urban science

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Solving Traffic Congestion through Street Renaissance: A Perspective from Dense Asian Cities

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Received: 30 December 2018; Accepted: 26 January 2019; Published: 29 January 2019

Abstract: Traffic congestion is one of the most vexing city problems and involves numerous factors which cannot be addressed without a holistic approach. Congestion cannot be narrowly tackled at the cost of a city's quality of life. Focusing on transport and land use planning, this paper examines transport policies and practices on both the supply and demand sides and finds that indirect travel demand management might be the most desirable solution to this chronic traffic ailment. The concept of absorption of traffic demand through the renaissance of streets as a way for traffic relief is introduced from two perspectives, with some examples from dense Asian urban contexts to demonstrate this. Firstly, jobs–housing balance suggests the return of production activities to residential areas and sufficient provision of diverse space/housing options to deal with work-related traffic. The second approach is to promote the street as a multi-activity destination rather than a thoroughfare to access dispersed daily needs, and to advocate more street life to diminish non-commuting traffic. Based on this, suggestions for better transport planning policies are put forward.

Keywords: travel demand management; land use pattern; low-mobility; active transport; street space; multi-activity destination; balance and adaptability; urban fabrics; Asian cities.

1. Introduction

With the increasing concentration of population and activities in cities, particularly in the automobile age, traffic congestion has become a major problem in most cities [1]. Given the negative impacts on individuals and the big economic, environmental and societal costs [2–4], major capital expenditures and countless other efforts have been put in place for tackling traffic problems [5], particularly in Chinese cities; yet little progress has been reported [6]. What is worse, the happiness of citizens and the liveability of cities have been found to be negatively associated with growing commuting time [7]. As long as the city and its population are expanding, new congestion invariably follows despite the advancement of technology or the provision of infrastructure [8]. It is logical to question then whether this vicious cycle can be broken and to ask whether there is a way out of traffic problems.

Traffic arises out of land use, a fact that has been formally acknowledged since 1954 by Mitchell and Rapkin in their publication "Urban traffic—a function of land use" [9]. Both transport and land use planning can make essential contributions to traffic relief, while at the same time improving the quality of city life. This paper focusses on the street as the dominant public space in place making—a place for consumption, production and living—and stresses its importance as a multi-activity destination, a role which is critical in traffic relief. Traffic congestion on the other hand can negatively impact the use of the street and community formation. Residents and the city alike can benefit from close proximity

between origins and destinations through reduction in travel demand and associated costs as well as changes to more sustainable modes, such as walking, biking and using public transport, which can also yield a heathier lifestyle.

This study examines the literature relating to the progress of traffic relief and investigates the root cause of congestion. It then explores the need to revive the streets as an important way to alleviate traffic congestion. The main objectives are to:

- Overview the traffic alleviation approaches within cities experiencing traffic congestion;
- Reposition the debate about traffic alleviation around the main cause of traffic congestion entrenched in inefficient land use patterns;
- Identify the role of neighbourhood streets in traffic relief through analysing the jobs-housing balance and opportunities for reviving street life using examples from Asia;
- Provide policy recommendations for linking transport and planning in order to alleviate traffic congestion, particularly in Asian cities whose dense land use patterns and limited road infrastructure are particularly vulnerable to congestion, even at low levels of car ownership.

1.1. Traffic Relief

Cities experiencing traffic congestion tend to go through four stages of alleviation efforts, each with a different focus and approach. Firstly, the attention is on the supply side with a distinct focus on capacity increases for private vehicles and less focus on expanding public transport. At stage one, the priority is primarily given to private transport infrastructure provision (especially freeways or toll-ways) and management improvement for mobility and speed, as opposed to improving accessibility. New road construction, however, only induces more car use and congestion still exists due to considerable 'latent demand' or induced traffic [10]. This is particularly true in larger, denser cities with necessarily limited road infrastructure, whose travel demands are too large and cannot be met solely with road transport focussed on private automobiles [11]. As said by many over the years, "you cannot build your way out of congestion" [5].

The recognition of the impossibility of solving congestion through expansion of road supply leads to stage two, which aims to transfer travel demand to rail or bus through heavy investment in public transport systems. This works temporarily in transferring traffic from private to public transport modes, but soon road congestion comes back as more cars are attracted to the less congested, free-flowing road conditions. Moreover, rail or bus riders often find themselves crammed in like sardines in public transport vehicles due to the expansion of travel demand on services ill-equipped to cater for such increased usage [11–13]. For example, this is the case of London's rail network where the problem of overcrowding is acknowledged and unlikely to be relieved before 2041 [14]. With growing population and per capita travel distance, the overall daily travelled distance increases dramatically, as does commuting time [15].

Since transport infrastructure supply increases alone cannot solve the traffic problem, authorities then begin to consider the demand side [16]. Stage three involves direct travel demand control with the introduction of congestion fees, car license plate auctions for the right to buy a car, as in Singapore and Shanghai (or lottery system in Beijing) or car use restrictions based on the last digit of number plates [6]. This is further aided in China with the strict Hukou (household registration) policy, soaring housing prices and the campaign of "sealing the wall and closing the street side shops" designed to remove illegal street-side shops that have sprung up in residential buildings and which create traffic. On the other hand, the policy of forcing such enterprises into shopping centres on the grounds of security, fire regulations, streetscape impacts, noise and traffic, may actually hurt the city economy due to removal of essential low-skilled labour enterprises [17]. Alone, this kind of demand suppression through car and population control does work effectively but cannot last long [5]. Additionally, it increases inequality and works against agglomeration economies [12].

Finally, stage four of traffic relief is the indirect control over travel demand through land use and transport integration (LUTI). This approach is not so commonly acknowledged, possibly because

it requires enduring efforts and authorities generally cannot wait for decades to see its effect upon traffic. Nevertheless, it is found that urban form and the built environment have substantial impacts on commuting distance and time, and that the change of land use patterns is essential to shorten the distance between origins and destinations, thereby reducing overall travel demand, particularly motorised traffic [18]. In view of "this functional isolation that denies cities as organic, living entities and sees transport as isolated patterns of origins and destinations" [8], there are now increasing efforts such as transit-oriented development (TOD), which are trying to better integrate transport and land use planning. This shifts the focus away from seeing the transport system in isolation from land use. Still, this alone is also not enough to tackle the already serious congestion problems in cities, especially considering the limited transit catchment areas in many places (particularly rail catchment areas around which most TOD is focussed) and the vast, sprawling metropolises, with their ever-growing population and soaring daily travel distances (from 1 km per person in 1900, up to 10 km per person per day by 1960 and 50 km per person per day by 2000) [15]. The root of congestion needs to be understood in order to find lasting traffic alleviation solutions.

1.2. Root Cause of Congestion and the Real Aim of Traffic Alleviation

On the surface, congestion is the problem of too many cars with insufficient roads or fast-growing numbers of commuters outpacing the provision of competitive public transport. Deep down, it is the problem of inefficient land use patterns that segregate the used-to-be close relationship between living, consumption and production space. Such spatial segregation and zoning combined with decreasing densities create huge travel demand for carrying out simple daily activities that were once achievable by short non-motorised trips on foot or bike. "Trip chaining" by public transport users whereby multiple trip purposes are achieved during a single journey (work, shopping etc.), is also more limited [19,20]. It is indeed the case that city dwellers are increasingly finding it hard to combine errands with the convenience of a single walking trip due to scattered destinations and stretched travel distances that are beyond the capability of walking or cycling [21]. Chinese cities are an example of more traffic problems arising with the increased spread of the automobile urban fabric. Such fabrics are increasing private motorised travel demand to get to and from destinations, such as shopping centres, CBD, employment areas and industrial parks, which are bigger in size, yet increasingly scattered in location.

The development of an increasing number of mega cities in China brings into sharp focus the dire consequences of disconnection between land use and transport that generates huge motorised travel demand, and which results in congestion, not just on the road, but also in the public transport systems [12,22]. Such traffic ailments may be manageable in the early stages of a city's rapid growth with simple provision of infrastructure or improvement in traffic management. In time, however, traffic increasingly gets out of control, even with the aid of congestion fee policies as well as public transport investment, simply because motorised travel demand exceeds the ability of such responses to cope with it. Sadly, it is the city's population, instead of the flawed land use pattern, that is frequently targeted as the culprit of the congestion in cities like Beijing where vehicular travel is rarely projected to stop growing and "the possibility of a lower-mobility future is not even considered" [23] (p. 866).

Generally speaking, the aim of travel is to get to some place to fulfil certain activities or more particularly, "the demand for transport is derived from the need to access employment, food and other essentials, health and education, visiting friends and family, and leisure activities and so on" [24] (p. 52). That is to say, getting somewhere is not the aim per se, but a kind of cost to overcome the spatial distance between the origin and the destination. As Lyons notes: "physical mobility concerns transcending distance" [25] (p. 6). The costs can take on many forms such as fuel, tickets or time for the individuals, infrastructure and services the government must provide, or other intangible costs which the whole society has to pay environmentally, socially as well as economically.

Given the above realities, the following questions arise. What if the distances between origins and destinations were to be greatly shortened? Can we slash or even eliminate the cost? Will there be any

traffic congestion when a considerable proportion of the motorised travel demand is dissolved and can be undertaken by foot or bike? The answer lies in physical proximity aided by virtual connectivity, with distances reduced or even eliminated. This results in less reliance on motorised transport and leads to active travel alternatives [25]. In this regard, it should be noted that without efforts in physical mobility, digital solutions alone are unlikely to produce the needed reduction in motorised transport. An additional point of relevance here is that in Singapore, Hong Kong and other Asian cities, with their preponderance of high rise residential buildings and intensively mixed land uses underneath, a significant proportion of travel is vertical in an elevator or on foot in staircases, followed by short walking trips in the vicinity of home.

Mired and unsettled in traffic congestion, we are getting distracted and gradually forgetting the real aim of urban travel—helping to live a high quality and happy life—something which was recognised as far back as Aristotle in ancient Greece [26]. Put simply, and at the risk of stating the obvious, people travel to their workplace not for the sake of the travel, whether it is slow or fast, but to get their work done and to make a living. Similarly, people driving to shopping centres or parks do so not for the journey. The real purpose is for survival and enjoyment. Hence, the ultimate target of traffic relief is not really for the faster, free-flowing movement of cars, goods or people, but for a better quality of city life. In other words, there would be no point to alleviating congestion if city dwellers are deprived of their street life through giving way to more and more cars, not to mention the alarming road traffic fatalities caused by high-mobility vehicular transport—1.25 million deaths globally with another 50 million injured annually [27].

Nevertheless, this point of creating a high quality of city life for people has been side-lined in misguided traffic policies which " . . . treat only the symptoms of an ailing transport system" [19] and are confined mostly to visible improvements in infrastructure and traffic management for the smooth flow of vehicles. This represents a car-oriented policy for the mere efficiency of vehicle movement or economic development, yet insidiously at the expense of individual health and happiness [28,29]. To put it another way, creating cities is not for cars but for people [30], as Lewis Mumford argued as far back as 1960 and as it is stated more recently in The Mayor's Transport Strategy for London, namely that it is necessary "to put people's health and quality of life at the very heart of planning the city's transport" [14]. So instead of keeping people away from the street on the basis of the safety of pedestrians or fast and efficient vehicular mobility, it is time to give back the streets to people [31]. For this reason, a street renaissance is needed to help revive civil society in which the grassroots and middle class resist the encroachment of this space from the kind of capital investment and political power which has "a large vested interest in road-based solutions to the transport problem" [19].

2. Street Renaissance and Traffic Relief

Streets have served different functions throughout the time. The revival of their role in the cities of today requires striking the right balance between jobs and housing needs, as well as seeing the street as a place of multitude of activities which build communities and a sense of place. These issues are discussed below.

2.1. Streets of Yesterday, Today and Tomorrow

Historically, human settlements invariably grow along the road or waterway where people, goods and information flow and concentrate. It is believed that the very need for saving on transaction costs generates the natural impetus of agglomeration on the road first [32]. This means that roads are not just for traffic but have become part of the economic order, being "markets" where many economic, social and political transactions take place. The further clustering of industry and population along such streets produces another order—spatial order, namely a city [32]. In essence, the multiple layers of functions on the street contribute to cost reduction in transactions by saving time, land and transport costs. The street blocks are the foundation of a city, aggregating production, consumption and living

space on top of transport functions [33], and in urban design terms, the ideal street block size for permeability by pedestrians, is 100 metres square to maximise choice of routes and ease of access.

With the advent of the car, this traditional street organisation began to vanish, giving way to automobile-based modern transportation systems, often with huge block sizes, curvilinear streets and many culs-de-sac which are antithetical to non-motorised transport. The streets revert solely to motorised movement space and with that, the withering of the street economy and street life [34,35]. Residents become increasingly car-dependent to get to work in the CBD, suburban office, business areas or industrial parks, and even shopping and leisure are increasingly out of reach by walking. A case in point is that "a 200 metre walk at 5 km/h to a corner shop for a litre of milk becomes a 5 km drive at 50 km/h to a 'big box' shopping centre" [19] (p. 8). Consequently, the bond between transport and land uses was broken and the quality of street life collapsed in many parts of cities, giving rise to traffic and that traffic then making congestion a fact of life. It is not the problem of the car itself but the low-density land use patterns, single-use zoning and hierarchical road layouts, which result in the overuse of and dependence on the car [8], or in certain instances public transport, which replaced walking and cycling at a local level to meet daily needs [1].

A street renaissance is urgently needed to bring consumption and production closely back to the living space to reduce long-distance travel demand and to increase the share of non-motorised transport modes for daily trips [36]. As such, people need safe, diverse and vibrant streets which accommodate various functions and activities. In such streets, life and work are so closely knitted, that local residents find it more efficient and convenient to walk than drive, thereby overcoming car dependence. An appropriate city fabric and streets as public space are required to provide multiple functions for consumption and production, as well as for leisure purposes so that an increasing proportion of residents neither must commute to a crammed CBD or peripheral suburban, business and industrial zones, nor be obliged to drive to shopping centres or city parks on a daily basis [37].

The following sections discuss what street renaissance is about and how it is linked to congestion alleviation. Specifically, jobs–housing balance from the street economy perspective and streets as walkable destinations are put forward to explain how these two approaches can deal with work-related and non-commuting traffic respectively.

2.2. Jobs–Housing Balance and Work-Related Commuting Traffic

As an urban planning principle, jobs–housing balance has long been adopted to tackle population and traffic congestion, dating as far back as Ebenezer Howard and the Garden City movement [38–40], yet little has been achieved so far [41]. The work of Jane Jacobs [42] on American cities also emphasised the need for urban vitality and diversity in activities, not only downtown, but also in the city districts and neighbourhoods, which can attract a wide range of jobs, services, schools, shops, restaurants, entertainment and recreation, as well as provide decent housing. One of the difficulties in achieving job–housing balance is the complexity of the co-location of work and workers. For example, Curtis and Olaru [43] find that commute time to work, and closeness to rail and facilities are considered to be factors of less importance in residents' housing choice. This is contrary to the common assumption in planning for self-sufficiency, that travel minimisation would be one of the major considerations for workers in deciding where to live. On the employment side, overly-simplifying the complex realities of firm location further makes jobs–housing balance an insufficient mechanism on its own to resolve traffic congestion, as it does not consider skills–job matching [41] or journey-to-work realities [44]. Evenly distributed employment would be at the cost of proximity to resources, such as specialised labour, complimentary firms etc. [22,41].

Despite such limitations, the balance of jobs and housing indicates the potential for traffic congestion relief, as ultimately the transport problem is related to land use [19,45]. The European case study by Hamiduddin [46] shows that the co-location of employment space and housing in a compact city model reduces work travel and encourages sustainable transport modes, such as walking and cycling. Furthermore, commuting time has been found to be influenced more by the jobs–housing

balance than socio-economic characteristics, such as income, age, gender and education [7]. It partially fulfils the policy target of self-sufficiency and provides the market with the spatial option for co-locating living and production spaces at a time when demand for proximity between home and work still exists in modern cities [47]. Although self-sufficiency may not be completely achieved, the jobs–housing balance is an important way that land-use planning can contribute towards traffic congestion relief, particularly in relation to work travel [48]. This is confirmed by Cervero and Duncan [49] who show that vehicle miles or hours travelled for work trips can be considerably reduced with abundance of jobs within four miles from home.

It is time to turn the attention to the local community and the street where jobs-housing balance, if jobs and homes are well mixed, can result in reduction in commuting distance [50] and more efficient commuting behaviour [51]. Achieving jobs–housing balance in a broader area, the whole city for instance, is naturally easier, but it does not necessarily mean reduction in commuting distance. There is, however, limited research on jobs–housing balance at the micro level, such as the neighbourhoods, while central and regional centres, industrial parks and traffic corridors have received more attention, despite being limited in numbers and offering relatively large scale, high-end or specialised employment. By comparison, the jobs–housing balance in the vast street network connected to the large number of neighbourhoods supports small-scale local employment opportunities and grassroots start-ups. The revival of the street economy with local opportunities can significantly reduce work-related commuting traffic. The major aspects of the jobs–housing balance, namely job creating and space/housing provision are presented in Table 1 and discussed below.

Table 1. Street-level jobs–housing balance.

Street-level jobs-housing balance (commuting traffic absorption and reduction)	Job creation	Creative industry/Industry 4.0 Urban agriculture Production-related services	**Street economy**
	Space/housing provision	Shops with upper-level office or housing East-west facing housing Community gardens and fresh produce sale space	

2.2.1. Job Creation

Employment has always been one of the top government priorities and society at large is believed to be quite inventive in creating jobs. In addition to services, such as retail and finance, street revival can bring to residential areas advanced manufacturing, urban agriculture and other production-related amenities, which have been largely excluded from areas where people reside.

It may be that we are used to the absence of production in residential areas and take it for granted that living and working should be naturally separated. Yet this is not the case. Historically, production activities have been an integral part of daily life in the city with artisanal manufacturing being held in individual households [52]. Alley factories in Shanghai were a typical street industry in the early 20th century, within a closely integrated residential and commercial space [53]. It was not until the 1970s that industry was segregated from residential areas because of environmental concern [52]. In this day and age with more stringent environmental regulations and the advent of smart manufacturing, Internet of Things, computerisation and digitalisation, it seems that the decentralised, computerised and interconnected industry 4.0 fits nicer within the urban fabric [54]. However, the interrelations between urban development and advanced manufacturing are yet to be properly explored and used [55]. This advanced manufacturing features small-scale distributed systems with quick-response, make-to-order modes, requiring less storage space with high dependence on modern logistics system. It demands a more educated and specialised workforce, yet without noise or pollution, which makes it possible and convenient to return to the city core and be mixed with housing [56]. An example is the high percentage (42.1%) of manufacturing departments in the core area of Tokyo [57], which indicates the competitiveness of urban-based industry against services or housing in the land or labour markets. Preserving the few industrial sites scattered in the built

areas and reintroducing clean manufacturing together with service departments and headquarters of manufacturing enterprises in the street blocks appear to be a smart strategy in creating jobs [58].

Similar to industry, agriculture is also making a comeback to the built-up area in the form of, for instance, allotment gardens in Europe and community gardens in the United States. Confronted with environmental issues and embracing sustainability, people started to consider the environmental, social and other economic benefits of urban agriculture, rather than just the sole function of food production and food security [59]. However, in China urban agriculture has been vastly neglected with most such activities being grassroots driven, scattered and fragmented, without legal protection or organisation [60]. There is an evident mismatch between enthusiasm for planting and growing on the one hand, and the space provided for urban agriculture on the other, which indicates a big demand for community gardens. Public or private open space such as parks, collective neighbourhood green areas, private backyards and balconies can be transformed into community gardens. This also means opportunities for employment in gardening and farmers' markets or stores where the local produce is sold.

The huge potential of the service sector also needs to be exploited further, as it has always been a vital part of the city, starting from traditional retail to specialised industry services. These days, the border between manufacturing and services is blurring, being reshaped by new technologies which facilitate the flow of ideas, goods and services, breeding thousands of new start-ups in fields such as social media and mobile apps, rather than the few big companies, such as Microsoft and hardware products, decades ago [56]. The innovation-driven or knowledge economy is typically occurring in crowded central cities and inner suburbs where exchanges of ideas are facilitated by closeness to other companies and surrounding supporting activities and amenities, such as cafés, restaurants and bars. This shift to dense, multi-use central urban locations is in contrast to the patterns of the past 50 years, characterised by isolated corporate campuses and research parks accessible only by cars. There is potential for local communities to attract technology companies by creating a physical environment that facilitates the growth of technology start-ups and entrepreneurial businesses within the street fabrics. These tech companies in turn not only provide technical support to traditional manufacturing and retail, but also reshape them into advanced manufacturing and commerce with technologies like the Internet of Things, Big Data and Cloud Computing.

2.2.2. Space/Housing Provision

The creation of new jobs requires the provision of various spaces for consumption, production and living. The affordability of space and the proximity between housing and shops, offices or production premises not only mean cost reduction in rent and fuel, but also less time and stamina spent on the increasingly congested roads or crowded transit by avoiding long commuting to and from work. Quite a few cities have realised the importance of affordable housing or offices and their link to boosting technological innovation. New York is a good example in transforming from a capital-driven to an innovation-driven city since the 2008 global financial crisis by launching programs, such as Incubators & Workspaces Program and Promoting Infrastructure Program [61].

It is time to reintroduce shops with upper-level office or housing space in dense streets/street blocks as they can serve as incubator place for start-up firms and businesses while contributing to traffic reduction. Traditionally, such hybrid buildings—both for work and living—have long existed not only for the benefit of lower overall rent, but also for the convenience of being able to juggle business and home duties with flexibility, including less or no commuting-related costs, time and efforts. A recent example is the scheme of AIR—Artist in Residence, in New York which encourages creative industry by allowing the artists or musicians to live in the loft [62]. Demand for mix-use buildings widely exists, which is illustrated by shops emerging from garages or housing, with living space on the top or at the back of the store. Design approaches that increase the height or width of shops will not only improve the working and living conditions but also offer more flexibility for advanced manufacturing, which may require higher ceilings for storage or operation. The return of

multifunctional buildings, together with associated regulations and designs, is essential for attracting start-ups, revitalising the street economy and reducing traffic pressure.

To improve the jobs-housing balance and reduce traffic, residential buildings should be built east-west facing on small blocks making them more affordable for housing and shops, with facades towards the street and easily seen by people passing by. Abundant provision of shops and the resulting lower rent or cost for business, help foster a vibrant street economy with less obstructive street interface, such as walls and fences. Such an improved streetscape and street vitality with an increased number of businesses encourages walking. In fact, employment density is considered a determinant of transport mode use [15].

Another merit of the east-west facing smaller affordable housing is that it can push down the house prices or rents with more stock available in the market. This is particularly relevant to slum dwellers worldwide, estimated to represent 1 billion people and 30% of the world urban population [63]. In Beijing, there is an estimated 100,000 "ant tribe" or "rat people" living in informal settlements, most of whom are low-income new migrants or underemployed college graduates, who live in windowless underground basements, buses, containers or have to share a bedroom with up to six strangers to be able to pay the rent [64]. The most important thing for them is not residing in a place with spacious rooms and ample sunshine all day long, but an affordable basic living space, particularly at night. China's current sunlight regulation which is believed to help guarantee a basic standard of living environment [65], may be a double-edged sword increasing the price of housing and requiring more space. Moreover, mixing different income households within the same residential area would benefit both the wealthy and the poor from the proximity of demand for services and labour provision, which results in a better jobs-housing balance with minimal travel demand.

As a production space for gardening enthusiasts, community gardens can also contribute to traffic reduction. They are within walking distance for local residents who do not have to rely on cars or public transport for access. As a matter of fact, on weekends an increasing number of Beijing citizens go to farms which are located far from the city and do not have good or direct access by public transport, which means a longer time spent on the road and more fuel costs for private transport [66]. An average household can also reduce its spending on food, which embeds petrol costs and long miles, while diminishing vehicular traffic linked to transport. The presence of indoor farmers' markets, street-side weekend fresh produce markets or stores catering for gardening needs is equally essential for attracting potential tenants and consumers within a short walking distance.

2.3. Multi-Activity Destination and Street Life (Life-Related Non-Commuting Traffic)

In addition to commuting, non-work related travel further worsens the traffic problem and extends peak hours. Longer travel to amenities can be more acceptable to the public in real life than that predicted by standard planning models [67]. Factors, such as public services and facilities as well as street fabric and accessibility, impact on real-life traffic, which includes travel to a wide range of destinations. The New Urbanism agenda aims to create a compact and diverse city and pedestrian-friendly streets to encourage walking and reduce car use through the development of traditional neighbourhoods and TODs [68]. Such an approach is working to some extent, resulting in increased walking trips for the purpose of leisure as in the case of Perth's Liveable Neighbourhood practice adopted as part of the New Urbanism [69]. Notwithstanding this, the daily vehicle miles travelled (VMT) by residents barely change due to the lack of walkable destinations, such as corner shops, delis or other services, despite the better network connectivity [69].

To address the traffic issue, we need to rethink the street as a destination where most daily requirements could be satisfied on foot without the need to drive around. Historically, the walking cities—5 to 8 km across, dense and compact with highly mixed land use—first emerged [70]. All destinations are available within about half an hour, by walking at 5 km/h. In transit (public transport) cities, which have grown along rail corridors and stations, most of daily needs can still be satisfied within walking distance or by rail and walking combined. Most destinations in these two

kinds of cities are within the 60–70 min of a daily travel budget [71]. However, this travel-time budget is out of control in an automobile city that is sparse and sprawling with segregated land uses [72]. The destinations are scattered in a bigger city—50 km across, where residents have to rely on private cars or public transport to achieve high enough speeds to maintain any semblance or a normal travel time budget.

In fact, the street is becoming less attractive for pedestrians, mostly due to the lack of walkable destinations, which leads to car dependence for daily needs to and from big box shopping centres or parks, often scattered outside of neighbourhoods and out of reach by walking. The street, with its declining streetscape, is increasingly regarded as an unsafe boring passage filled with fast-moving vehicles, toxic fumes and noise, connecting home to various destinations for specific and separate purposes, such as working, shopping or leisure. We are gradually forgetting that the street used to be the dominant form of public space in daily life [33] where the locals satisfy their necessities, go for business, meet people and participate in activities and events. The street was also an extension of the private family space for raising children, spending time and getting old. Essentially, the limited number of destinations along the now less attractive streets results in inactive street life that highly promotes and depends on motorised transport modes. A way to revert back to making streets alive, safe and attractive is to create destinations where people want to be. This needs to be done within a supportive environment that encourages the street economy and street life by balancing the urban fabrics and the travel time. These are discussed below.

2.3.1. Destination Creation

There are different ways to make the street an attractive walkable destination where everyone can find something that appeals to them. Three of them are presented here, namely making the street a place for shopping and recreation, a place where one can find public services and facilities, and finally, offering space for business incubators and work.

Shopping and recreation: Amenities are an important factor in creating excess traffic [48] and contributing to congestion. Shopping centres, superstores and hypermarkets separate the customers and producers; they are unsustainable not only in promoting car dependence but are also hurting the local economy. Bringing consumption and production close together can help restore feedback loops [36] through components, such as the neighbourhood centre. In addition to a few local shops, such as a grocery store, supermarket, deli or local general store, there is also need for 'click-and-mortar' stores that have both a local presence and online shopping capability. Farmers' markets or mum-and-baby shops, for example, which target specific circles and have online shopping as well as physical retail outlets, are gaining popularity as attractors for both shopping and recreation. Additionally, small restaurants and food stalls help foster a vibrant street environment and create a sense of community by providing meal options throughout the day and midnight snacks—something quite common in China.

The linear street is supposed to be the fundamental public space, connecting dotted parks, plazas and squares and featuring slow movement with shops or parks adjacent. Living close to a green space is more important than its size for the people who use it [3]. Such leisure space allows for acquaintances and friendships to develop, attracting a variety of people for varied reasons at various times. It is the foundation for civil society. Thanks to traffic calming, visibility from the street and proximity to housing, pedestrians do not have to be constantly vigilant about fast-moving vehicles, be worried about personal safety or be anxious about catching the last bus at night.

Public services and facilities: In addition to shopping and leisure, there is a multitude of other amenities that also attract the locals. Their size can be adjusted to the local neighbourhood. Schools in Beijing, for example, not only disproportionately cluster in the inner city [22], but are also bigger in size with larger catchment areas than their counterparts in Tokyo (see Table 2) [6]. They attract around 10% of the weekday traffic volume created by private cars which pick up or set down primary school children. The same goes for other public facilities in Beijing, including hospitals, libraries

and governmental services, which are so scarcely distributed in the newly developed areas that residents have to flock to downtown to use such amenities [73]. This again generates additional traffic and congestion.

Table 2. Comparison of school catchment areas in Beijing and Tokyo.

City	Catchment Area (Year 2011)		
	Primary School	**Senior High School**	**College**
Beijing	14.86 km^2	56.78 km^2	184.39 km^2
Tokyo	1.67 km^2	5.03 km^2	11.70 km^2

Source: [6].

Incubators and workspaces: In an age of mass innovation, it is time for a street renaissance to motivate individual innovators to actively participate in the burgeoning new economy that values face-to-face interaction, supporting activities and amenities. If we rely only on a few and isolated spots such as universities or technology parks, which have limited numbers of research and support staff, it would be difficult for many cities to embrace the innovation-driven growth model. Perth, Western Australia is a typical example—the city experiences the pain to transform its mining mono-economy and one-dimensional service-based economy, partly due to the limited walkable street space. In other words, Perth needs to change its current land use pattern that features car-dependence, mono use and lack of activities. Instead, it needs a people-oriented street network which accommodates various functions rather than transport only, to provide space for technology and advanced manufacturing sectors to flourish. Given the burgeoning of the sharing economy, the street, with its low business cost, has become the ideal place for trial and error. Apart from numerous makerspaces, micro social space or even lab space can thrive on the street. Other options include co-working spaces and low rent apartments as in place in New York to attract tech start-ups by bringing down the rent for offices and housing, as well as the fuel costs and time through a better jobs–housing balance which reduces the need to drive [61].

2.3.2. Balancing

Creating street destinations requires support from all stakeholders, particularly from transport and planning in the first place to change the existing travel patterns. Table 3 describes the land use factors which can affect travel behaviours.

Table 3. Land use impacts on travel.

Factor	Definition	Travel Impacts
Density	People or jobs per unit of land area (acre or hectare)	Reduces vehicle ownership and travel, and increases use of alternative modes. A 10% increase typically reduces vehicle miles travelled (VMT) 0.5–1% as an isolated factor, and 1–4% including associated factors (regional accessibility, mix use, etc.).
Mix	Proximity between different land uses (housing, commercial, institutional)	Tends to reduce vehicle travel and increase use of alternative modes, particularly walking. Mixed-use areas typically have 5–15% less vehicle travel.
Network connectivity	Degree that walkways and roads are connected	Increased roadway connectivity can reduce vehicle travel and improved walkway connectivity increases non-motorised travel.
Roadway design	Scale, design and management of streets	Multi-modal streets increase the use of alternative modes. Traffic calming reduces VMT and increases non-motorised travel.
Active transport (walking and cycling) conditions	Quantity, quality and security of sidewalks, crosswalks, paths and bike lanes	Improved walking and cycling conditions tend to increase non-motorised travel and reduce automobile travel. Residents of more walkable communities typically walk 2–4 times more and drive 5–15% less than those in more automobile-dependent areas.
Transit quality and accessibility	Quality of transit service and access from transit to destinations	Increases ridership and reduces automobile trips. Residents of transit-oriented neighbourhoods tend to own 10–30% fewer vehicles, drive 10–30% fewer miles, and use alternative modes 2–10 times more than in automobile-oriented areas.

Source: [74].

The impact of each land use factor on travel is limited and varies; there may even be conflict between different factors. It is the cumulative and synergistic effect that matters for traffic reduction [74]. As with the theory of yin and yang, there are contradicting or opposite forces in any system which cannot be eliminated, yet can be transformed [75] in order to strike the jobs–housing balance. In the light of this ancient Chinese philosophy, it can be interpreted that the traffic ailment stems from losing balances in the city system, such as the balance between different urban fabrics and the corresponding travel-time budget. Therefore, the idea of a balanced and adaptive street is indispensable in the revival of the street as a walkable destination offering a wide range of attractions.

Balance of urban fabrics: According to the theory of urban fabrics [35] (p. 445), "cities should be identified as a combination of three overlapping fabrics" based on their transport systems and the universal travel-time budget. These three fabrics are walking, transit and automobile-based [70]. Historically, there are widespread urban fabrics that value accessibility in both walking and transit cities, linking homes, jobs and key facilities within acceptable distance on foot, by bike or public transport [69,70]. However, with the advent of cars, it is mobility not accessibility that is playing a more important role in the organisation of economic activity and social life in the city. This freedom of movement not only spurs suburban sprawl but also reshapes the traditional walking and transit fabrics with automobile fabrics. The motorised high mobility, combined with less constraints on the closer spatial distances, comes at the cost of traffic congestion, time lost in travel, fuel related costs and deeply affects the intimate relations between where people live, work, shop and entertain. Reviving the walking and transit city fabrics is suggested by Newman et al. [35] for their great value in facilitating the knowledge economy as well as easing the traffic. This is supported by the growing trend of big tech companies setting up branches in city centres to follow the new creative class of employees who are attracted by the quality of life offered there. Although the extensive car-based urban fabric is unlikely to disappear, it needs to be reshaped for the growing demand for walking and transit fabrics [35].

The balance of the urban fabrics involves keeping various equilibriums, and balancing block sizes or the road network is an integral part of it. Dense streets and small blocks have been widely considered as a typical feature of the walking and transit fabrics. The small-block network has a better traffic efficiency than the supper-blocks based urban grid [76]. In Beijing, the streets are characterised by a "half street economy" as they are segregated by wide roads, traffic fences and heavy traffic flow. This is in contrast to the dense and narrow street network in Tokyo where both the local shops and residents benefit from traffic calming and easy pedestrian crossings (see Table 4). In response to the negative aspects of the wide and sparse streets, a national policy of transitioning from big gated communities towards small open blocks was issued in China [77]. The comeback of fabrics with dense streets and small blocks can be seen in the planning of the Nanjing Honghua airport area redevelopment, not just for traffic relief but for other benefits as well [34]. Evidence from Ningbo city also supports this evolving trend of block size—from traditional small blocks (2 hectares average) in the old city centre to large surrounding communities (of 15 hectares) built around the year 2000, to again the current small sizes (of 2 hectares) under construction in the core area of the Eastern New Town [78].

Table 4. Comparison of road network between Beijing and Tokyo.

City	Road Area Ratio	Density of Road Network	Curb to Curb Width
Beijing	7.11%	4.85 km/km^2	14.64 m
Tokyo	18.75%	19.04 km/km^2	4.2 m (national)

Source: [6].

Balancing the urban fabrics is also associated with a balance of street uses to deal with tensions arising from demand for the finite street space [79,80]. The urban street should first be a public domain a meeting, liveable and lively place, and then a space for commerce, with mobility to support it. After all, "it is accessibility not mobility that is at the heart of economic and social welfare" [81] (p. 105). Furthermore, the balance of the formal and informal should not be neglected, as these two aspects

not only compete but also complement each other in the street space, both spatially and temporally. The informalities involve informal transport that can be used for daily travel purposes, informal housing to accommodate the vast number of slum dwellers, "ant tribe," "rat people" and opportunity youths, as well as the informal economy to create jobs [82]. Cervero [83] points out that the integration of transport and land use should be pro-poor, which means inclusive use of the street for all people. It also means an adaptive and flexible street that can be used for a variety of purposes at different times.

Balance of travel time: According to Marchetti [71], the mean travel time per resident in the city is around one hour per day (60–70 min). This universal travel-time budget further explains that the number of out-of-home trips within the one hour travel time is generally fixed on a daily basis [84,85]. Given that every car passenger presently spends as high as 50 min daily in the car [25], which not only results in traffic congestion, but also poses health and social problems with less time budget and stamina left to support an active lifestyle, it is justifiable to turn this around with more time spent in active transportation, outdoor physical or social activities. Though the overall travel time budget cannot possibly be changed, it is better to optimise its composition through a rebalance of the three urban fabrics. The walking and transit fabrics are associated with a more active lifestyle and help reduce traffic congestion as well as improve public health and quality of life [86]. Similarly, Frank et al. [87] find a positive association between walkability and time spent in active transport with a corresponding reduction in VMT. What is also worth mentioning is that slower travel speeds do not necessarily mean more time used for travelling due to the shorter trip distances required within a concentration of destinations [88], which also justifies the efficiency and value of living a slow and simple life in terms of wise spending of the travel budget.

In essence, balancing travel time is more about the balance of passive and active transport modes or lifestyles. It results from the need to maximise people's free time through creating efficient spatial-functional structures around the street [30]. With the phenomenon of peak car use, Newman et al. [35] advocate for a new town planning that is no longer car-dependent and can be extended to car-based suburbs. According to The Mayor's Transport Strategy for London, by 2041 all Londoners will be doing at least 20 min of active travel a day and walking will be prioritised, particularly around schools [14]. The concept of 20-min neighbourhoods is also introduced in the Plan Melbourne 2017–2050, which is about living locally with the support of active transport options [89,90]. Table 5 summarises the opportunities for making streets walkable destinations.

Table 5. Streets as walkable destinations.

Streets as walkable destinations	Destination creation	Shopping and recreation Public services and facilities Incubator and workspace	**Street life**
	Balancing	Balance of urban fabrics Balance of travel time budget	

3. Policy Recommendations

In order to reduce traffic congestion, further efforts which link together transport policy and land use planning are required. Many developers are reluctant to engage in mixed-use schemes, which include provision of commercial and housing space, because of a perception of risk and complexity, especially within the same building complex. These two areas of transport and land use planning need to come together in an innovative way that allows for the street to re-emerge as the main public space and a focus of the new economy. It builds on a new holistic approach combined with planning flexibility, which are discussed below. This will reduce the perception of risk, making mixed use and co-location of jobs and housing the standard within the new revived street economy and diminishing the need to travel. With the emphasis on mixed land uses since the 1990s as a way of managing travel demand and making neighbourhoods livelier, there are now architectural approaches to buildings that minimise any conflict between residential and other functions [91] and also planning solutions that

achieve efficient mixing of uses by the placement of different use buildings within a diverse urban milieu [92].

3.1. Holistic Approach and Multiple Lasting Efforts

A holistic approach is needed to deal with traffic congestion as it involves numerous factors and complexities [72]. First of all, continuous efforts are required in providing accessibility to deal with the expanding city population and per capita travel distance. Though we have experienced peak car use and are seeing its decoupling from GDP growth [72], the aim is to overcome automobile dependence rather than eliminate car use. With its comparative advantages over other transport modes, the car will still hold its niche and play a specific role in supporting economic growth and facilitating quality of life [6]. This is in line with the fourth era of travel [11] in which road, rail, slow modes and air will continue to satisfy our transport needs. What should be avoided is the practice of transit adjacent development (TAD) which further contributes to the overuse of vehicles [93].

Secondly, there is still opportunity to use congestion pricing to construct mass transit, particularly in Asian cities with high-density urban form and low per capita road availability [10]. In addition, car restriction policies can positively impact people's choices between public and private transport modes. For example, Pan et al. [94] found that TOD alone does not effectively contribute to reduction in car ownership and travel unless vehicle use restriction is in place. Further, we should avoid the failure for land use to leverage the benefits of proximity to fixed-line transit by only targeting the performance of the transport network [95]. This is the case in Perth where the primary objective of the railway is to compete with the car for patronage, which results in many railway stations surrounded by large park-and-ride sites with little consideration of walkability, health, environmental benefits, employment and economic development [93–95]. Instead, the overall benefits from integration between land use and different transport modes needs to be maximised [96,97].

Thirdly, more attention to long-term solutions related to indirect travel demand management is needed to reduce VMT by encouraging active transport, such as walking and cycling, as road and public transport provision or restraint of private vehicles are not enough to solve the traffic problems [6]. Travel demand management can be tackled through measures which encourage voluntary reduction but also through pricing, including fees and fines, and better technological solutions. Voluntary demand reduction through changes in land use and transport patterns would be far more effective than treating an ailing transport system, as an ounce of prevention is worth a pound of cure. The demolition of the Chenoggye freeway in Seoul, South Korea is an excellent case that demonstrates the fact that traffic can dissolve or disappear by simply taking roads away. Therefore, the renaissance of the street with a better jobs–housing balance and revitalisation of the street life, though time-consuming, could be a lasting cure to the current traffic problems. They can bring the travel origins and destinations closer, thus reducing motorised travel demand and encourage walking and cycling for utilitarian purposes [29].

In residential neighbourhoods in the Asian dense cities, as in most other parts of the world, streets are owned by the public [98]. They are part of the commons and with traffic congestion, particularly at peak hours, become the equivalent to a scarce commodity because of too much demand. The introduction of a congestion fee could be seen as a fine for the use of the publicly owned space in a way that denies others access to it. This can financially control travel demand, especially by private cars.

Intelligent transport systems (ITS) and particularly, cooperative ITS which combine "interactions between vehicles, roadside infrastructure, mobile devices and back-office systems" [99] (p. 18), are rapidly being developed and implemented. They are an area of application of artificial intelligence based on real-time data integrated with machine learning [100]. Such systems are helping with raising safety, reducing waiting and travel time for vehicles as well as any associated emissions and pollution. Similar expectations are accompanying the development of autonomous vehicles [101]. However, ultimately the goal of such technological traffic/engineering solutions is to facilitate mechanised

movement rather than contribute to place making and improved sense of community. Although initially these technological solutions may help in managing travel demand, the more successful they become, the more likely they are to maintain or increase rather than diminish the need for travel. It is hence important to look for and implement policies which have lasting effects in reducing traffic congestion. Jacobs [42] emphasised this need in her seminal work when she pre-figured the development of traffic calming approaches and street renaissance to solving the problems of cars in cities. She stated [42] (p. 363):

"Attrition of automobiles operates by making conditions *less* convenient for cars. Attrition as a steady, gradual process would steadily decrease the numbers of persons using private automobiles in a city . . . attrition of automobiles by cities is probably the only means by which absolute numbers of vehicles can be cut down . . . Tactics are suitable which give room to other necessary and desired city uses that happen to be in competition with automobile traffic needs."

Fourthly, traffic policy and land use planning are "rarely simply technocractic exercises" [10] (p. 1). They are linked to market mechanisms and technology development. With distribution of housing and jobs decided by the market [48], it is wise to create more choice for citizens and firms in deciding about location and transport mode selection. An example is the China-Singapore Economic Corporation Zone in Suzhou Industrial Park which, although planned with jobs-housing balance from the start, still has a serious home–work separation due to the mismatch between housing and job markets during the development and construction stages [38]. Various barriers or incentives can be removed or created for the market to play its role in alleviating traffic congestion. For instance, availability of affordable housing adjacent to the workplace together with a tax reform on property stamp duty might facilitate better movement of residents following ever-changing employment opportunities by providing options and reducing costs in moving house, which is likely to reduce the need to drive.

Technical progress is always a major driving force behind city growth, but technology alone can neither resolve the traffic congestion nor replace people's need for interaction. For example, the lower-cost, on-demand transport-as-a-service (TaaS) is expected to significantly improve the mobility and efficiency of the physical transport system [102]. However, the savings in road capacity and parking space resulting from abandoning car ownership are likely to be compromised by the projected increase in demand for motorised travel. Similarly, telecommuting also has impact on traffic, but its effectiveness in shaping the type and level of traffic in the cities is not clear because of the two opposing trends—centralising and decentralising—it produces [103]. Technology can bring hope, yet can also create dilemmas as is the case of automobile technology which provides high mobility but also congestion. So, instead of hoping that technologies such as autonomous electric vehicles (A-EVs) will ease traffic, non-technological approaches which improve land use patterns can reduce the negative externalities of car use.

Last and not least, as an approach to traffic alleviation, the renaissance of street hinges on reforming a series of laws and regulations in a number of fields, such as housing, transport and environmental protection, in order to provide living, production and consumption space that is nearby, diverse and affordable. Such amendments are invariably associated with political, cultural and psychological elements as is the case with advanced manufacturing which is cleaner and quieter, yet still not acceptable enough for the general public to allow it to return in the residential neighbourhoods [104]. Another barrier that needs to be overcome in the case of China relates to sunlight and fire regulations because of concerns for safety and fairness in respect to east-west facing housing and hybrid buildings.

3.2. Transport and Planning—a Visionary Debate and Flexible Decision Process

It is increasingly realised that a flexible, experimental approach is necessary in modern planning practice to deal with complexity and uncertainty [79]. Cities are a complex chaotic system and understanding and predicting traffic may be well beyond our grasp [105–107]. Hence "planning has to move from a prescriptive activity to a process of learning and adaption" [108] (pp. 29–30).

First of all, people need to rethink modern transport and planning which are largely based on functionalism or rationality. They regard cities as a living machine that can be simplified as an assembly of parts or a series of orders [106]. A lesson that people have learned is the unexpected large amount of traffic volume derived from an "orderly" city form created by segregating land uses for specific purposes—residence, transport, employment and leisure, the four fundamental city functions [107]. Modern people need to learn from ancient towns which were modelled as complex adaptive systems where the various components, particularly human inhabitants, constantly interacted, learned and adapted [106,109]. These naturally grown towns or cities evolved through actions by individuals and local communities rather than via step-by-step implementation of blueprints and top-down planning by a few representatives of the elite [110]. In other words, noisy and untidy cities may not be as dysfunctional as often assumed and some diversity in land use and transport can make them more resilient with more capacity and options to cope with unexpected natural or human-made disasters [111].

Secondly, a new combined transport and planning strategy is needed which should be incremental and locally based. As in a chaotic system, though long-term prediction is logically impossible, it is predictable for short periods because of sensitivity to the initial conditions [105]. That means that people should shift their attention to the neighbourhood and at the street level with the participation and support of the local community. Different functions and activities will be mixed well and constantly adapted within a certain degree of spatial entropy or chaos, yet still featuring self-similarity and scale invariance—fractal structures commonly seen in nature and ancient towns [110,112]. In other words, due to the inherent complexity and adaptability of humans and their varied perception about congestion and happiness [113,114], it is time to think of travel demand management under the shared vision of local residents to incorporate assumptions and weighted values that favour active and healthy living [115] and sustainable transport modes and match transport demand to the supply of infrastructure [116]. The impacts of vertical mobility also need to be considered, particularly for the dense Asian cities [117].

Lastly, a commitment to travel demand management is required to remove many built-in incentives for car use as noted by Cervero [83], and this cannot be done without political and community engagement to disrupt existing practices, policies and trends [116,118]. Without an overthrow of the conventional traffic regulations, it is unlikely we will see approvals for reduced number of lanes and vehicle speed in neighbourhoods, simply because of expected changes in travel behaviour resulting from improved land use associated with increase in active transport and decrease in the demand for cars and road space. Thus, a new approach to transport planning based on a visionary "debate and decide" is suggested by Kenworthy [19,119] to replace the "predict and provide", computer-driven process employed in the conventional transport-land use planning models. It is increasingly realised that these models are unable to simulate latent or induced demand and undercount shorter trips [74], which are mostly non-motorised, almost with no consideration of complex factors, such as a place's history, heritage, tradition, culture, economy and political conditions, and using simply distance or proximity to work [7,44].

4. Conclusions

This study outlines the different approaches used to alleviate traffic congestion in cities ranging from increased traffic capacity through provision of extra roads and public transport, to control of traffic demand through congestion fees and restrictions on vehicle licence plates, and to indirect control through integration of land use and transport. It finds that alleviating congestion requires reducing demand for vehicular transport and encouraging active transport modes by bringing the travel origin and destination closer to each other through integrating land use and transport planning. The root cause of congestion lies in the inability of the transport system to handle the ever-increasing motorised travel demand derived from inefficient land use patterns that segregate uses and lengthen travel distances.

Physical proximity together with virtual connectivity is believed to be able to overcome the high cost of spatial distance resulting from such dispersed destinations. Thus, the street can play a significant role in reducing vehicle use by becoming a place for living, work and leisure. This can help revive street life and make residential neighbourhood streets attractive multi-activities places which strike the right balance between offering local jobs and diverse space/housing options. Production activities can return to residential areas and streets will no longer be seen just as a thoroughfare to somewhere else. More street life will diminish the need for non-commuting traffic to dispersed daily needs. Instead streets and neighbourhoods will provide opportunities for sustainable living and place making.

Achieving congestion alleviation through linking land use and transport is a complex task given the history of urban development in auto-dependent countries such as Australia and the USA. However, it is less of an issue in dense Asian urban contexts, which have a long history of very compact, mixed land uses, though these have been under increasing threat in recent years from auto-based planning. Traffic reduction requires a holistic approach and consistent efforts within transport policy and beyond, not only because of the complexity of the city system but also because of the unpredictability and uncertainty of its inhabitants. This means establishing a balance between the three city fabrics—walking, transit and automobile-dependent—and a redistribution of the travel time budget with the preferred vision of low-mobility and active lifestyle. That is to say, instead of simply pursuing efficiency in the transport system, traffic amelioration ought to be by the people, of the people, for the people taking into account the place's history, cultural, economic and political circumstances and using new visionary methods that allow for deliberative, productive debates and flexible decision making. Such a new holistic approach to solving traffic congestion through the revival of the streets should be underpinned by localised democratic principles, promoting the well-being of the city inhabitants.

Author Contributions: Conceptualisation, L.W., J.K., X.G. and D.M.; Methodology, L.W., J.K., X.G. and D.M.; Formal Analysis, L.W., J.K., X.G. and D.M.; Investigation, L.W., J.K., X.G. and D.M.; Resources, L.W., J.K., X.G. and D.M.; Writing—Original Draft Preparation, L.W., J.K., X.G. and D.M.; Writing—Review & Editing, L.W., J.K., X.G. and D.M.

Funding: This research received no external funding.

Acknowledgments: The authors acknowledge the contribution of an Australian Government Research Training Program Scholarship in supporting this research.

Conflicts of Interest: The authors declare no conflict of interest.

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