications as to which specific indicators of Liveable Urbanism were appreciated by its residents, and which were not. Spatial Indicators like Urban Mobility, Social Infrastructure, Physical infrastructure, environmental conservation, and Economic Opportunity chose for the study were analyzed with the case of Kochi. Also, an observation survey and questionnaire survey were done to assess the issues lacking to attain Liveability and finally develop a Framework for Kochi.

4.Results and Analysis

Evolution of Liveable Urbanism

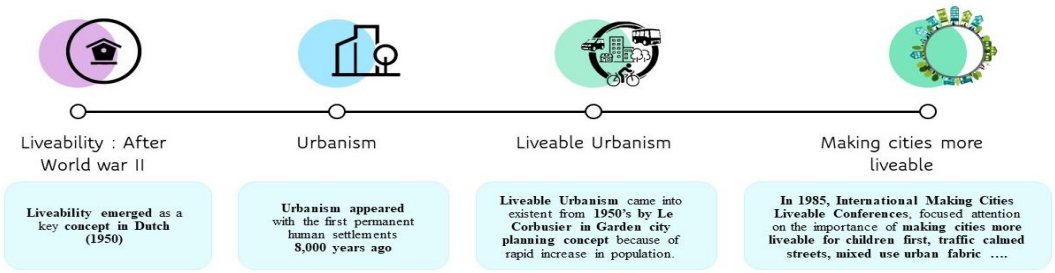

Figure 1 - TimeLine of Liveable Urbanism

Though the liveability concept came from the Dutch period in the 1950s, urbanism had already emerged 8000 years ago as Fig.1 details.

Indicators

Liveability indices give knowledge into the quality of life accessible to individuals and give proof of the future condition of the city based on Liveability.

Liveability Indicators

<u>International Level</u>

i EIU (Economist Intelligence Unit- Global Liveability Index)

According to the EIU liveability ranking, they use 40 liveability indicators that are grouped under five weighted categories namely, stability (25%), healthcare (20%), culture and environment (25%), education (10%), and infrastructure (20%)

Mercer Quality Of Living Index

Mercer evaluates native living conditions in more than 450 cities surveyed worldwide. Living conditions are analyzed according to 39 factors, grouped into 10 classifications (Mercer, 2019): Political and social environment, Economic environment, Socio-cultural environment, Medical and health considerations, schools and education, Public services and transportation, Recreation, Consumer goods, Housing, Natural environment.

ii OECD BLI Index (Organization for Economic Co-operation and Development)

OECD BLI aims to achieve Sustainable Development Goal Targets and has 24 liveability indicators that are grouped under eleven classifications; Housing, Income, Jobs, Community, Education, Environment, Civic Engagement, Health, Life, Safety, and Work-Life Balance. (OECD, 2020).

<u>National Level</u>

iii Liveability index, 2010

The Liveability Index 2010 is a systematic index of the quality of living conditions in Indian cities. The report is brought-out after a comprehensive study on 37 cities, ranked based on eight pillars demographics, education, health & medical standards, safety, housing, socio-cultural political environment, economic environment, and natural build & planned environment basis.

iv Ease of Living Index, 2019

According to the Ease of Living Index, the liveability of Indian cities is based on three pillars, which include various aspects of the well-being of citizens. The three pillars include a total of 14 categories and 50 indicators. The framework of the Ease of Living Index 2019 is as follows: Quality of Life (35%), Economic Ability (15%), Sustainability (20%), and Citizen Perception (30%). There is no reason to any of the categories is more important than the others. Therefore, they are given equal weightage. Since the number of categories varies each pillar receives different weights (Ease of Living Index 2019: Methodology Report, 2019).

Urbanism Indicators

'Urbanism' means what happens inside cities, the form and function of cities, and how cities relate to the rural areas. It often refers to the study of how citizens of urbanizing areas interact with the social and built environments of cities (Rogers, 2020). 13 key urbanism themes come under the following 13 chapters but the study looks into 3 main chapters: ***Smart Cities***, ***Compact Cities***, *and* ***Sustainable Cities*** (Rogers, 2020).

i Smart Cities (Digital Cities)

A Smart city aims to **'Improve the quality and sustainability of life** through the integration of technological solutions' with Infrastructure and services (The Concept of a Smart City in Urban Management, 2016). Smart cities challenge to make cities more efficient, sustainable, and liveable. The six pillars of the Smart City Initiative are Smart Society, Smart Governance, Smart Economy, Smart Mobility, Smart Environment, and Smart Living.

ii Compact Cities

Compact city theories concentrate on creating the right balance that caters to social, economic, and environmental needs. Compact City Indicators are Walkability, Connectivity, Mixed-use and Diversity, Mixed-use Housing, Traditional buildings, Smart Mobility, Sustainability, Improvised Architecture and Urban Design, and Quality of life (**Simon Elias Bibri, John Krogstie, Mattias Kearrholm, 2020).**

iii Sustainable Cities

The definition of 'sustainable' is a development that is capable of meeting today's needs without compromising the ability of future generations to meet theirs. Sustainability depends on abstract issues namely environmental, social and economic. In the main, they are characterized by compactness, a mix of uses, and interconnected street layouts, supported by strong public transport networks, environmental controls, and high standards of urban management (**Mike** Jenks, Colin Jones, 2010).

Comparative Analysis – Liveability and Urbanism

Based on the above liveability and urbanism Spatial Indicators are chosen and comparison for Liveable urbanism is done for my study. By comparing the various indicators to see which indices were the most common and therefore arguable ones that the various literature agrees will be the most successful in providing a high quality of life.

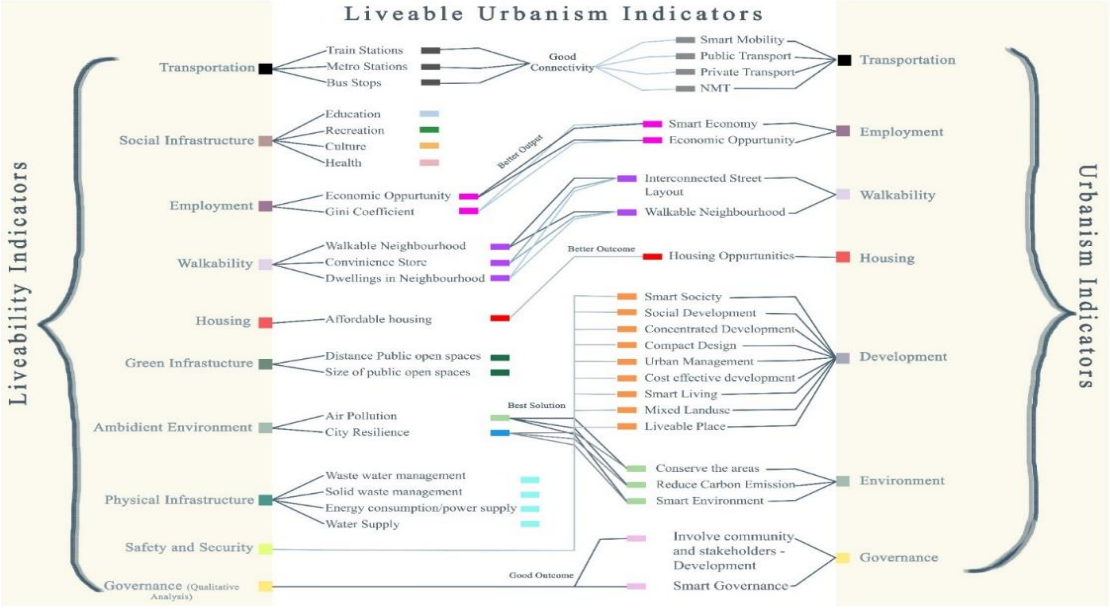

Figure 2 - Comparative Analysis of Liveability and Urbanism

Source: Author Generated from EIU, MERCER, OECD, Liveability Index, and Ease of Living Index

Liveable Urbanism Indicators with Measurable Indicators and Standards

Indicators for Liveable Urbanism with measurable indicators derived from the comparative analysis of Liveability and Urbanism based on the above studies.

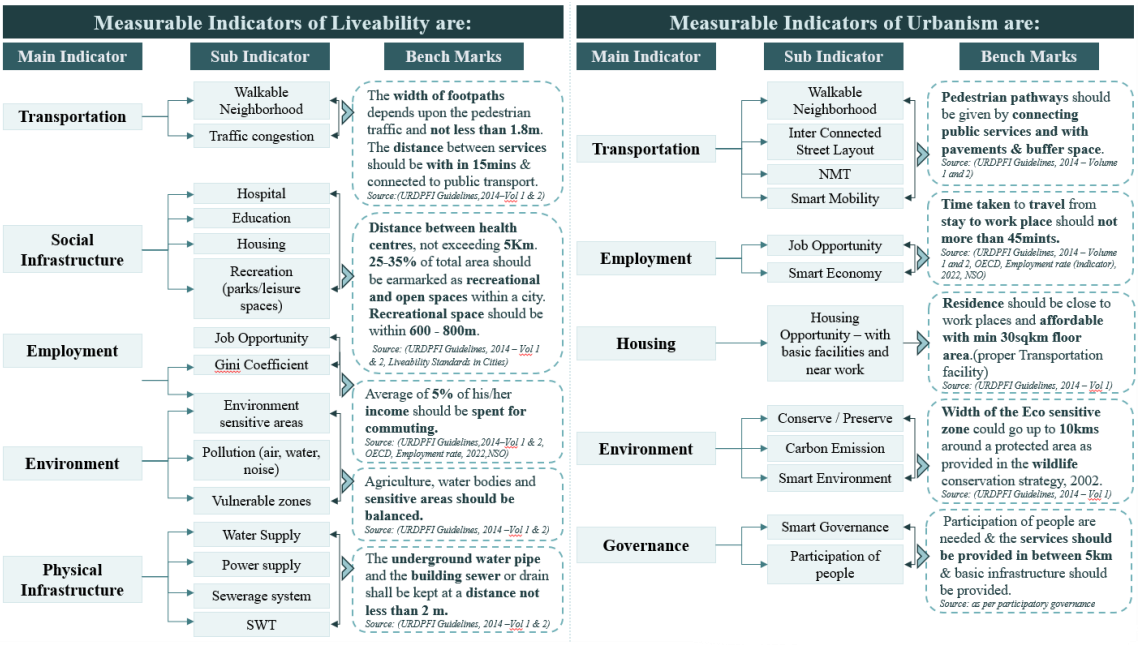

Figure 3 - Liveable Urbanism indicators with Measurable Indicators and Standards

Derived Indicators for Liveable Urbanism

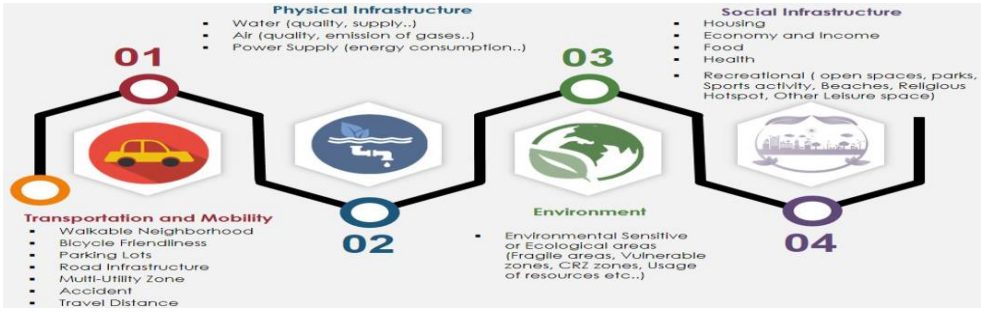

Figure 4 - Derived Indicators

1. Best Practices - Liveability

i Copenhagen

Copenhagen is 'The Most Liveable City' 2021' and in 9th Position in Liveable city according to Monocle's Liveable Cities Index. Copenhagen aims to make the city liveable, so all aspects of citizens' lives are taken into consideration in an inclusive strategy of urban planning which includes jobs and affordable houses but also a green environment and citizens' health. One of the best practices in the world for liveable cities. It contains various indicators and tools that have been used to attain Liveability (Copenhagen: resilience and liveability, 2018).

Indicators are Protection against flooding, Security against Crime, Affordable Housing, Clean Air, Mobility, Employment Possibilities, and Green areas.

ii Vienna (Austria)

Vienna remains the most liveable of the 140 cities surveyed by EIU and 1st Position in Liveable city where the city is well-placed to continue its success as an attractive, prosperous, and inclusive metropolis. Vienna has an excellent reputation for being clean and green. Its air quality is good and has accessibility to drinking water. Meanwhile, noise and light pollution are both considered low. To attain liveability they set a few indicators that improve the quality of life of the citizens (The Global Liveability Index, 2019).

Indicators are Walkability, Social Infrastructure, Public Transport Access, Large Public Open Space access, Affordable Housing, and Local work opportunities.

iii Bangalore (India)

Bangalore is one of the Liveable cities in India (Bengaluru ranks as the most liveable city in India - 1st Position in Liveable city - India) but due to rapid and unplanned urbanization, the city is facing a wide range of risks. To overcome these issues, the Sustainable Cities Initiative City Report January 2014 has set various Indicators with tools that include: eliminating Urban Poverty, employment opportunities, mobility, affordable housing, raising living standards, and providing basic services to slum areas to attain liveability (Aromar Revi, Garima Jain, Neha Sami, 2014).

Indicators are Eliminate Urban Poverty, Employment opportunities, Raise Living Standards, Safety and Security, Mobility, Affordable Housing, and Basic Services.

Best Practices - Urbanism

iv.Best Urban Infrastructure Project

Park was constructed in 2015, mitigating urban climate vulnerabilities such as floods, water shortages, and heatwaves, Up to 60% of the park's area serves as a rainwater catchment surface, mitigating floods by relieving pressure from the drainage and sewage systems. The collected stormwater is then treated and can be used as potable water, diversifying the city's water sources and also providing new business opportunities for locals. It stretches more than 2km along much of the old canal bed and adjoining banks (Arquine, 2020).

Indicators are Economic, Environment, Health, and Social.

iv Tel Aviv's Central Promenade Renewal (Development Between Water And Land), Israel

The renovation project aimed to transform this historical cordon by creating a new continuous interface that enables free pedestrian flow to and from the sandy beach, throughout the city's central waterfront. By utilizing careful structural and detailed design, the project's environmental footprint was minimized, accessibility in all aspects was achieved, and a sensible urban 'new ground' was created. The strategic objectives of the project are New Flow, Continuity, Equality and Accessibility, Ecology, Hospitality, Public Facilities, Public Terraces, Specificity, and Liminality (María Francisca González, 2018).

v Street Design - Pune

The project aims to prioritize streets for people and not for vehicles, thereby restoring the position of the streets of Pune as the dominant and most vibrant urban public realm. Design and develop streets for the safety of all road users. The purpose of USDG (Urban Street Design Guidelines) is to provide a mechanism for establishing the street system which will accommodate growth, provide transportation choices and keep the city liveable.

Indicators are Street Element - Footpath, Cycle track (NMT), and Bus stops. BRT, Carriageway, Shoulders, Parking, Safety Element - Pedestrian crossing, Traffic calming measures, speed breakers, traffic signals, Central medians, Railings, Bollards, Street lights, street furniture, signage marking and Multi-Utility - Plantation, Utility and services, stormwater management, garbage containers, public toilet (Urban Street Design Guidelines, 2016).

Comparative Analysis of Best Practices with Measurable Indicators

Based on the derived indicators from the literature review, the best practice are compared and generated inference for the studies. This would help to know how each indicator has been used in each best practice and how did they solve the issues to attain liveability and a healthy environment. The comparative analysis of the six best practices is shown in the table below.

Indicators of Liveable Urbanism	Best Practice 1 – Copenhagen, Denmark	Best Practice 2 – Vienna, Austria	Case Study 3 – Bengaluru, India	Best Practice 4 (Urbanism) – Lineal Gran Canal Park, Mexico	Best Practice 5 (Urbanism) – Promenade Renewal , Israel	Best Practice 6 (Urbanism) – Urban Street, Pune	Inference
1. Transportation Pedestrianisation / walkable neighbourhood, Bicycle Friendliness, Parking lots, Road Infrastructure, Multi utility Zone, Road Accidents, Travel Distance	Introduced **intelligent transport system** to reduce traffic congestion, that is they focused on **more Mobility and Less Traffic** Concept.	The city provides **affordable public transport** and has invested in an extensive **bicycle network to keep traffic congestion** in the streets low.	Growing **traffic congestion** associated with **private vehicle** use have been reducing through **Intelligent Transport System**. Bangalore **police organization** introduced an app called **B-Trac** for better management of traffic .	**Park is in reachable distance by 30mints** on public transport.	**Easily accessible through public** / private **vehicles** as well as its well **connected by cycle lanes.**	Pune developed **few streets/ roads** based on the Urban **Street Design Guideline** for **better infrastructure** development. Pune were **renovated with proper allocation for pedestrian, cycling, street venders, parking lots.**	All the studies shows that a good connectivity can **reduce traffic congestion and dependency more on public transportation than private** and can attain a healthy and liveable life.
2. Physical Infrastructure Water, Air, Power Supply	The city was **facing both air, water and waste mangemnt issues, goverenment** adopted many programs to reduce the issues. Their main target to **zero waste city** by 2050	**Air pollution** are **less** due to dependence of **public transportation and usage of streets.** By using **sewage sludge as an energy resource** for in house energy needs.	Through **B Trac, pollution was reduced.**	**Up to 60% of the park's area** serves as a **rain water catchment surface**, which helps to **mitigate floods** by relieving pressure from the **drainage and sewage systems.**			All the studies discuss about water quality, air quality, energy consumption & each city **adopted different methods like smart technologies.** But in urbanism level mexico park, **helped to reduce the issue by 60% .**
3. Environment Environmental sensitive / ecological areas	Copenhagen is facing **flooding issues**, it is solved through **costal protection projects,** especially in Denmark and the US.	They **encouraged** various companies to **change the way they used energy** and water and the way they disposed wastes. The program was successful from 1999 to 2020. This leads to **less usages of water and decreased air pollution** in Vienna.	Due to urbanization the **stress is on public spaces** like streets, open spaces (parks) etc... Government of India have **introduced various programs** to overcome.	This project is **constructed for mitigating urban climate vulnerabilities** such as floods, water shortages, and heat waves, in addition to **preventing unequal urban development** in an underprivileged part of the city.	The **project's environmental footprint was minimized** by using **environmentally friendly structures.** developing in betweenland and water.		Different types of **environmental issues** are happening in cities based on topography. Some programs **help the city to reduce the environmental impact** but in other study they mainly **focused on materials (to reduce ecological footprint).**
4. Social Infrastructure Housing, Food, Health, Recreational (Open Spaces, Parks, Sports Activity, Beaches, Religious notspot, Other Leisure Space.	**Crime rates** are reduced through smart street furniture's. Copenhagen incorporated **green areas** along the streets and connected home to work place through this green space. They are planning for **Affordable housing** in future.	Vienna city is **well connected to education,** community, etc... Vienna people **faced affordable housing issues** when there was **population increase,** various housing schemes were introduced. Vienna scores **high** in terms of **public transportation and public housing.**	Main **aim** was to **raise the living standards,** especially in **slums & informal settlements** through **Sustainable development goals.** Main target to **Eliminate extreme urban poverty** in Bangalore city.	The **accessibility of the park** will **encourage interactions between people** of all ages and gender, **improving social unity in the area.** More than **100 new trees have used in that park.** It is one of the biggest open spaces/parks created in Mexico City.	This project **enables free pedestrian flow** to and from the **sandy beach, throughout the city's central waterfront.** It acts as a **recreational space;** with seating, roof top balconies(exsisting structure).		The **crime rates are more** in all cases, which could be **reduced through smart sensor technologies.** Green spaces are available in all studies that helped to **reduce temperature.** In all livable cities people find it **difficult for affordable house**, as govt. look initiatives still its lacking.
5. Economic and income	Copenhagen, is designed to **improve the life of residents** not just environmentally, but also **socially and culturally and more job opportunities to make a liveable city.**	Created **more local work opportunity** for the people. **Serious crime** is **rare** and **employment levels are high,** creating a safe and stable environment for the city's residents.	Main target to **expand employment & productivity.** Bengaluru **scored high** on the parameter of **economic** (decent score). Bangalore city have great **job opportunity.**	**Presence of the park** will help to increase the **revenue of local businesses.**			Bangalore and Vienna are high in economic rate but copenhagen is facing issues in **job oppurtunity, so government initiated to install wind mills, solar** etc.. this would help to **improve the economy of local people.**

Table 1 - Comparative study of Best practices with Derived Indicators

Source: Author Generated from Copenhagen: resilience and liveability, 2018, (The Global Liveability Index, 2019), (Aromar Revi, Garima Jain, Neha Sami), (Arquine, 2020), (María Francisca González, 2018), (Urban Street Design Guidelines, 2016).

Indicators Derived From Best Practices/Case Studies

Figure 5 - Derived Indicators from Best Practices

Case of Kochi

Kochi City is located on the South West coast of India, Kochi is well-known as a trading port with a rich history in the spice markets. Kochi's lively transport and multicultural center, while the historical towns of Fort Cochin and Mattancherry, though well-touristed, by remaining all character. Kochi lies barely 5 meters above sea level and has a coastline of 48 Km. The city is facing natural disasters and therefore it's crucial for the urban development of Kochi.

Figure 6. Study area Map

Source: Author generated map from (Human Development Report, 2011)

India's Smart Cities Mission aims to promote urban infrastructure by providing a decent quality of life along with a clean and sustainable environment with the application of Smart solutions. The smart city project aims to improve the Quality of Life (MoHUA, 2021), and Kochi was chosen as one of the first 20 cities by the Government of India. The Projects initiated under CSML are Water supply systems, Underground sewage systems, Roads and Pedestrian areas, Main roads, Energy Supply, Energy Efficiency, Solid waste and Sanitation, Parks and open spaces, Canal restoration, urban mobility, Housing, Health, Economy and Employment, Education, Safety and Security, Social Infrastructure, Identity and Culture, and Spatial Mapping.

Even the Morgenstadt Global Smart Cities Initiative (MGI) project chooses Kochi in 2020 to attain liveability through the analysis, identification, and development of sustainable solutions. Demography: The present population of the adjoining municipalities and panchayats is less than the population of Kochi Municipal Corporation (the population of Kochi in 2011 is 2,149,000 and by 2030 population will be 4,064,000) (Human Development Report, 2011).

Potentials for Liveable Urbanism:

Kochi ranks 45th in the Ease of Living Index 2018, all of India. To make Kochi Liveable, the city needs to promote the well-being of its citizens, by providing a safe, inclusive, and sustainable city that allows its residents access to the necessities of life. CSML has 4 themes:

i Connected and accessible city
ii A city with a vibrant identity
iii A clean, green, safe, and healthy city
iv An inclusive and smartly governed city.

Development Potential of Constituent units of the planning area is Industrial Concentration towards Chittoor area, IT Institutions along Kakkanad area, Industries Institutional along Vaduvacode Puthenkuriz, Residential Tourism along Maradu – Tripunithura, Tourism along kumbalam region, Heritage along Fort Kochi area, and Port related development along Elamkunnapuzha.

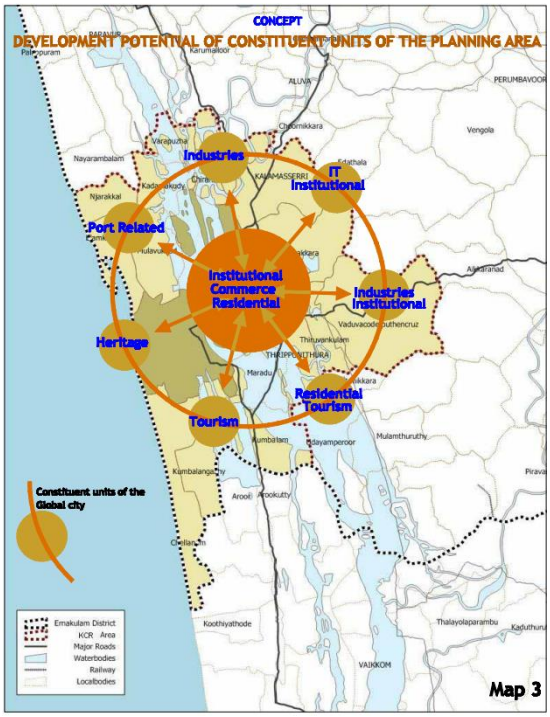

Figure 7 - Development Potential of Kochi City
Source: (District Urbanization Report - Ernakulam)

Urban Growth and its Key Challenges

Due to rapid haphazard urban development, the city struggles to maintain its services and infrastructure resulting in poor waste management, water contamination, and drainage. This urban sprawl creates increasing levels of commuters, with an increase in private vehicle ownership due to a lack of intermodal transport, resulting in traffic congestion, and low levels of street safety and walkability (Liveable Urbanism Kochi Handbook, 2019-2020). Hence, the Challenges faced by Kochi are Ecological Imbalances, Car dependencies, Waste Management, a Narrow Economy, and Social Disparity. Most of these challenges are suffered by the poorer in society.

Kochi city has the potential to make the city more liveable through various smart city initiatives and improve Infrastructure facilities, improve mobility, provide affordable housing for low-income groups, and proper distribution of water and sanitation issues will be solved.

Analysis

Due to rapid urbanization, the city finds it difficult to maintain its services and infrastructure; which resulted in environmental degradation. CSML aims to improve the quality of life of the citizen and promote urban infrastructure with a clean and sustainable environment. Therefore, Kochi city has the potential to make the city more liveable through various smart city initiatives and improve Infrastructure facilities, improve mobility, provide affordable housing for low-income groups, and proper distribution of water and sanitation issues will be solved.

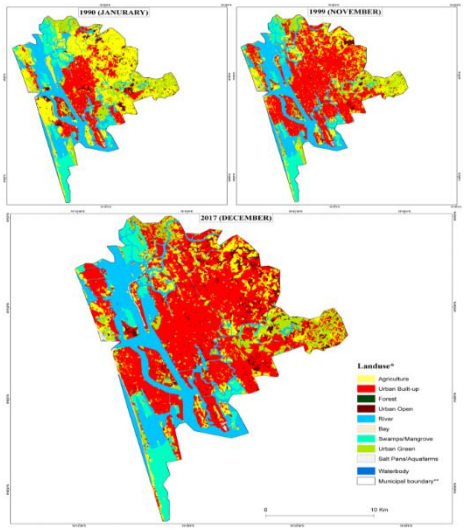

Figure 8 - Land use changes over the years
Source: (Evaluation of Classification Techniques for Land Use Change Mapping of Indian Cities, 2020)

Framework for Kochi

The secondary analysis, observation survey, and online survey found that the Kochi city is facing various issues which are affecting its liveability and sustainability; even though the city has been chosen as a Smart city; it lacks various issues based on transportation, connectivity, power supply, solid wastes management, and so many. Kochi faces major issues are transportation (traffic congestion, narrow roads, lack of parking, etc.).

Derived Indicators for the Kochi City

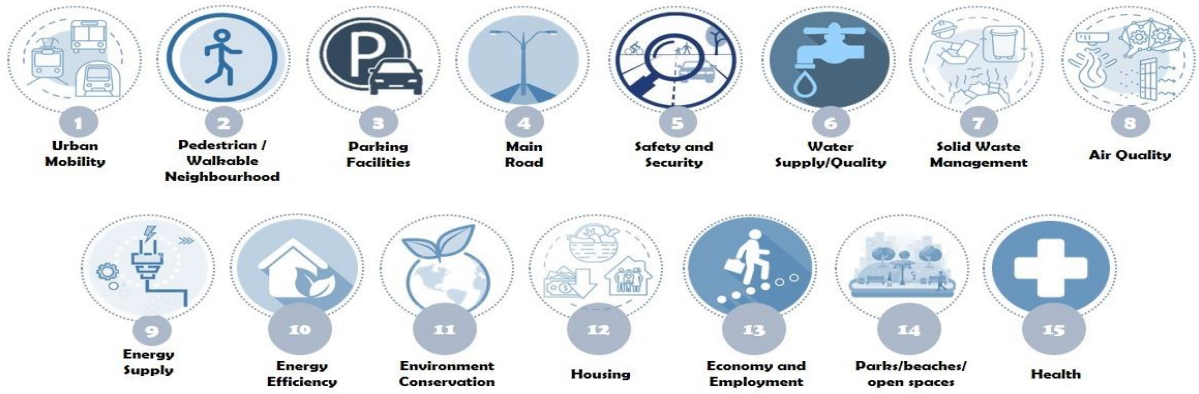

Figure 9 - Final Indicators for Kochi City

Liveable Urbanism Indicators	Sub-Indicators	Bench Marks/Standards
1. Urban Mobility	Pedestrian / Walkable neighbourhood	• If **arterial roads more than 25m ROW** to have **min. of 2.5 m pedestrian path** (with trees) & **proper street furniture and 2.5m bicycle path** preferably in **each direction** is a mandatory measure. • **Public walks** should be **min. 1.2 m wide** *(Source: (URDPFI Guidelines, 2014, pg. 225, 335)*
	Bicycle Friendliness	• **Cycle / NMT track lane width** should be between **2.2 - 5.0m & min. width** should be **2.5m for a 2 lane cycle track & 1.9m for a common cycle track & footpath** *(Source: URDPFI Guidelines, 2014, pg. 312).*
	Parking Facilities	• **Parking spaces** for individuals with **physical disabilities** when placed between **two conventional diagonal or head on parking spaces** should be **3.6 m to 3.8 m wide** and the **length** of the aisle should **7.3m, 6.3m & 6.5 m** for head on, **90° and 60° parking** *(Source: URDPFI Guidelines, 2014, pg. 314 – 316, 335).*
	Road Infrastructure	• **Basic amenities** like ATM, Parking, Convenience shopping, religious facilities etc... should be **within 600-800 m** *(Source: URDPFI Guidelines, 2014, pg. 168).* • **Percentage of residents living < 400 m** of a **local bus stop** and **percentage of residents living < 800 m** of **train station** *(Source: Sustainable development goals and quality of life targets, 2015)* • **Minimum road width** should be **9m** it may **vary based on the type of road** *(Source: URDPFI Guidelines, 2014, pg. 147, 420, 423).*
	Travel Distance	• **Time taken to travel** from **stay to work place** should **not more than 45min.** *Source: URDPFI Guidelines, 2014 – Volume 1 and 2, OECD, Employment rate (Indicator), 2022, NSO)*
	Safety and Security	• The **accidents rate/number** will be obtained from **NATPAC or Police Stations.**
2. Physical Infrastructure	**Solid Waste Management**	• **Solid waste landfill sites should be within 20 - 30 km from the residential neighborhood** *(Source: URDPFI Guidelines, 2014, pg. 365).*
	Air Pollution	• **Air Quality** can be calculated manually: **Spectrometry and Chromatography** (Air Quality Index Method) *(Source: Sustainable development goals and quality of life targets, 2015).* • **Each industry is required to maintain three ambient air quality** measuring stations within **120 degree angle between stations** *(Source: URDPFI Guidelines, 2014, pg. 234).*
	Water Pollution	• The **underground water service pipe and the building sewer or drain** shall be **kept at a sufficient distance not less than 2 m** apart so as to **prevent contamination of water** *(Source: Sustainable development goals and quality of life targets, 2015).* • **Number of canal water quality testing** points showing dissolved oxygen content of **≥2.0 mL/L** *(Source: Sustainable development goals and quality of life targets, 2015).*
	Energy Supply	• The **provision of one electric substation of 11KV** for a **population of 15,000** can be considered for **electricity distribution.** • **500 Ha** is needed to **control power station** as an **exclusion zone** and **maintained as a vacant space** and developed as a **green belt area** *(Source: URDPFI Guidelines, 2014), pg. 424, 364, 236).*
3. Social Infrastructure	**Housing (Affordable)**	• **Low income housing, the min. Plot size should not be less than 30 sqm** *(Source: URDPFI Guidelines, 2014, pg. 426).* • **Average of 30% to 50% of his/her income can be used for housing** *(Source: URDPFI Guidelines, 2014, pg. 426).* • **Need to refer URDPFI Guideline for the development of different type of houses** *(Source: URDPFI Guidelines, 2014, pg. 426 – 427).*
	Food	• **Groceries, housing and other essentials** should **not be more than 30%** of his/her **monthly income.** *Source: (URDPFI Guidelines, 2014)*
	Recreational Facilities (Parks/open spaces/ beaches/ Sports)	• **25-35% of total area** should be earmarked as **recreational and open spaces** within a city. • **Recreational space** should be **within 600 - 800m** *(Source: URDPFI Guidelines, 2014, pg. 168)* • **Amenities** such as school, medical clinic, community hall with sports facilities, restaurant etc... **Within 1.6 - 2 Km** *(Source: (URDPFI Guidelines, 2014), pg. 168, 315).* • **Sport facility for international sports** event with **2 ECS / 100 sqm (parking) of floor area** *(Source: (URDPFI Guidelines, 2014), pg. 168, 315).*
	Hospitals	• **Distance between health centers, not exceeding 5Km** (Availability of hospitals within **15mins travel distance**) *(Source: URDPFI Guidelines, 2014 and also refer pg.: 245, 315, 154, 384, 402).*
4. Environmental Conservation	Usage of Natural Resources Availability of Agricultural Lands Environmentally fragile areas	• **Salient Features of NDMA Guidelines** for Management of **Natural Hazards** can refer in the **URDPFI guideline**, it **may change based on the city, topography** etc... *(Source: URDPFI Guidelines, 2014, pg. 244 – 247).* • The **width of the Eco sensitive zone** could go up to **10kms** around a **protected area** as provided in the **wildlife conservation strategy**, 2002. • **Sensitive corridors, connectivity, and ecologically important patches**, crucial for landscape linkages, are even **beyond 10kms width**, these are will come under **eco sensitive zones.** • **Agriculture, water bodies and sensitive areas should be balanced with the developed areas.** *(Source: URDPFI Guidelines, 2014, pg. 415, 165).*
5. Economic Opportunity		• **Time taken to travel** from **stay to work should not more than 45min** *(Source: URDPFI Guidelines, 2014)* • Average of **5% of his/her income** should be **spent for commuting** *(Source: NSO).* • **Percentage of people** that receive **steady income** like wages/salaries, government benefits, pensions, allowances, and other source of **income** *(Source: OECD, Employment rate (Indicator), 2022).*

Table 2 - Framework for Kochi

The Kochi has a great opportunity to make the city more liveable, economic ability, sustainable, and resilient.

Limitations

Considering the COVID-19 limitations the components of Liveable Urbanism were conducted through an observation survey, and an online survey for a case of Kochi city as a model for assessment can be done and further validation of indicators is required through primary study such as focus group discussion, ward level survey and so on.

5.Conclusion

This study gave an understanding of what is Liveable Urbanism and lists the various key challenges and opportunities in planning. The potential of Liveable Urbanism to improve the quality of life of the citizens in the city and social and economic uplifts are also analyzed.The study gave an overview of the various initiatives taken by the Indian government by addressing the issues through the smart city proposal (which comes under AMRUT). It is observed that in India the cities are focused on the liveable

city but only a few initiatives are taken compared to other cities (outside India). It is analyzed through various best practices for liveability and urbanism with the derived indicators. The Liveability of the city in India is ranked through the Ease of Living Index. Finally, the indicators which are derived from the literature review are analyzed with Kochi city and the study tries to develop a framework for Liveable Urbanism in the case of Kochi city; based on the available secondary data, observation surveys, and online surveys are conducted. From that; indicators are derived for the city. As a whole; Liveable Urbanism can increase the quality of life, improve air quality, mitigate climate change and flooding impact, improve public health, create job opportunities, promote public transport (with a walkable neighborhood) energy efficiency reduces energy costs, and attract visitors. That is, the study conceptualized Liveable urbanism in the case of Kochi City.

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