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Historical Foundations to Modern Innovations of Urban Village

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Abstract

In recent decades, the importance of historical villages has been widely acknowledged because of their aesthetic and ecological contributions. Additionally, they have the potential to promote local socioeconomic growth through heritage valorization. The urban village concept, essential for sustainable urban development, has evolved significantly from its traditional village origins. It is based on historical sustainability practices, which include environmental, social, and economic dimensions. Over time, this concept has been reinterpreted into modern urban planning, primarily focusing on developments. This research examines urban villages' historical evolution, modern transformation, and their important role in current urban development. It analyzes the sustainability aspects of historic villages, their transition into modern urban villages, the distinct spatial and organizational shifts in contemporary contexts, and the essential design principles for today's urban community design. Furthermore, integrating advanced technologies such as the Internet of Things (IoT) and smart grids in urban villages, exemplified by Kelvin Grove and Seattle projects in Australia and United States respectively, has revolutionized resource management and energy efficiency, further aligning the urban village concept with contemporary sustainability goals. This study emphasizes the growing relevance of the urban model village in promoting sustainable urban communities.

Keywords: Urban Village; Sustainability; Urban Planning; Traditional Village.

1. Introduction

The urban village concept has emerged as a crucial element in contemporary urban development discourse, particularly in the United States (Neal, 2003). This concept, deeply rooted in the historical model village known for its comprehensive sustainable practices, represents a nuanced and innovative approach to modern urban planning (Bhatt et al., 2023). The urban village is not just a spatial construct but a philosophy of living that blends traditional values with the complexities of contemporary urban life (Baffoe & Roy, 2023; Franklin & Tait, 2002; Aziz Amen, 2017; Aziz Amen & Nia, 2018; Olla et al., 2023). Indeed, Chung (2010) describes the urban village (or village-in-the-city) as a rural village that has been encompassed by the expansion of urban spatial or administrative areas, while Mare (2006) explained that developers, governments, and planners used the term "Urban Village" to describe a new patterning of human settlement.

Historical villages were not just commonplace residential settlements but self-contained ecosystems that embodied environmental sustainability, social cohesion, culture, economic self-reliance, and efficient spatial organization as daily practices rather than mere ideals (Lin et al., 2023; Tang et al., 2022). These villages operated within a framework of sustainability that is now being revisited in the context of modern urban challenges (Pan & Du, 2021). In American cities, where issues such as urban sprawl, environmental degradation, and social disconnection are prevalent, the lessons from these historical villages are particularly relevant (Resnik, 2010; Smiraglia et al., 2021).

This study aims to critically examine the urban village concept, exploring how historical lessons can influence and shape the future of urban development. The main research question addresses how the principles of historical villages can be integrated into contemporary urban planning to address current urban challenges. The objectives include assessing the sustainability practices of historical villages and proposing a framework for their application in modern urban settings.

Employing a qualitative research design, this research analyzes data collected from various urban development projects and planning documents. The methodology section will detail the sample size, data collection methods, and analysis techniques. The expected contribution of this research is to offer new theoretical insights and practical guidelines for urban planners, policymakers, and community leaders. The paper is structured as follows: after this introduction, the next section reviews the literature on urban villages, followed by a detailed presentation of the research methodology. Subsequent sections discuss the findings and their implications for urban development and conclude with recommendations for future research and practice.

2. Sustainability in Historic Villages

The sustainability of historic villages is essential in comprehending how traditional practices and principles can be adjusted for present-day urban development (Amen & Kuzovic, 2018; Amen & Nia, 2021; Somoye & Akinwande, 2023; Terracciano et al., 2023), particularly in the United States (Slocum, 2020). These villages, which incorporate environmental, social, economic, and spatial elements, established self-sufficient and resilient communities that can serve as blueprints for modern urban development. Figure 1 demonstrates how the sustainability of urban villages and their

surface area increases over time in Hangzhou in China, for example. The number of villages and the surface area increased from nearly none to 125 and 450 km², respectively, from 1950 to 2020 (see Figure 2).

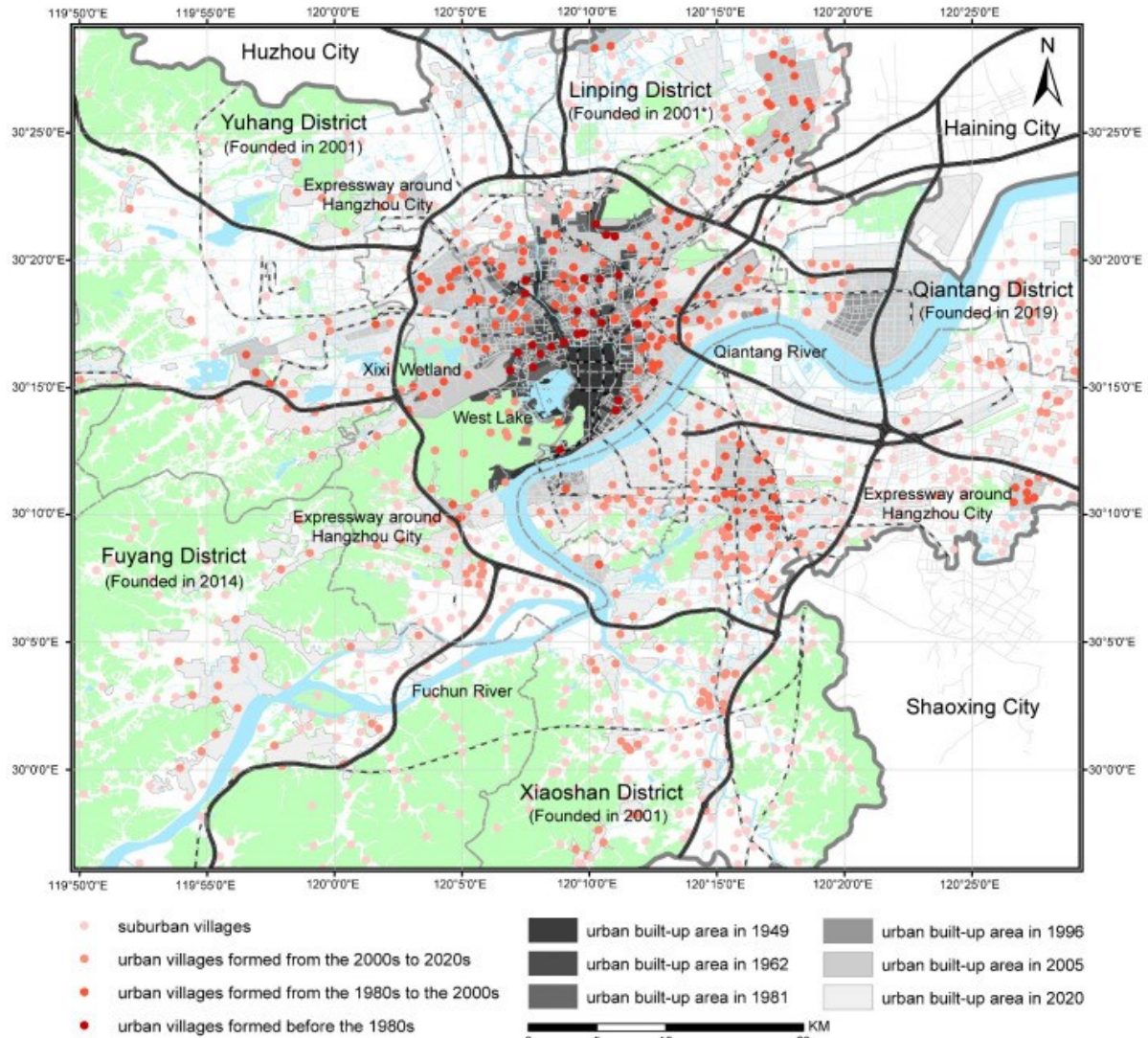


Figure 1. Spatial distribution of urban villages in Hangzhou urban district Wu & Zhang, 2022).

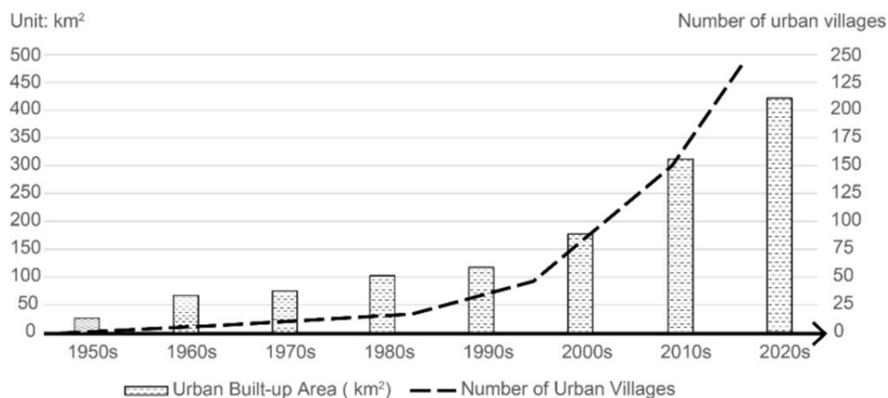


Figure 2. Built-up area of Hangzhou main city and the number of urban villages (1960–2020) (Wu & Zhang, 2022).

Historic villages had a close connection not only with population growth but with nature. Their practices, such as crop rotation, water conservation, and using renewable resources, were not just economic activities but integral parts of their culture and daily lives. These practices aim to minimize environmental damage and promote long-term sustainability. In today's world, as environmental sustainability becomes increasingly important globally, these practices are gaining significance, particularly when faced with conflicts between urban development and environmental conservation. Figure 3 presents the key aspects of preserving and managing historical villages in European and Chinese contexts (Mu & Aimar,

2022). European villages are noted for minimal relocations and demolitions, a focus on long-term sustainability, resilience-focused initiatives, support for small local enterprises, community-driven methods, and training programs to enhance local skills. Additionally, European approaches include cooperative planning, fostering mutual respect, and building trust. Conversely, Chinese villages are often marked by significant relocations, a high degree of commercialization, diverse businesses driving economic growth, government-centric management, the influential role of village leaders, and a combination of minimal NGO involvement with limited public engagement. Despite the differences, there are notable commonalities between the conservation efforts in historical villages in China and Europe. Both face challenges with funding, experience a robust governmental presence, prioritize villages that have received specific designations, and utilize spatial planning and various project development strategies as key instruments for preserving their historical villages.

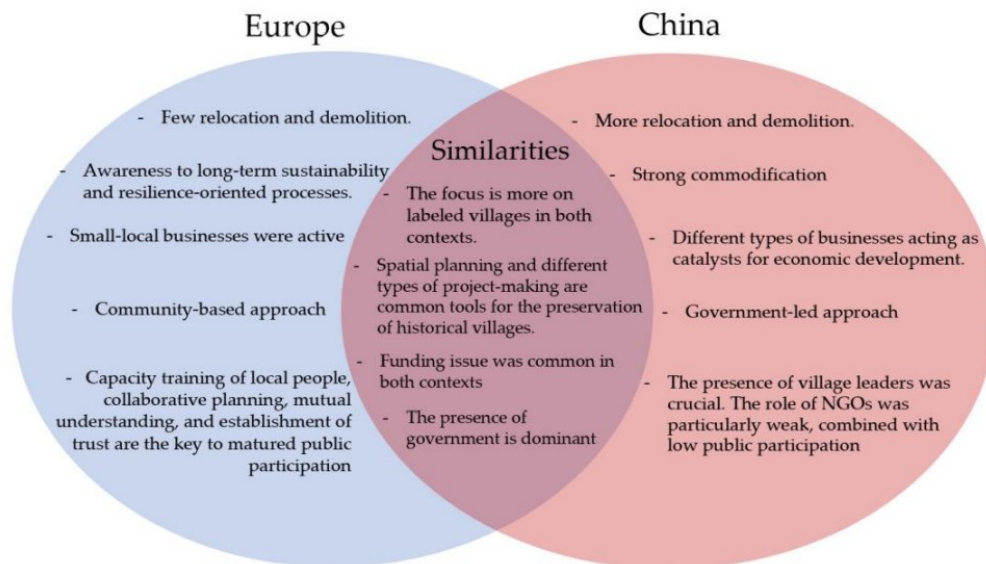


Figure 3. The similarities and differences between the case study villages in European and Chinese contexts (Mu & Aimar, 2022).

The social structure of historic villages was a defining aspect of their sustainability. Marked by solid communal bonds and collective responsibilities, these communities fostered a sense of belonging and mutual support. This social cohesion, often missing in modern urban settings, is important for building resilient communities. In the United States of America (USA), where urban environments can be isolated, reintegrating these social aspects of historic villages could be key to fostering community engagement and resilience (Planetizen, 2024).

Economically, historic villages operated on a self-reliance model, primarily based on agriculture and crafts (Lal, 2012). Figure 4 illustrates an example in Katana South Kivu, Democratic Republic of the Congo, showing how self-reliance is employed in construction and illustrating the quality of depending on oneself for various needs and resources rather than relying on others (Alisonwright, 2024).

The concept of self-reliance involves being independent, autonomous, and taking care of oneself. It is often associated with relying on internal resources to give life coherence and fulfillment. This quality is important for managing situations where external help may not be available. The self-reliance model promotes a circular economy that efficiently utilizes resources and minimizes waste by minimizing dependence on external resources.



Figure 4. These are typical the standard housing seen in Katana South Kivu, Democratic Republic of the Congo. The residents are drying cassava starch (Alisonwright, 2024).

The sustainability practices of historic villages offer a wealth of knowledge and principles that can be adapted for modern urban development. These practices will help urban planners and developers to create urban communities that are sustainable, resilient, and cohesive. These communities will reflect the wisdom of the past while addressing future challenges.

3. Spatial configuration

The transition from traditional villages to modern urban communities has resulted in significant changes in spatial organization and configuration, which have implications for sustainability and community dynamics (Jiao et al., 2023; Lu & Ahmad, 2023; Obeidat, 2023). Indeed, historic villages showed organic growth patterns deeply connected to the natural environment and community needs. They fostered strong community bonds and efficient use of resources with a spatial organization that supported sustainable and cohesive community life. Homes, communal spaces, and agricultural lands were strategically placed to promote community interaction and environmental sustainability.

In contrast, modern urban neighborhoods in the USA, for example, often exhibit a planned and segmented spatial organization characterized by urban sprawl. This sprawl leads to increased distances between residential, commercial, and recreational areas, which requires greater reliance on transportation. This urban design has resulted in more giant environmental footprints, higher energy consumption, and increased carbon emissions due to dependence on automobiles (Wang et al., 2018). An illustrative graph in Figure 5 depicts the distribution of mobility among residents in six cities in the USA. It shows the median travel distances for daily movements of residents, which are 4,642.8 meters in New York, 7,214.1 meters in Chicago, 4,916.0 meters in Philadelphia, 6,929.7 meters in Los Angeles, 3,397.7 meters in Houston, and 6,589.9 meters in Phoenix, respectively.

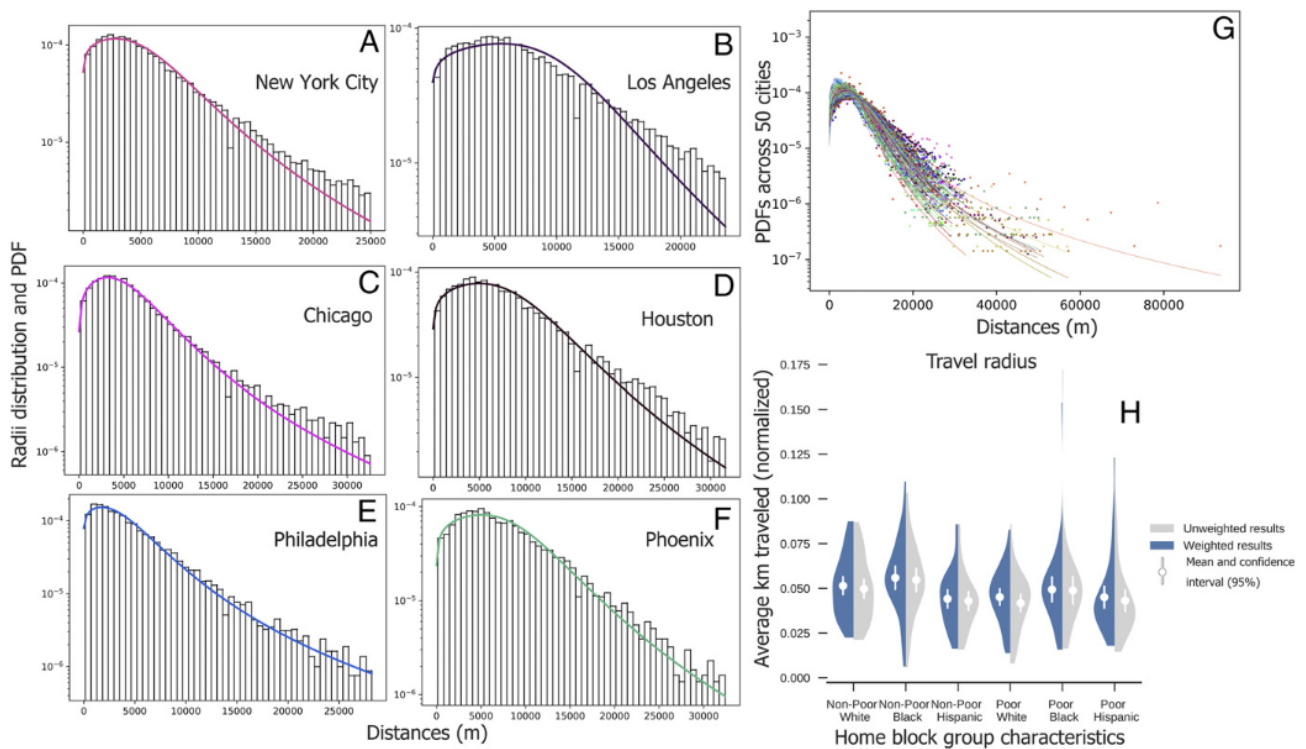


Fig. 2. Travel distances. (A–F) The distributions of radii for individuals’ everyday mobility patterns in the six largest cities. Median radii for New York City: 4,642.8 m; Los Angeles: 7,214.1 m; Chicago: 4,916.0 m; Houston: 6,929.7 m; Philadelphia: 3,397.7 m; and Phoenix: 6,589.9 m. (G) The distributions of the 50 largest cities in the United States. (H) Comparison of the kernel density estimations of the underlying distributions of normalized weighted and unweighted results (SI Appendix, section 2.3).

Figure 5. Distributions of the radii of mobility among residents in the 50 cities (Wang et al., 2018).

The spatial distribution in contemporary urban neighborhoods has an impact on community dynamics. The lack of integrated communal spaces often seen in modern urban settings can hinder the development of strong social networks, which are crucial for community resilience. This contrasts with the close-knit community structures of historic villages, where social interactions were naturally woven into daily life.

Indeed, contemporary urban planning in the USA faces the challenge of adapting historical lessons to modern contexts. This involves creating urban neighborhoods that balance individual space and community interaction. Strategies such as

incorporating green spaces, promoting mixed-use developments, and ensuring accessibility and walkability are key to creating sustainable urban environments.

4. Design and planning principles in the USA case study

In contemporary urban planning in the USA, the principles of design and planning reflected in the urban village model are increasingly relevant (Gunder, 2011). These principles include integrating green spaces, fostering community interaction, economic sustainability, and efficient land use. Indeed, green spaces, such as parks, community gardens, and green corridors, are integral to modern urban village design (Figure 6). These areas offer ecological benefits like air purification and temperature regulation and provide recreational spaces that enhance community well-being (CNU, 2024).



Figure 6. New Urban planning (CNU, 2024).

Communal spaces, such as plazas and community centers, are important in promoting social interaction and building community bonds. These spaces serve as hubs for community activities, cultural events, and social gatherings, contributing to urban neighborhoods' collective identity and cohesion (Francis et al., 2012). When designing urban villages, economic sustainability is achieved by integrating residential, commercial, and recreational spaces. This mixed-use approach encourages local employment, reduces commuting needs, and supports the local economy, resulting in a vibrant and diverse community.

Adapting traditional village elements to contemporary urban settings in the USA requires innovative approaches to housing density, mixed-use developments, and community-led planning processes. The goal is to translate historical principles into modern contexts to create sustainable and resilient urban communities. Also, designing urban spaces that are resilient to environmental and social changes is important. This involves creating adaptable spaces, such as flexible housing and multipurpose community areas, and incorporating technology and innovation, including smart city technologies, sustainable transportation solutions, and innovative approaches to waste management and renewable energy application in the built environments (Eakin et al., 2017; Kapucu et al., 2021). The spatial and organizational differences between historic villages and contemporary urban neighborhoods in the USA present challenges and opportunities for sustainable urban development. Furthermore, this approach ensures that urban planners and developers can create spaces that foster sustainability, community engagement, and an improved quality of life.

5. Evolution and Integration of Technology in Urban Villages

Currently, with the evolution of Artificial Intelligence (AI), Internet of Things (IoT) technology plays an important role in efficient resource management within urban villages. IoT systems can monitor and manage everything from water usage and energy consumption to waste management by using sensors and smart devices throughout the community. For instance, in Kelvin Grove urban village in Australia, IoT technologies are utilized to manage energy efficiently and sustainably (Gonsalves et al., 2024). The village features smart meters and energy management systems that monitor and control the energy consumption of buildings, optimizing usage and reducing costs. Additionally, the integration of smart grids helps to manage electricity distribution effectively, especially during peak load times, enhancing the overall energy resilience of the community.

Smart grids are another technological advancement that urban villages can leverage to enhance energy efficiency. This is the case, for example, in Seattle City in Washington, United States (Urbanist, 2024). Indeed, these grids use digital communication technology to detect and react to local changes in electricity usage (Figure 7). During peak demand times, smart grids can redistribute electricity to where it is needed most, thus preventing outages and promoting energy conservation. Additionally, they support the integration of renewable energy sources, such as solar panels, into the grid, making the energy system more sustainable and less reliant on fossil fuels. Commercial Drive, in Vancouver, British Columbia, Canada, leverages smart grid technology to integrate renewable energy sources, such as solar panels, into the community's

energy system. The smart grid helps to balance the energy supply, especially when solar power generation is high, storing excess energy or redistributing it within the grid, thus promoting sustainable energy use.

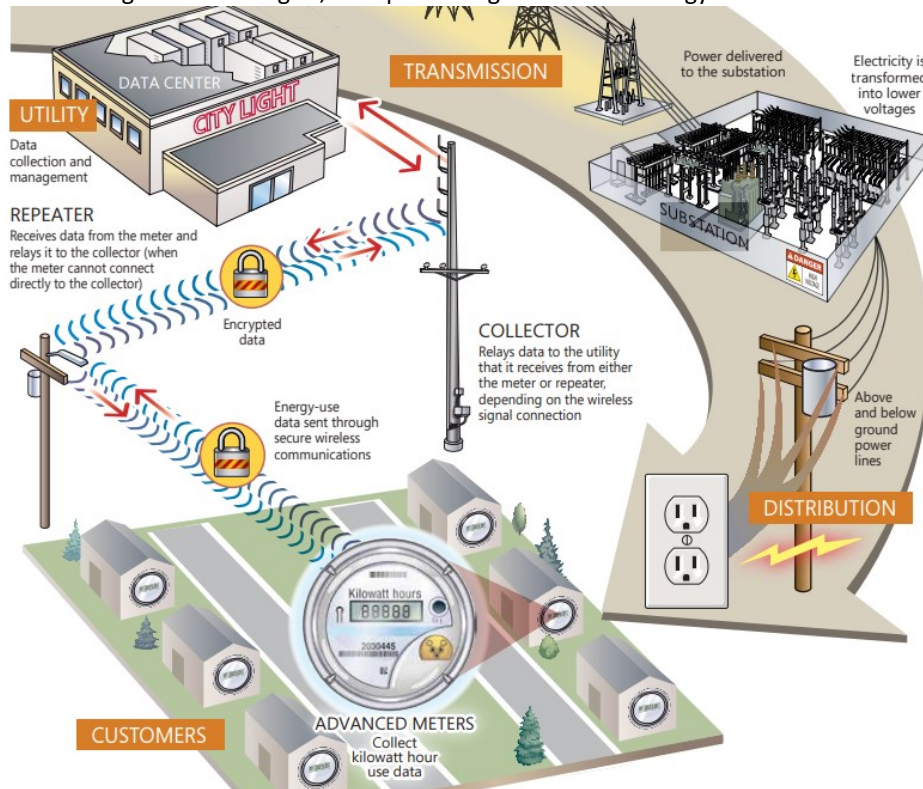


Figure 7. Schematic example of a smart grid technology and advanced metering infrastructure (AMI) in Seattle City Light (Urbanist, 2024).

Table 1: List of IoT technologies utilised in urban villages

Aspect of IoT Application	Description	Variables and Examples	References
Resource Management	Monitor and manage resources like water and energy, optimizing usage and reducing waste.	Smart meters (e.g., Neuroio Home Energy Meter for energy usage), Water flow sensors (e.g., YF-S201 Flow Meter for water usage).	(Generac, 2024)
Energy Efficiency	Ensure efficient energy use and integrate renewable energy sources.	Smart grids (e.g., Aclara Smart Grid Solutions for electricity redistribution), Photovoltaic (PV) inverters (e.g., SolarEdge SE7600A-USS for solar energy management).	(Aclara, 2024)
Waste Management	Optimize waste collection routes and schedules, improving efficiency and reducing environmental impact.	Smart waste bins (e.g., Enevo One Collect sensor for fill level monitoring), RFID tags (for tracking waste bin collection routes).	(Rfijournal, 2024)
Traffic and Mobility	Manage traffic flow and improve public transportation systems, reducing congestion and enhancing mobility.	IoT traffic sensors (e.g., Libelium Plug & Sense Model for real-time traffic conditions), Smart parking meters (e.g., Parkeon Strada Smart for guiding to available spots).	(Stojanova et al., 2022)
Environmental Monitoring	Collect data on environmental conditions like air quality and noise levels, improving pollution control and public health.	Air quality sensors (e.g., Honeywell HPM Series Particle Sensor for pollutants), Noise level monitors (e.g., Brüel & Kjær Type 2250-S for sound pollution).	(Bruel, 2024; Honeywell, 2024)

Public Safety	Enhance urban safety through improved surveillance and emergency response systems.	Smart surveillance cameras (e.g., Axis P3375-LVE Network Camera for unusual activity detection), Emergency call points (e.g., Code Blue IA4100 for real-time alerts).	(Blanchat, 2014)
Infrastructure Management	Monitor the health of urban infrastructure, predicting maintenance needs and preventing failures.	Structural health monitoring sensors (e.g., LORD MicroStrain sensors for bridges and buildings), Adaptive streetlights (e.g., Twilight CitySense for adjusting brightness).	(Dale, 2018)

6. Conclusion

Exploring the urban village in its historical context offers valuable insights into the development of sustainable communities. Under this current change, the principles that defined these villages in the past remain relevant today, guiding the creation of urban spaces that are both resilient and cohesive.

The future of urban development, especially in the United States, lies in blending historical theories with modern innovations. By integrating these timeless principles with contemporary advancements, urban areas that are sustainable, vibrant, and cater to diverse needs can be created. The urban village, with its deep historical roots and modern significance, serves as a model for sustainable urban development in the future. Furthermore, Incorporating the latest advancements in Artificial Intelligence and Internet of Things technology into urban villages enhances resource management and energy efficiency and marks a significant step towards realizing the vision of creating sustainable, adaptive, and technologically integrated urban communities for the future.

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Conflict of Interests

The Authors declare that there is no conflict of interest.

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