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Decoding Human Life: Transforming Our Quotidian Movement and Activity in Urban Public Spaces into Social Business

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Abstract

The transportation sector accounts for nearly one-third of many national economies; yet, a significant gap remains in our understanding of daily human movement and activities within cities. Traditional transport economics, although based on rational principles, often leads to systemic failures, including high debt, underutilized infrastructure, social inequality, unsustainable resource demands, and environmental degradation. This disconnect arises from a top-down approach that does not reflect the realities of urban life. Amidst the climate crisis and resource depletion, new transport models are emerging, aided by real-time data and advanced machine learning, which allow a deeper exploration of human mobility patterns. This paper aims to redefine transport economics and propose prototypes of social business concepts by analyzing the "human mobility DNA" and "urban life code," which reflect the unconscious drive for community that has shaped urban life since the beginning of civilization. Streets and public spaces, historically the heart of economic activity, are now lifeless spaces and lack small businesses. This paper proposes the process of reclaiming these wasted spaces, reviving vibrant street life, and promoting microeconomic activity through collective resource management. The envisioned outcome is a multimodal mobility and public space ecosystem that fosters pedestrian and bicycle-friendly environments, interconnected transit, and compact, self-sustaining city structures, ultimately balancing economic growth with environmental and social well-being within planetary boundaries.

***Keywords*:** Ontology of human urban life, human mobility code, quotidian activity, human well-being, collective street management, public space as social business

Abstrak

Sektor pengangkutan menyumbang hampir satu pertiga kepada banyak ekonomi negara; namun, masih wujud jurang yang ketara dalam pemahaman kita mengenai pergerakan dan aktiviti manusia seharian di dalam bandar. Ekonomi pengangkutan tradisional, walaupun berasaskan prinsip rasional, sering membawa kepada kegagalan sistemik, termasuk hutang yang tinggi, infrastruktur yang kurang dimanfaatkan, ketidaksamaan sosial, permintaan sumber yang tidak mampan, dan kemerosotan alam sekitar. Ketidakselarasan ini berpunca daripada pendekatan dari atas ke bawah yang tidak mencerminkan realiti kehidupan bandar. Dalam menghadapi krisis iklim dan penyusutan sumber, model pengangkutan baharu sedang muncul, dibantu oleh data masa nyata dan pembelajaran mesin lanjutan, yang membolehkan penerokaan mendalam terhadap corak mobiliti manusia. Makalah ini bertujuan untuk mentakrif semula ekonomi pengangkutan dan mencadangkan prototaip konsep perniagaan sosial dengan menganalisis "DNA mobiliti manusia" dan "kod kehidupan bandar," yang mencerminkan dorongan tidak sedar terhadap kemasyarakatan yang telah membentuk kehidupan bandar sejak permulaan tamadun. Jalan raya dan ruang awam, yang secara sejarahnya merupakan nadi aktiviti ekonomi, kini menjadi ruang yang tidak bermaya dan kekurangan perniagaan kecil. Makalah ini mencadangkan proses menuntut semula ruang yang terbazir ini, menghidupkan semula kehidupan jalanan yang rancak, dan menggalakkan aktiviti mikroekonomi melalui pengurusan sumber secara kolektif. Hasil yang dihasratkan ialah ekosistem mobiliti multimod dan ruang awam yang memupuk persekitaran mesra pejalan kaki dan basikal, transit yang saling berhubung, serta struktur bandar yang padat dan mandiri, yang akhirnya mengimbangi pertumbuhan ekonomi dengan kesejahteraan alam sekitar dan sosial dalam lingkungan sempadan planet.

Introduction

Life in cities is comprised of two fundamental activities - daily activities for our needs and movement between the activity locations. Since the dawn of civilization, humans have shaped all manmade built environments around these core elements. Our social, economic, and cultural life evolved, shaped, and transformed around these two basic elements of urban life. First component, human mobility is an essential component of our creativity that comes from our unconscious desire to become a part of a community. We are born to move, migrate, and settle in communities. Without

movement, we feel isolated, lonely, and suffer from boredom. Humans built an array of mobility ecosystems to satisfy our need for movement. The second component encompasses the daily activities that fulfil our survival needs, foster creativity, provide recreation, encourage social interaction, and drive economic activity. Urban culture emerges from this social cohesion. Our survival as a species depends on community, which extends beyond social and cultural aspects to include the physical environment that supports our daily activities.

Between our primary spaces, home (First Space) and work or study (Second Space), our communities thrive within "Third Space." (Lefebvre, 1968) which refers to the dynamic and socially constructed areas where diverse urban experiences intersect, blending public and private life, and fostering community interaction. And this largest visible third space is an array of spatial ecosystem – markets in open spaces, streets, public spaces, squares, parks, and other common spaces. In the third space, people engage in everyday activities, exchange cultural diversity, and perform social interactions that shape urban life and economic activity, and most importantly, a place for social business to address societal challenges. Third Spaces are hubs for social interaction, diversity, and cultural expression, fostering a sense of belonging and community (Soja, 1996.).

However, the rise of the automobile and top-down economic ideologies in the modern era led to lifeless streets, disconnected communities, degraded the quality of life, and produced an unsustainable path throughout the 20th century. This paper proposes a circular economy system (Foundation., 2013) in third spaces, particularly on streets, driven by social business and shared resource management. The goal is to create an asset-light, locally empowered approach that revitalizes public spaces, reclaims underused vehicle areas, and transforms surplus resources into neighbourhood well-being with a thriving local economy. A dialectical relationship between these two foundational elements of urban life and an emerging form of prototype social business system is one of the philosophical foundations of the multimodal mobility solutions proposed in this paper.

To counter the failures in mobility space planning and poor design principles that have led to disconnected urban economies, disembodied experiences in public spaces, and systemic economic inequality in cities, this paper introduces the concept of the creation of high-quality public spaces from the findings of daily activities and movement pattern while forming a framework and basic foundation of the

largest social business in veery cities. This ecosystem of public space and multimodal mobility, supported by local social business frameworks, aims to replace traditional large-scale mobility infrastructure planning with common spaces that are collectively managed and governed by shared norms, agreements, and regulations among users. This approach offers a more equitable, community-centered solution for developing sustainable urban environments.

Literature Review

Transportation sector generally contributes to one-third of most nation's economy. And yet we still do not fully understand the underlying pattern of quotidian human movements and activities of our daily life in cities. The traditional assumptions and models in transport economics, though designed with rational and practical intentions, have often led to outcomes that contribute to systemic failures, such as high debt, financial strain, underutilized mega structures, lopsided scale leading to increasing inequality, unsustainable resource needs, and overwhelming external negatives. These failures of traditional transport economics arise largely from a disconnect between theory and policies and the reality of the true nature of human movement behaviours.

Facing climate crisis and resource depletion, alternative models of transport economics are emerging that prioritize social equity, environmental sustainability, and local solutions for managing shared resources and achieving a more balanced economy. The availability of real-time data, combined with new intelligence and technologies, is opening a door to understanding the existence of our hidden mobility code. Mobility shapes who we are. Mobility infrastructure shapes the form and economy of cities. The paper aims to develop a different relationship between alternatives from transport economics while drawing in-depth insights into daily human movement and activities by utilizing real-time tracked data to uncover the true nature of our daily activities and needs that would promote economies staying within "planetary boundaries" while ensuring social equity.

The foundation study is based on the trailblazing discovery of the "human mobility code" and its implications for defining urban mobility boundaries in the recently published two-volume book series by the author (Karim D. M., 2023.). These insights stem from an eight-year collaboration with a German startup leveraging innovative technology to analyse human movement and activity patterns across six European and two Asian cities. This earlier primary research collected and gathered human movement data and daily activities from a tracked but geoprivacy-

enhancing toolkit to influence local transportation models, practices, and policies to shift towards holistic transport models that prioritize asset-light infrastructure systems, environmental and financial sustainability, equity, public health, and managing limited shared resources. The outcome of new transport economics and supporting ecosystem that will aim to achieve new urban multimodal transport infrastructure, such as vibrant streets, pedestrian- and bicycle-friendly environments, and interconnected public transit systems that support compact, dense, and self-sustaining city structures.

Urban economics and capitalism play a role in shaping cities, focusing on the economic processes underlying urbanization, the structure and functioning of cities, and the spatial organization of activities within urban areas. Urban focus capitalism's tendency to commodify urban space and generate structural causes of inequality (Harvey D. , 2013.). After World War II, urban renewal and associated massive system of highways and infrastructural transformations, suburbanization, and the total re-engineering of city and region resolved the problem of capital surplus via "secondary circuit of capital". One of the fundamental causes of this structural inequality in the post-modern lifestyle (Lyotard, 1984.) was linear travel demand circulating around fossil fuel-based resources, including automobile technology based on the monocentric city model (Alonso, 1964.). Over time, the city's planning division developed travel demand models assuming humans will generate longer trips to access jobs in downtown from suburban locations. These pattern of transportation economics needs mega structures such as highways, wide urban streets, and intercity trains. However, rapid urbanization trend created severe class struggle, social division and inequality in 21st century. Climate crisis, resource depletion, and financial strain are aggravating the urban quality of life. Transportation economics form and policies developed in the last century are falling apart and need a major overhaul to adjust to the current social, economic, and environmental conditions of the 21st century.

Current theories and policies of transport economics often create a vicious cycle of unsustainable growth. To understand why traditional transport economics often fails, we must into six major flaws in its underlying assumptions 1) overemphasis on infrastructure that requires intensive borrowing creating high-debt and annual financial strain, 2) overwhelming negative externalities in environmental, resource, energy and social costs, 3) misalignment of human movement and activities that could be tangible and intangible which is linked basic habitual and

instinct reflection of human species, 4) exchange values of derived demand of automobile reliance that does not meet frequent and minute nature of human activities and movement 5) overreliance pf short-term focus, ignore long-term impacts and lack resilience under future changing conditions and 6) exploitation of human and resource utilization creates waste and lower productivity resulting in social disconnections such as inequality and exclusion.

These symptoms are connected to underlying travel demand models and traditional supply-demand theories that are based on unreliable static sources of data and oversimplified assumptions about complex human movement and activities. By identifying where conventional economic models fall short, this research intends to derive new travel demand models and multimodal mobility infrastructure systems that better align with sustainable, equitable transport systems. For instance, traditional linear travel demand assumes over 80% of daily trips are longer, which requires high-speed highways, mega-streets, and vast underutilized parking lots. Instead of mundane urban life reflected in our quotidian movement and daily activities in cities from real-time data identified in the author's book, traditional monocentric linear commodity consumption theories rely on 'spectacular' mega shopping, gigantic recreation, or overused digital product consumption. However, breaking this enmity's existing cycle is not easy and requires solid and scientific evidence, such as a proposed series of research to counter equally powerful tools and models to replace these outdated 20th-century underlying ideological foundations.

Informed by insights into everyday human activities and movements, the principal investigator and co-investigators aim to explore and test multimodal economics focused on the "practice of everyday life" bodies (Certeau, 2011) and the mobility DNA elements of the "human mobility code." (Karim D. M., 2023.). This investigation builds upon recent economic experiments in Western Europe, particularly in response to the emerging "asset-light business model." (Toyoda, 1950.), (Womack, 1991.), (Jacobs J. , 1985), which parallels the rise of the service and sharing economy (Company., 2010.) in the fourth industrial era.

Drawing inspiration from (Raworth, 2017.) Doughnut Economics and (Ostrom, 1990.) principles of local, collective governance, partially implemented as common-pool resources in Amsterdam, this exploration of a multimodal economics model seeks to curb excessive demand and unsustainable consumption while safeguarding "planetary boundaries" (Steffen, et al., 2015) and enhancing human

well-being. The proposed mobility economics system in this paper emphasizes long-term investment in human development (Sen, 1999.) and well-being of future generations. By incorporating emerging economic theories and applying circular economy principles ((Boulding, 1966.), (Stahel, 1982.), (Braungart, 2002.), (Foundation., 2013)), this paper touches onto transition from a linear, wasteful economy to a regenerative circular system. This proposed research will mark the beginning of a complex series aimed at shifting away from traditional linear transportation economics. It seeks to establish an asset-light, locally driven, collective model for revitalizing public spaces by reclaiming underutilized vehicle spaces and regenerating excess resources into an effective local economy. The goal is to develop a shared, multimodal mobility, public space ecosystem and associated multimodal mobility economics and social business platform that aligns with the short-trip nature and mundane daily activities within self-sustaining neighbourhoods. The aim of this paper is to focus on creating a sustainable, low-emission mobility system designed to thrive in a post-Anthropocene world.

Methodology and Approach

This paper delineates the methodology and findings pertaining to four interrelated foundational principles aimed at establishing an alternative framework for urban planning, design, and the economic aspects of transportation infrastructure delivery systems that could create a platform of local social business entrepreneurship (Yunus, 2011.) proposed by Muhammad Yunus in his seminal work on the micro-credit financing model (Yunus M. , 2003.). The conceptual development of the "human mobility code" (Karim D. M., 2023.) and mobility boundary (Karim D. M., 2017). It is grounded in the novel discovery as explored in the author's previously published books. This paper reintroduces these initial concepts with updated and refined methodologies. Furthermore, the economic dimensions and the framework for social business for public space were developed independently to address critical gaps, thereby creating a comprehensive understanding of a new approach to a sustainable mobility ecosystem, which seeks to supplant the outdated and flawed 20th-century vehicle-centric paradigms of urban development. The following sections detail the modified and newly interconnected methodologies employed in this research.

Decoding Urban Life: quotidian movement and activities

Among all new and innovative ideas and solutions provided in this paper, the one underlying concept that pulls them all

together is the understanding of the existence of our hidden 'mobility code and its DNA elements'. Additionally, recent research has focused on analysing the patterns and underlying dynamics of human daily activities, both tangible and intangible, to gain a deeper understanding of how individuals accomplish their daily needs as an integral part of their everyday lives.

The underlying concept of the 'human mobility code' is, however, simple. Mobility shapes who we are. We move to satisfy our internal, hidden individual desire for movement. Over time, we develop mobility habits that create a mobility motif with a unique pattern. The question is, how do we display such a unique mobility identity? First, a human is a living organism that self-organizes its own activities. Whether searching for food, reproduction, or simple recreation, we move from one place to another. Second, the movements and stillness become part of our daily habits and develop into an internal, hidden structure that dictates our daily movement habits. Our conscious brain directs other intelligence, but our desire for movement and daily activities are predominantly controlled by our unconscious sense, so it remains unknown. Our brain does not calculate our movements or activities every day and tell us what to do. The habit of movement and staying somewhere for activities is ingrained into our senses, through feelings, emotions, tangible, and intangible purposes. Finally, our movement and activity habits start to show an individual, group, or collective mass pattern. From there, we develop tools through the different mobility modes to decide how we will move in the most energy-efficient and economical way.

Similarly, the nature of human activities plays a crucial role in shaping and influencing the built form and the broader built environment, including the design and functionality of public spaces. Our mobility takes a full form and displays the many hidden natures that are unique to every individual. This hidden but stable form of movement and activities is presented herein as our "mobility code" and "urban life code" along with traces of DNA elements, similar to our biological DNA but influenced or changed by the living environment, societal and cultural norms, geography, and built or mobility forms, our adaptation culture, and the ecosystem available to us. When these systems change, our mobility and activity, along with its DNA, change to adjust to new conditions but stabilize and reemerge after a period to show the same individual traits.

Formulation of Mobility in Motion

Mobility in motion simply refers to daily habitual movement by humans in cities. A defining characteristic of the human species is our remarkable capacity to create and utilize a diverse range of tools,

each tailored for distinct tasks and purposes (Shea, 2017.). This highlights a key aspect of human evolution and cognitive development (Stout, 2017.). The same is true for human mobility for both passenger and freight systems. It is our natural habit to use multiple mobility options ('multimodal mobility') if those options are available, affordable, comfortable, and easily accessible. The integration of these options within diverse contexts is commonly referred to as a "mobility ecosystem". This unique human capacity, which distinguishes us from other species, allows for the expression of a mobility ecosystem as a multimodal mode share which is formulated as follows:

$$T_{i,j} = W_{i,j} + V_{i,j} + C_{i,j} + PT_{i,j} + PT(od)_{i,j} + TR_{i,j} + MM_{i,j} + NM_{i,j}$$

for total person trips (1)

$$MS_c = 0.5 + \frac{\sum_n^i WM_{i,j}}{\sum_n^i T_{i,j}} \quad s.t.\, A_{i,j}, BE_{i,j}, SE_{i,j}$$

for the collective mode share for the area of the city (2)

$$MS_P = \frac{W_{i,j}}{\sum_n^i T_{i,j}} \, s.t.\, BE_{i,j} \,\&\, SE_{i,j} + \frac{\sum_n^i WM_{i,j}}{\sum_n^i T_{i,j}} \, s.t.\, A_{i,j}, BE_{i,j}, SE_{i,j}$$

for individual person mode share (3)

where MS_c = Collective mode share, MS_P = Person or individual trips, i, j = trip origin (i) and destinations (j), $T_{i,j}$ = Total person trips, $W_c \approx$ Walking constant or roughly 0.5. representing 50% mode of share for collective pattern, $W_{i,j}$ = Walking trips for individual person trips, and, $V_{i,j}$ = Vehicle trips (∈ medium to long distance), $C_{i,j}$ = Total cycling trips (∈ short distance), $PT_{i,j}$ = Total public transit person trips (∈ medium to long distance), $PT(od)_{i,j}$ = Total on-demand shared or transit trips (∈ short to medium distance), $TR_{i,j}$ = Total train trips (∈ very long distance), $MM_{i,j}$ = Total micromobility trips (∈ shorter distance), and $MM_{i,j}$ = New modes invented in the future (∈ short to medium distance), $WM_{i,j}$ = wheeled mobility modes (other than walking), $BE_{i,j}$ = Quality Built Environment, $SE_{i,j}$ = Socioeconomic conditions (income and wealth, health, employment, social status, political, social and social networks, age, gender, race, other physical factors) and $A_{i,j}$ = Mobility access which a function of 7Ds (Density, Diversity, Design, Destinations, Distance to Transit, Digital Access).

Formulation of Mobility in Stillness

Mobility in stillness refers to the habitual time spent by individuals at various locations within urban built or natural environments. This mobility in stillness concept is intricately linked to traditional land-use systems, which regard space as a fixed and objective commodity, which is opposed by LeFèvre's "production of space" (Lefebvre H. , 1991). He argued that space is not merely a neutral, passive backdrop as a fixed and objective reality for social actions,

but rather it is actively produced by social, political, and economic forces. He sees the necessity for inclusivity, accessibility, and democratic engagement in urban spaces (Lefebvre H. , Le droit à la ville., 1968.). Subsequently, Harvey critiques the effects of neoliberal governance on public spaces, arguing that the planning processes often prioritize commercial interests over community needs (Harvey, 2006.). Rather than allowing public spaces to fall victim to privatization, where corporate interests and capital-driven developments undermine the fundamental rights to public, accessible, and inclusive urban environments, Harvey advocates for transforming these spaces into platforms for democratic engagement and social justice.

In response to these foundational critiques, new planning paradigms have emerged over the past two decades, such as the Dutch model of "spatial planning and design." (Priemus, 2007.) This model seeks to reflect the complex layers of the urban ecosystem, emphasizing the interrelations between various modes of travel and the underlying natural built environment (Forman, 2014.). This paper aligns with the broader perspective of physical space and the emotional connections individuals form with places (Tuan, 1977.). A new perspective on urban public spaces is proposed herein, with detailed methodologies outlined in the subsequent sections. To conceptualize mobility in stillness, daily staying activities, and the time spent per visit at diverse locations (both private and public) are broadly categorized as follows:

$$TS_p = \sum_{j=1}^{n} t_{pa} \quad (4)$$

Where TS = total time spent for individual person p, t_{pa} = Time spent by on activity a by individual person p, and n = Number of activities. Individuals select places based on their habitual and emotional connections, which can differ according to various factors such as purpose, personal preferences, limitations, available alternatives, associated costs (both tangible and intangible), and the overall quality of the spaces. For analytical purposes, the time spent in these spaces can be broadly categorized as follows: 1. Very short stay (less than one hour, typically transfer between modes, waiting to meet people, etc.), 2. Short stay between 1 to 2 hours (typically shops, restaurants, people-watching in public spaces, other leisure), 3. Medium stay between 2 to 5 hours (non-sleeping activities like lifestyle and personal habits), Long stay between 5 to 8 hours (typical work or study), and 5. Very Long stay more than 8 hours (typically sleep time is 7 to 9 hours). These staying durations are later used in the analysis of the urban life network model, which is present in Section 4.0.

Creation of Quality Public Space

Truly well-designed quality public spaces are typically underpinned by a complex, multilayered system that includes economic, social, and cultural norms, as well as habits and practices. We can apply progressive design ideas to fix the hardware of our broken mobility spaces, similar to fixing digital software, but the Covid-19 pandemic has already pointed out very clearly our mobility hardware problems of underutilized or wasted nature and unnecessary consumption that enabled us to right-size our mobility infrastructures or facilities (Price, 2021) when condition changes.

Fortunately, we have been paying attention to the better design of our streets over the last two decades. Human relation with space is embedded in four basic instincts. Human's lack of blueprint creates a desire to interact with other human in public space. This initial impression is built through the dialectic process of mental and physical well-being. In the postmodern era, the approach to constructing urban environments and public spaces has undergone a significant transformation, supplanting the nuanced sensibilities characteristic of the modern period that began in the early twentieth century. But the knowledge of this relation is sporadic and haphazard. Engineers or planners who oversaw the redesign of walkable, bikeable, transit-oriented places were often inspired by progressive ideas, without paying attention to the four distinct layers of mobility facilities as public space. This paper reintroduces four new major mobility space concepts (Karim D. M., 2023.). This third layer would intentionally build our public space for daily life activities. The final layer would be understanding how our emotion, feelings, and human resonance is connected to build environment to avoid systematic inequality and alienation with public space. The authors expect the final layer need artistic and cultural convergence once the third layer is accomplished properly.

To incorporate the first three layers of human and space relations in 21st-century living spaces, the four new concepts of mobility space transformation were proposed (Karim D. M., 2023.).

- The first concept incorporates people's habit of gathering in popular places, referred to as "Multimodal ecomobility hubs". Instead of centralizing multimodal access at transit stations, the ecomobility hub concept spreads the mobility hub to every corner of a neighbourhood within a very short walking distance. The hubs would act as a one-stop service spot for all types of mobility modes that would be context sensitive and align with local

mobility cultures. Ineffective traditional travel demand management becomes effective at multimodal ecomobility hubs.

- The second concept is invisible spaces. Ironically, many 'traffic spaces' given over to vehicles are never used by vehicles. These spaces make up roughly one-third to more than 40% of total mobility space in our cities. The concept provides a systematic process through space typology, category, identification, and the reclaiming of these invisible spaces, and converting them into quality public space where social business can thrive.
- The third concept is green (mobility) spaces. The concept of creating six major types of green space in mobility facilities is introduced to bring back at least one-third of the space for organic nature that was lost to the 'modern' automobility system.
- The fourth concept is intentionally creating human spaces. Through a reclaiming and greening process, another one-third of spaces would be dedicated to various daily human activities. The objective is to revive lost mobility culture through social interaction, recreation, gathering, and lingering activities, the observing of humans by humans.

The creation or revival of these new public spaces reclaimed unused or underutilized mobility systems is not a utopian dream, but rather a barebone of basic human right to equity, daily life necessities, and the long-term viability of well-designed places. The entire mobility space in cities can be formulated as follows:

$$MS_j^i = HS_j^i \cup G_m S_j^i \cup IS_j^i \cup SFS_j^i$$

Where MS = Total mobility space, SFS = Shared flow spaces, HS = Human spaces, $G_m S$ = Green (mobility) spaces, IS = Interaction spaces.

To address very basic issues, this book proposes to start a new rule and borrow a page from the mobility boundary concept, a second page from the human resonance concept, a third page from the resiliency perspective, a fourth page from space allocation science, and a final page from an equitable lens. When these principles are applied correctly, a new equation of street planning and design emerges for total street space (SS):

$$SS_n^l = \frac{1}{3} HS_j^i + \frac{1}{3} G_m S_j^i + \frac{1}{3} SFS_j^i$$

where n = l types of street classification, n is the total number of streets in cities, SFS = shared flow spaces for moving vehicles,

and i = types of space in each mobility space to j types of street urban design form.

Economics of Mobility Boundary

Our mobility economy system has emerged as a major strain on the planetary systems. Ever-expanding mobility infrastructures with underlying traditional infrastructure around vehicle-oriented systems are pushing the planetary boundary (Steffen, et al., 2015) and urban boundary (Hoornweg, Hosseini, Kennedy, & Behdadi, 2016) to an unsafe zone. The link between the limits of mobility system expansion and the planet's limits is missing in the daily mobility planning process. The mobility boundary concept was introduced by the author (Karim D. M., 2017) to identify the limits of mobility expansion, toward the maximum benefit of human well-being while keeping the strain on the planetary system within a safe zone (See Figure 1). Both unchecked expansion and growth, and never-ending new "efficient" and sustainable technologies are equally unsustainable. The boundary concept proposes to abandon our 'infinite cycle of repeated growth and failure' ideology (Berg P. , 2011) built into the broken utility-based "slash-and-burn" unchecked capitalism system (Williaams & Khanna, 2020) in favour of setting new mobility limits to control demand and limit unchecked megastructure supply practices. The intention is to impose a boundary to push the system planners and decision makers to a low-emission and multimodal ecosystem.

Building on Sen's approach (Sen, 1999.), which emphasizes measuring a country's average achievements in three fundamental aspects of human development - health, education, and standard of living - this study identifies six fundamental elements of human well-being that should be prioritized for incremental improvements. These enhancements can only be achieved through local social business entrepreneurship and the collective management of neighbourhood's resources and urban environments. Identifying the future aspects of the symbiotic relationship between the six fundamental interactive elements in a mobility ecosystem, the concept of shifting mobility approach envisions a novel urban morphology, shapes a new experience of urban space, and turns unexplored assets into an ecosystem of vibrant, sustainable innovation. The concept is built on six fundamental elements (and associated planning policies) of the mobility ecosystem: (1) healthy environment, low-carbon footprint and clean energy; (2) smart growth principles using multimodal ecosystem; (3) sociability and liveability by enhancing social capital and innovation; (4) smart and easy access to all types of mobility services; (5) sustainable safety by reducing

crash risk and severity; and (6) very low impact and resilient infrastructures that prioritizes sustainable and shared uses. The well-being of the community is summarized in a Genuine Progress Indicator (GPI), which represents the quality of life for city residents. The path to a desired level of mobility ecosystem (MES) of this mobility boundary is formulated as:

$$MES_{t+1} = IBC_{t=0} + \sum_{i=1}^{n} \Delta FBC_t\,(F \mid P)$$

$$\Delta GPI = MES_{t+1} \pm \sum_{i=1}^{n} E_{(t+1)} \geq 0$$

Where t = a practical timeframe for planning and implementation, IBC = Initial boundary conditions (or zero or old or current) for mobility, urban and planetary level, FFBC = Final boundary conditions within timeframe t, E = Sustainability constraints $=\int (FE_i)=$ where i represents number of fundamental ecosystem (FE) elements, F = Economic fundamentals, P = Policies for development planning, design, mobility, social, environmental, cultural aspects of urban development. Aggregate sustainability constraints will be identified through an investigation of the limiting boundaries of each fundamental ecosystem element (FE) and the net benefits achieved through the progress of sustainable, shared resources and infrastructure, utilizing policy incentives and effective strategies.

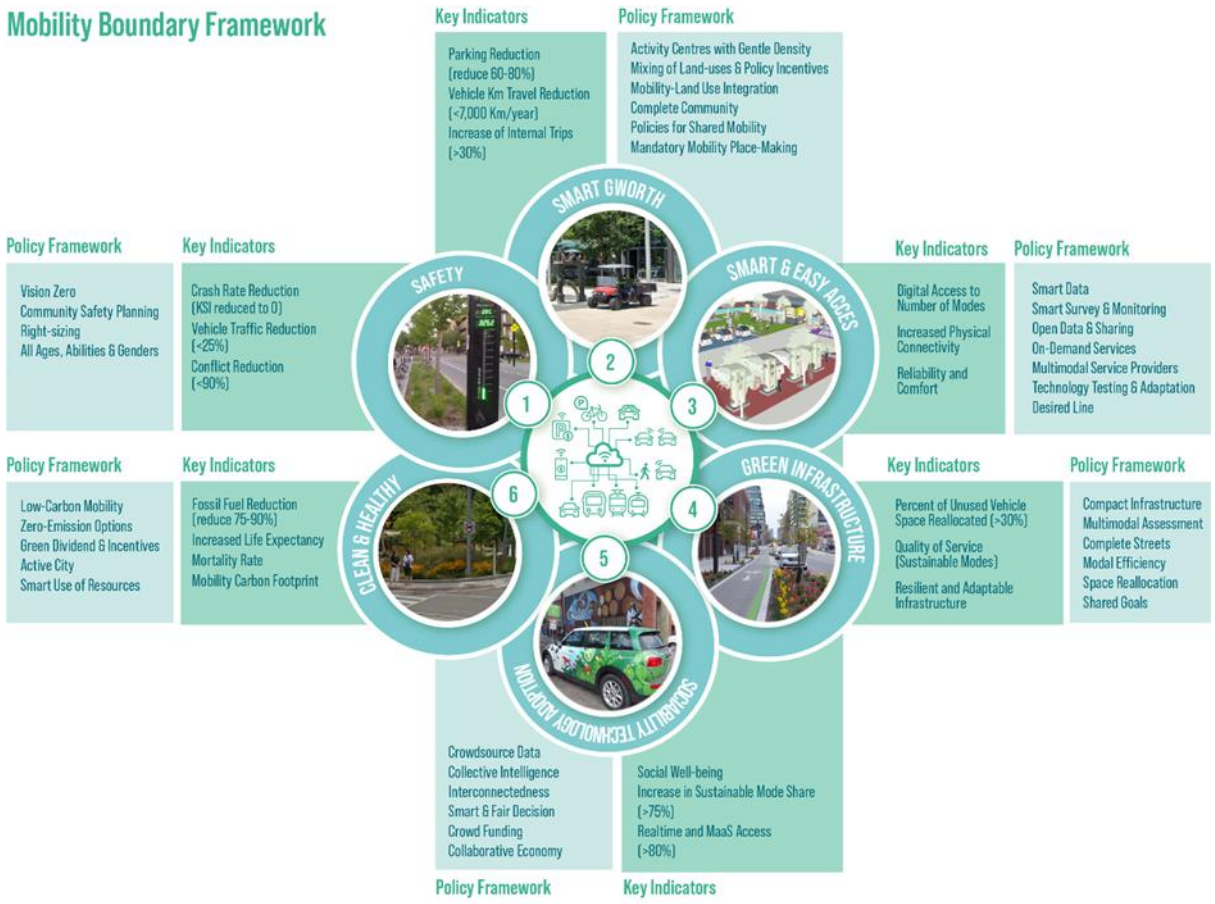

Figure 1: The concept of mobility boundary

Public Space as Social Business

Social business, as defined by Yunus (Yunus, 2011.), is a business model aimed at solving social problems in a financially self-sustaining manner. It is distinct from traditional businesses, as it does not distribute dividends to investors; profits are reinvested to expand the social impact of the business. Social businesses operate with the primary goal of addressing issues like poverty, health, education, or the environment while they strive to be financially sustainable and avoid the traditional business focus on profit maximization for shareholders. Yunus' ideas can be applied to urban development, especially in street revitalization, public space creation, and the revival of small-scale retail and entrepreneurship. The guiding principle here is the empowerment of local communities to create sustainable, socially beneficial economic activity.

In this prototype social business for public space in cities, the initial focus is on four major areas:

1) Public space creation and governance: New reclaimed public space creation could be approached by empowering local

residents and businesses to form social enterprises aimed at maintaining and improving these spaces. For example, a social business could be responsible for managing local mobility pakettes, provides shared mobility services such bikeshare, carshare, and management of rideshare activities, maintaining mini parks while integrating street theatres and arctic performance platforms, collective management of common area in plazas with amenities, and creation of maintenance of pedestrian areas, with revenue coming from food stalls, craft markets, or entertainment events held within these spaces. The focus would be on providing a public good while ensuring that the space remains sustainable without needing continuous external funding.

2) Street revitalization: Microcredit (low-interest and accessible loans) can be used to provide capital to small businesses, artists, pop-up shops, artisans, street vendors, and local entrepreneurs in underdeveloped or neglected urban areas. For instance, local women could receive microloans to set up food stalls or handicraft businesses along a street that has been historically underserved. These businesses would not only bring life back to the area but also offer employment opportunities and foster a sense of community ownership. Social businesses focused on collective agreement of the form of urban renewal can play a key role in transforming declining streets into vibrant, economically active corridors. For instance, a social business could be created with the goal of managing and maintaining local street markets in reclaimed green and human mobility spaces or revitalizing vacant storefronts into community-run cafes or co-working spaces. Profits from the enterprise would be reinvested into the further development and maintenance of the area, circulating economic surplus within the community. Another example of social business could be established to convert abandoned vehicle spaces or parking lots into community gardens or public spaces for flower, fruit, or vegetable growing businesses, generating employment through urban farming and creating social gathering places that improve neighbourhoods' connectivity and liveability.

3) Reviving Old Small Retail and Entrepreneurship using microcredit: Microcredit could help revitalize old small retail and on-street or curb-side vendors that have suffered due to competition from larger chains or e-commerce. Through small, targeted loans, local shop owners can upgrade their storefronts, stock more competitive products, or implement digital tools to reach a broader customer base. A young entrepreneur might receive a microloan to open a pop-up sidewalk,

median, or curbside collectively managed mobility space that sells eco-friendly products, encouraging sustainable consumption while contributing to the revitalization of the commercial landscape.

4) Local neighbourhood economic empowerment: Both microcredit and social business can empower local entrepreneurs, enabling them to participate in and contribute to the local economy. A group of local entrepreneurs could create a social business that offers services like waste collection, landscaping, and park maintenance in exchange for small fees or donations from the community and local businesses. This would ensure public spaces remain well-maintained and foster a sense of community stewardship. Small loans could be used by local artists, street performers, or community groups to create installations, cultural events, or art markets in public spaces. This not only enhances the visual and cultural appeal of the area but also provides micro-entrepreneurs with opportunities to develop sustainable ventures. An artist could take out a microloan to finance a public art installation or mural project in a neglected urban park.

Results and Discussion

This section describes a series of new findings, including a summary of previous relevant results from recently completed research and practical experience from real-life neighbourhood or area redevelopment projects across North America and Asia.

Decoding Urban Life: quotidian movement and activities

The human mobility of each individual is unique but also follows some regular collective pattern. Collective movement displays a relatively stable behaviour. Individual movement pattern shows a series of common motifs of mobility and staying activity sequence. The results indicate we need a more realistic mobility supply, i.e., an infrastructure system and economics that match both our individual and collective needs, instead of the current vehicle-oriented system focusing on individual needs but producing many negative externalities.

Individual mobility code: Using the general and Mobility Markov Chain method (Gambs, Killijian, & Cortez, 2011), a clear mobility pattern of the individual emerged. Each person has a unique combination of multiple modes; their distance, travel time, and speed are unique to that individual. No single person displays exactly the same or a similar mobility pattern. Every person's mobility pattern is statistically significant, indicating a unique mobility footprint is not accidental. This unique discovery is called the "human mobility code," with distinct elements of DNA that constitute each and every individual's mobility code. Figure 2 presents clear evidence from the cluster

analysis (principal component analysis, PCA) of 200 users across eight cities in Europe and Asia, demonstrating that the combined movement and activity centres of individuals within the same cluster do not overlap with those of others. In addition, the results show that we make nearly six to eight trips every day during regular periods. During the time of constraints, such as the COVID-19 pandemic, the number of trips was reduced by half.

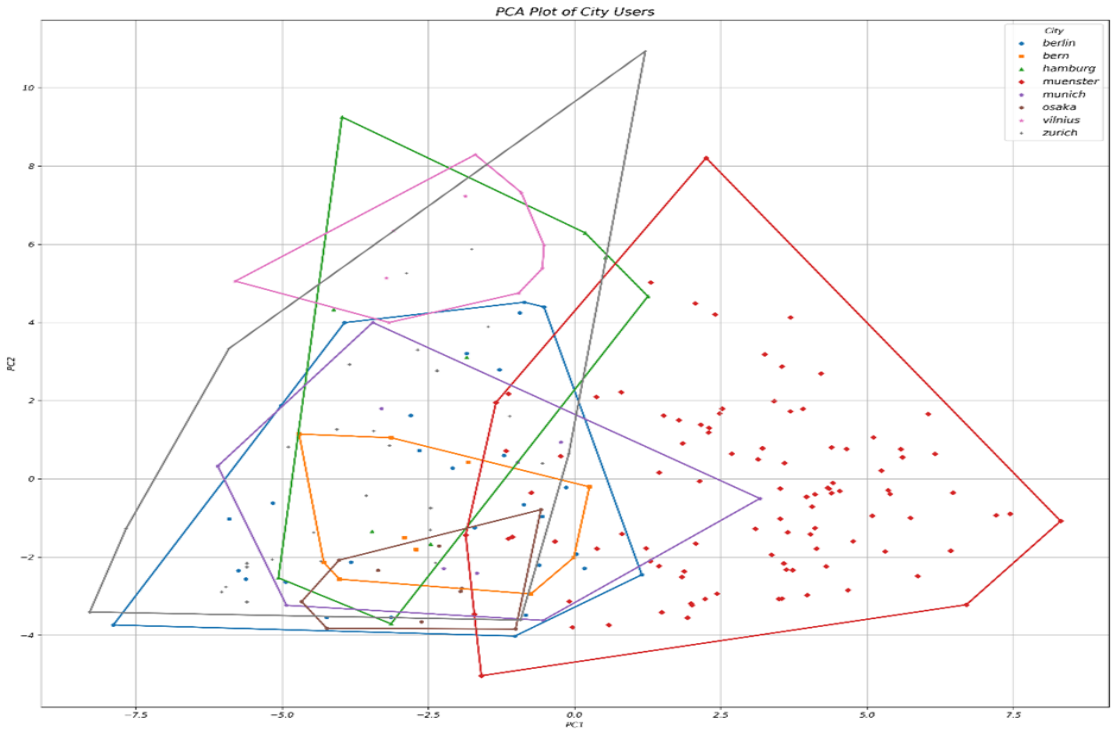

Figure 2: Cluster analysis indicating that each user's mobility and stay profile is unique to every person in cities

All users in the database have shown repeated use of the same combination of multiple modes. None was unimodal. At least two mobility modes (an extreme example is the car and walking) were used by everyone in the database. The most common multimodal users regularly use at least three or four mobility modes. Those who combine five modes are less frequent but not rare. The probability density function and cumulative distribution of mobility are illustrated in Figure 3. Occasionally, some users switch mobility modes, but over time (roughly six months) their behaviour stabilizes. Unlike folklore among vehicle-oriented practitioners, not a single person used a single mode (i.e., car-only), meaning a unimodal person does not exist in reality. It's practically impossible to use a car for all possible trips and conditions without supporting access trips, such as walking, cycling, or micromobility.

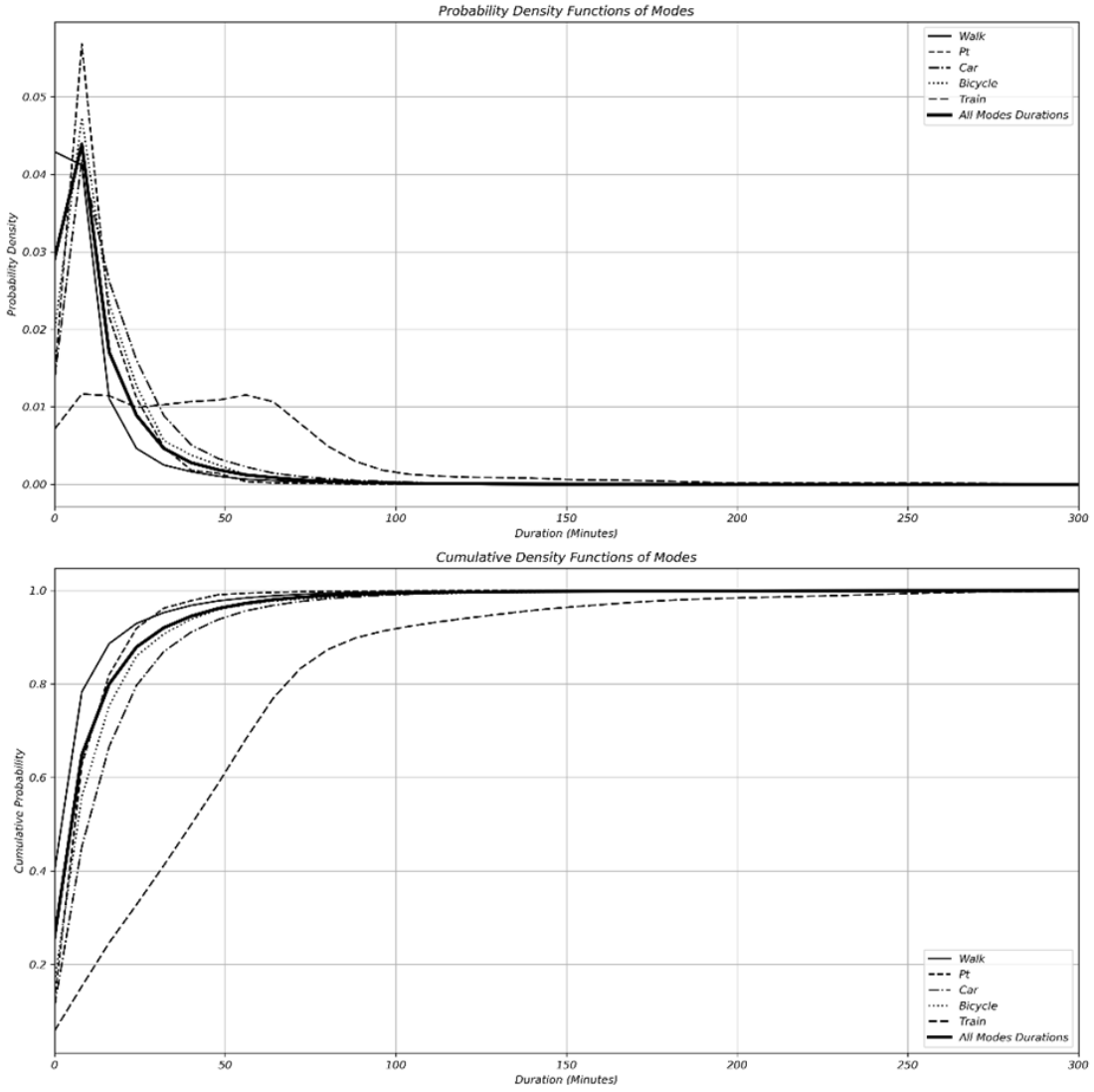

Figure 3: Probability density function and cumulative probability of multimodal mobility modes

Collective mobility code: Some unique collective pattern, our hidden desire to produce a collective pattern. Walking is the most fundamental of the building blocks of human mobility. The majority of personal walking mode share falls within a range from 33% to 71%; however, when all trips in the area or city are combined, half of our total trips come from walking. It also shows that no seasonal, geographic, built form, or any other disruption was able to change the ever-constant group or citywide walking mode share. And yet, our walking infrastructure in the city's infrastructure receives less than 5% of the transportation budget. Additionally, the results show the existence of 'mobility mode couples' between vehicle and transit trips since their

characteristics (distance, duration) are similar, i.e., one-third of total trips are vehicle trips which could be replaced if a comfortable, easily accessible, and high-frequency public transit service is provided. Walking, cycling, and micromobility also act as dependent modes and often "couple" with long-distance modes, i.e., vehicle and transit. The most critical finding is that most urban trips are remarkably short (less than 10 km), except an a small share of long-distance train trips.

Daily life activity code: Human daily activity patterns are inherently complex. On average, individuals generate multiple trips between various locations, with each trip typically associated with a corresponding stay. On a daily basis, individuals produce approximately 3 to 4 trips, roughly half of their total daily trips. Stays, however, are not homogeneous. The most frequent type involves very short durations (less than an hour) between movements (~40%-43%). In contrast, a substantial portion (~23%) of stays are much longer (more than 8 hours), such as overnight stays at home. These long stays are typically associated with two-way trips, with walking being the most common last-mile mode of mobility. Both very short and long stays follow a log-normal distribution, indicating that most data points cluster towards shorter durations, with a long tail extending towards longer times.

In contrast, short (1–2 hours), medium (2–5 hours), and longer (5–8 hours) stays exhibit patterns that align with a beta distribution, reflecting a variety of shapes where data may be concentrated near the extremes (close to 0 or 1) or more evenly spread across the range. These stays often correspond to activities such as eating, recreation, brief meetings, appointments, work or study-related tasks, or other habitual lifestyle events. These stays function as temporary pauses between sequences of short trips. After a certain period, movement typically resumes. Longer stays outside the home, usually related to work or school, necessitate extended durations to complete tasks. These longer stays also often precede return trips in the reverse direction, whereas shorter trips are connected by one-way trips.

The probability density function and cumulative distribution of mobility are illustrated in Figure 4, showing that approximately 55% of the stays are shorter than 120 minutes (2 hours), and around 70% of trips last less than 5 hours. These findings suggest that the majority of human activity is characterized by short or medium durations, highlighting the tendency for habitual patterns like the predominance of short trips undertaken by individuals daily.

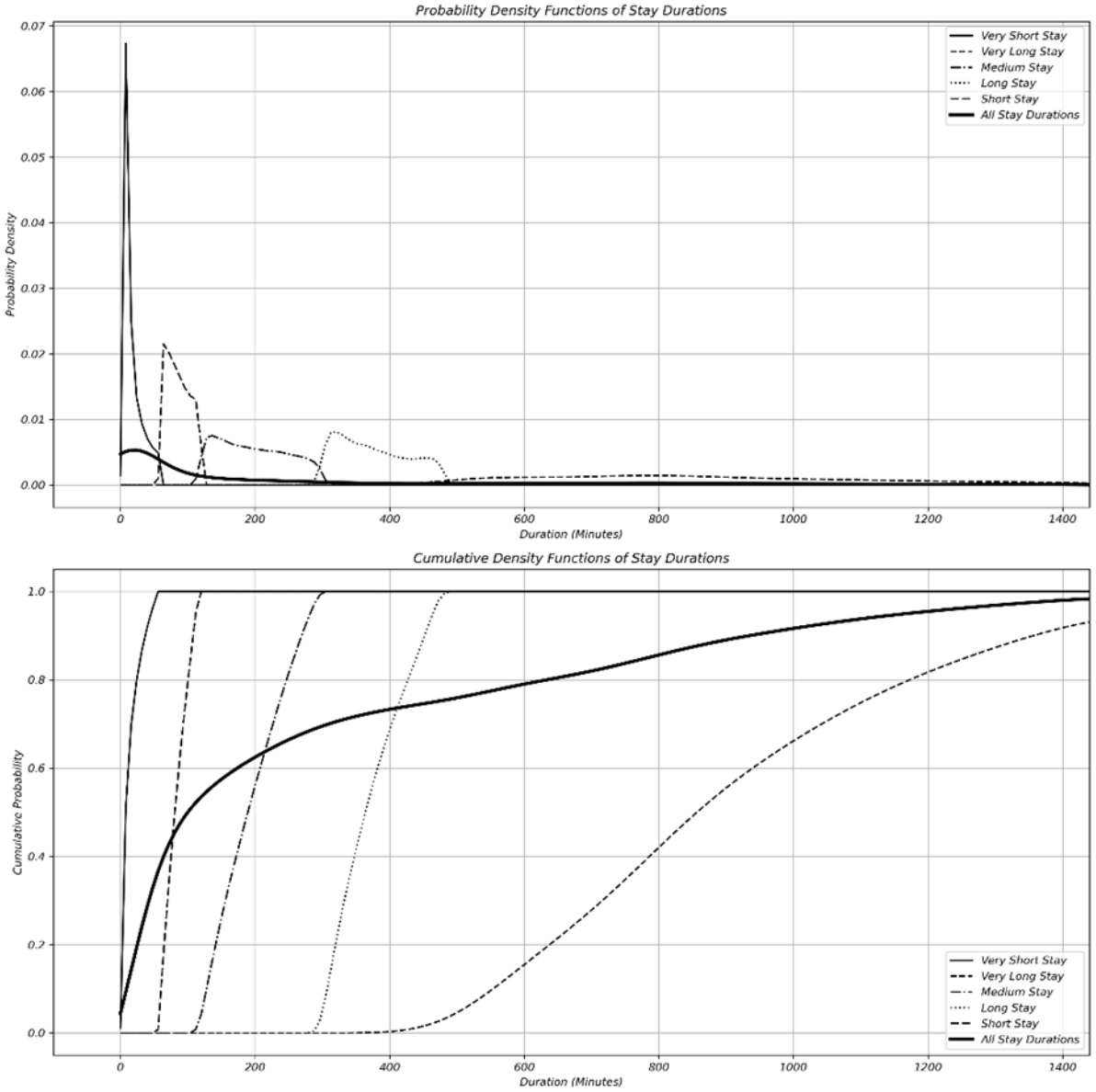

Figure 4: Probability density function and cumulative probability of types of stay

Urban life code: Analysing individual movement and daily activity networks through Markov chain analysis reveals distinct patterns in personal habits and the complexity of urban life. Figure 5 provides a detailed profile of one user's daily activity and movement network, shedding light on the hidden patterns that characterize urban living. Several common trends emerge: for example, walking is highly probable after both long and medium stays, suggesting that following extended periods of rest, individuals frequently rely on walking, the most accessible and common mode of mobility. Likewise, short stays are closely associated with walking. Public transit usage also shows a strong connection to walking, with a notable link between cycling and very short stays.

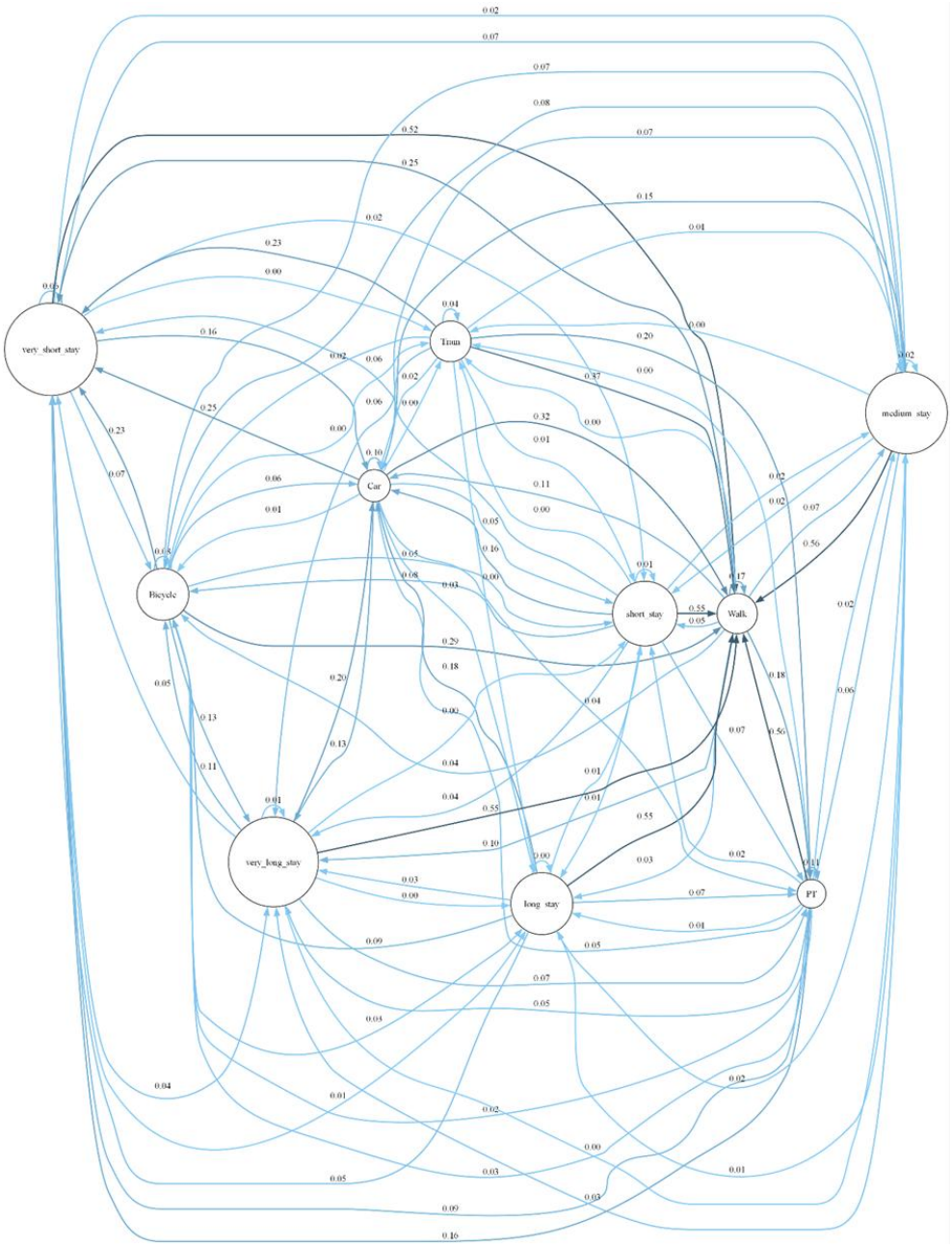

Figure 5: Example of urban life code and network profile of daily activity and stay of Berlin city residents

Collective city profile: A comparative analysis of urban life codes and network profiles across different cities reveals that residents within the same city tend to exhibit relatively homogeneous movement and activity patterns. As demonstrated in Figure 6, these similarities can be attributed to shared mobility infrastructures, despite individual differences. For instance, Bern, Switzerland, exhibits the highest level of consistency in residents' urban life patterns, with approximately 94% similarity. In contrast, only 62% similarity is observed between Vilnius, Lithuania, and Münster,

Germany. The differences in mobility patterns arise from variations in transit infrastructure, with Vilnius lacking rapid transit options and primarily relying on buses and intercity trains, while Münster offers a comprehensive network of trams, trains, express and local buses, as well as high-quality cycling and walking facilities (with a 37.6% mode share) and reduced vehicle usage (36.4% mode share). These insights suggest that the successful elements of mobility systems and infrastructure in well-performing cities can be adapted and applied to cities with underdeveloped sustainable mobility systems and inadequate public space.

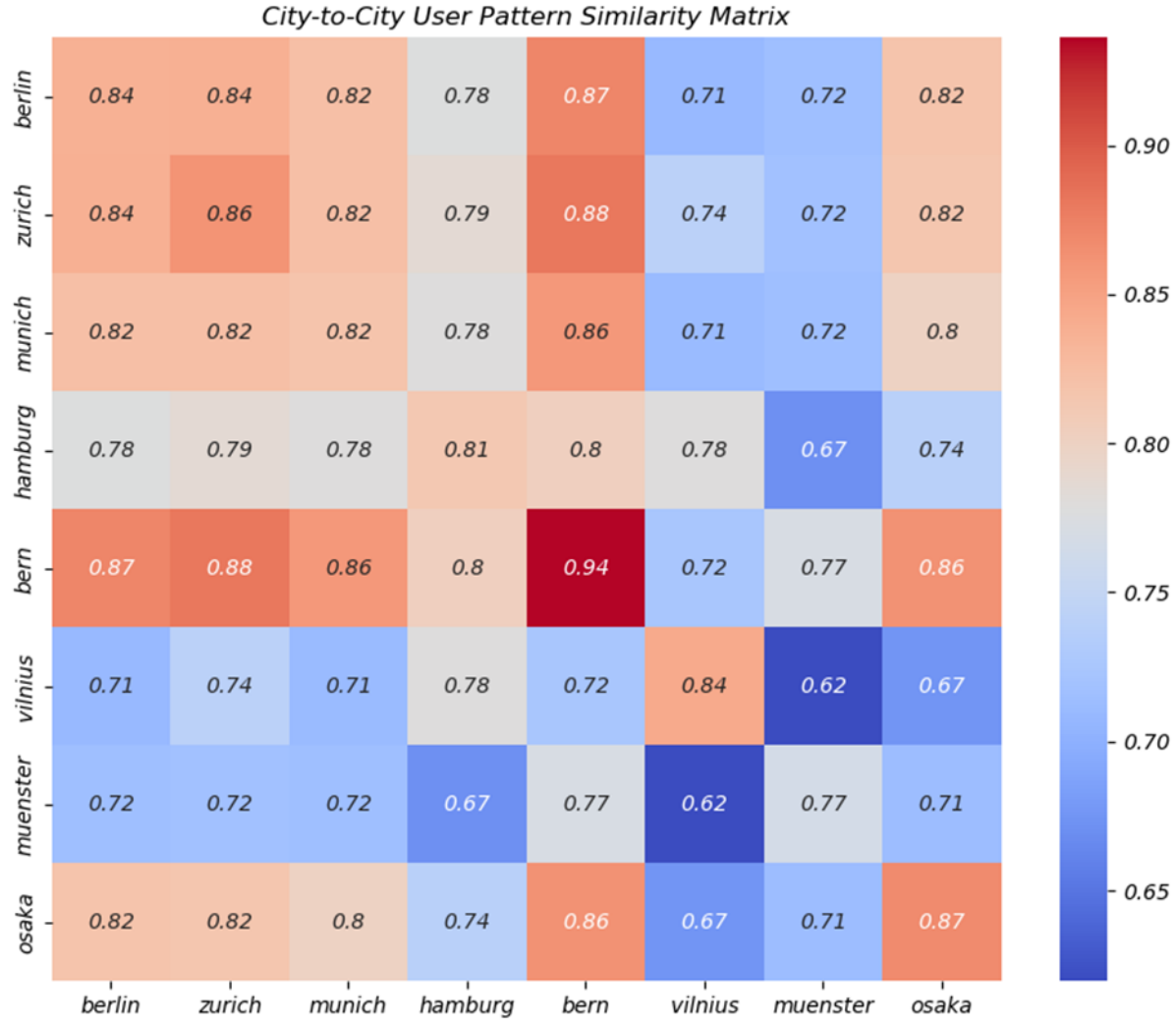

Figure 6: City-to-city similarity and differences in their urban life

Creation of Quality Public Space

The creation of inclusive urban mobility spaces that accommodate all genders, races, ethnicities, ages, and abilities remains an elusive goal, despite growing awareness. Over the 20th century, much of the public realm was converted into wide vehicle streets and parking lots. However, large-

scale infrastructure often breeds inefficiency and waste. An analysis of public space dedicated to mobility systems reveals that approximately 30-40% of street space allocated to vehicles remains unused or neglected. Moreover, about 20-25% of vehicle travel lanes are underutilized, due to overly wide or unnecessarily flared lanes. On average, roadways are occupied by vehicles for only 10% of the day, while intersections see usage just 25% of the time. These underutilized spaces are primarily found within public streets or a city's right-of-way, yet many adjacent areas deemed "essential" for vehicles are similarly underused. By applying more thoughtful engineering and design standards, communities can reclaim these spaces for green and human-centred purposes. Through creative design and collective neighbourhoods' efforts, up to 30-40% of public streets, half of private streets, and 60% of vehicle storage spaces could be repurposed. These findings highlight significant inefficiencies in traditional infrastructure development, revealing a misallocation of city funds and public resources.

Mobility Economics and Public Space as Social Business

Human activity is often overlooked in the planning of public streets. While all public streets can be designed to accommodate diverse mobility modes and create new public spaces by reclaiming underutilized or unused vehicle-dedicated areas, without a strategy to activate these spaces with engaging daily activities, even the most progressive design ideas may fail to bring life to the streets. The concept of "green (mobility) parks" addresses this issue by integrating mobility infrastructure with green and human spaces within a city's small, expansive, and interconnected public realms. These spaces will primarily come from unused or abandoned spaces described in the last section. This approach identifies six potential types of new green spaces (Large invisible mobility space, Island Parks, Mobility Parkette, Micro Parkettes, Mini Corner Space), highlighting their hidden locations, varying shapes and forms, and high-level design strategies for reclaiming these areas for public use. Figure 7 illustrates these potential spaces and the design principles that guide their transformation into vital green (mobility) spaces in urban environments.

Using the prototype and high-level concept of social business, a variety of space created through social business plat for variety to address an array for human needs. If done with careful thought, street design, planning, and policies could act as the catalyst to encourage these activities by default. "Human space" is introduced here to reflect at least six major types that touch

most of the a human's social life and culture on our streets and in our public places. All these activities need special sizes, shapes, and a few common criteria (Figure 8). This is the core idea of the human space concept, in addition to the preceding complete street approach. The idea is simple: deliberately create space to give an option for human activities rather than just adding "typical" walkable or bikeable features to "complete" our urban streets and other mobility spaces. This is not a comprehensive list of human activity; rather, it is an attempt to invoke design thoughts beyond concrete, asphalt, or the typical streetscape.

- Streets for street vendors, commerce, and economic activity. This does not support off-street retail, but rather deliberately creates flexible space beyond just for food trucks.
- Space for the social life that creates our identity through public space.
- Space for art and culture activities that preserve our heritage, on public outdoor spaces instead of hiding behind the walls of inaccessible museums or galleries, making art and culture open to every citizen at any time.
- Space for street theatre and performance to activate static and dead space with signs of human life.
- Space for street organics to bring urban food, the natural environment, and wildlife to our urban doorsteps.
- Space for knowledge, awareness, and interaction to increase our connectivity between people, neighbours, and different cultures to address our inequality and invisible divisions.

The creation of these spaces and the empowerment of local economies provide a straightforward yet effective solution to a complex array of social challenges. By utilizing circular economic principles in street and public space-related social enterprises, the generated surplus profits can be reinvested to broaden the well-being of local people. This process incrementally strengthens community resilience, better equipping neighbourhoods to address the imminent challenges posed by climate change through locally driven efforts

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Figure 7: Creation of quality green (mobility) park through reclaiming traffic spaces

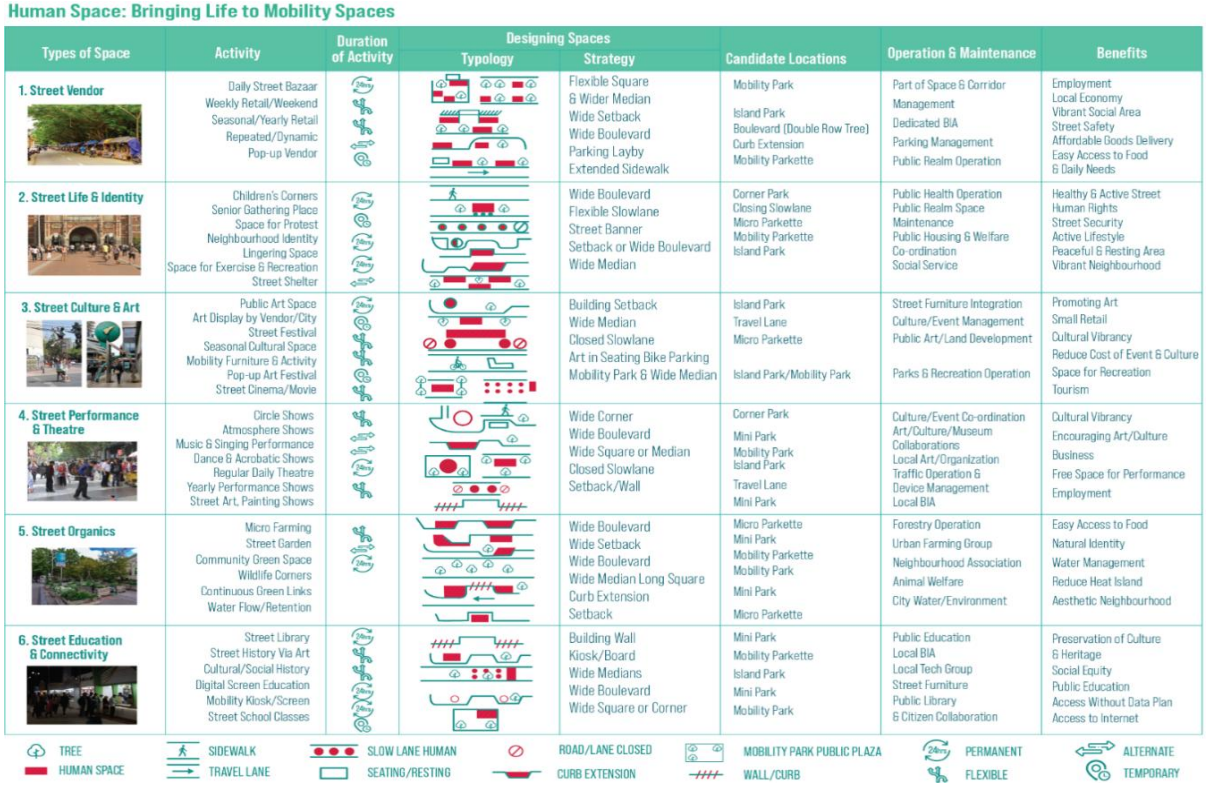

Figure 8: Creation of platform for variety of social business and entrepreneurship

Limitations

While space reclaiming and creation of quality of public spaces gain ground recent decade, alienating local or original residents through gentrification

Conclusions

Human mobility and daily activities are fundamental to the identity of Homo sapiens, with natural movement representing one of the earliest expressions of true freedom. Among all urban forms, mobility systems constitute the most extensive, dynamic, and vibrant third spaces within cities. Despite their importance, our understanding of the intricate patterns and systems underlying human movement remains limited. This paper contributes new insights into this complex yet beautiful world of urban life, revealing that the ontology of human movement is shaped by frequent small trips between short to medium-duration activities. These movements and activities influence nearly every facet of human civilization, forging intimate connections with the third space and nurturing lifelong bonds with the built environment. Such intimate interactions underpin the foundation of communal living and foster local social, cultural, and economic dimensions of urban life. The infrastructure required for the most frequent and short-distance trips typically involves smaller, more compact systems, such as walking paths, cycling lanes, and transit networks, rather than the oversized infrastructure often constructed under the false postulation that most trips are long. Similarly, short to medium-length stays are best accommodated by smaller shops and businesses located near mobility hubs and communal gathering places, rather than the sprawling shopping malls surrounded by vast, underutilized parking lots. This flawed approach to urban infrastructure and built forms has led to an immense waste of space, resources, and public funds. The paper proposes an alternative model to reclaim underutilized spaces and transform them into green, human spaces. By introducing the concept of the "mobility boundary," it emphasizes the importance of sustainable infrastructure limits to prevent the creation of unsafe zones and to avoid reaching a tipping point beyond which recovery is impossible. This concept identifies a threshold beyond which the negative effects of excessive mobility infrastructure become evident. Reclaimed spaces hold the potential to stimulate local economies by reviving small businesses, supporting street vendors, and promoting various forms of social enterprises that address the pressures of urban living. This paper proposes a prototype for social businesses in public spaces that could be further refined through ongoing research and data collection from successful case studies worldwide. It also introduces new frameworks for space management and governance, seeking to address the unscientific allocation of land currently dedicated to empty parking lots and oversized vehicle infrastructure. These

ideas are not mere utopian visions but are grounded in practical applications that have been successfully implemented in numerous cities across North America and Europe. As David Harvey might have argued, reclaiming public spaces is a critical step in challenging the exploitation of unchecked capitalism in shaping urban life.

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