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WALKABILITY OF CHINESE CITIES

EVALUATING LIVE-WORK-PLAY CENTERS

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NATURAL RESOURCES DEFENSE COUNCIL
SCHOOL OF ARCHITECTURE, TSINGHUA UNIVERSITY

ABOUT NATURAL RESOURCES DEFENSE COUNCIL

The Natural Resources Defense Council (NRDC) is an international nonprofit environmental organization with more than 3 million members and online supporters. NRDC works to safeguard the earth—its people, its plants and animals, and the natural systems on which all life depends. Since 1970, our environmental lawyers, scientists, and experts have worked across the globe to ensure the rights of all people to clean air, clean water, and healthy communities. We use scientific, economic, and policy expertise to spearhead comprehensive environmental improvement with a broad range of local partners in Asia, Europe, Latin America, and North America.

ABOUT SCHOOL OF ARCHITECTURE, TSINGHUA UNIVERSITY

The Department of Architecture of Tsinghua University was established by the renowned architectural scholar Liang Sicheng in Oct. 1946 and transferred to School of Architecture, in 1988, comprised of the Department of Architecture and the Department of Urban Planning.

Tsinghua School of Architecture has been maintaining the distinctive features and advantages in the aspects of personnel training, scientific research, theoretical innovation, creative practice and international exchanges. As the key discipline of the University during the implementation of the national projects of "211" and "985", architecture subject of the School was ranked the first in all the previous national subject assessment.

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FOREWORD

The edition you hold in your hands marks the latest in the Natural Resources Defense Council China Program's Sustainable Cities research project on non-motorized transportation. In August 2014, we published our first city walkability report and became the first institution in China to evaluate urban walkability. The report used statistical data, publicly available information from local policies and Google satellite imagery to assess the walkability of downtown areas in 35 first- and second-tier cities. Our study evaluated the walkability of 35 Chinese cities from 4 dimensions: safety, comfort, accessibility, and management. Hong Kong, Shenzhen, and Shanghai were ranked the top three most walking-friendly cities in the country at the time.

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Our second report released in June 2016 conducted further analysis on 17 second- and third-tier cities mainly in central and western provinces. It utilized the same methodology as the previous evaluation but also introduced five notable case studies on street improvement initiatives. Coupled with the 35 cities from the first report, the total number of cities covered reached 52, presenting us with findings of a wide and diverse distribution of Chinese cities. The second report found that the walkability scores of smaller cities were generally low.

In the third walkability report in 2018, we partnered with Professor Long Ying of Tsinghua University's School of Architecture and Beijing City Lab to examine walkability using a new index of measurement: the vitality score. The vitality score was calculated by using the number and variety of daily service facilities along streets, such as stores, restaurants, and schools. These are also referred to as points of interest (POI). The report evaluated 769,407 streets in 287 cities at the prefecture level and above. Results showed that 95% of the evaluated cities had an average score of 60 or above. 31 of the 36 total provincial capitals, sub-provincial cities, and municipalities scored 70 or above, with Xiamen ranking the highest at 83.3. The data enabled us make recommendations to improve the street vitality of respective neighborhoods and streets based on POI.

Although the third walkability report has made some improvement on the methodology and covered a large number of streets, we realized that the walkability of cities is much more than just an indicator of street function reflected by "points of interest". Therefore, for the fourth report, we continue to work with Professor Long Ying's team at Tsinghua University and add a layer of assessment of the street infrastructure, such as street furniture, pedestrian crosswalks, bike lanes, etc., which we refer to as the built environment.

INTRODUCTION

China's rate of urbanization is on a fast track with over 10 million rural people becoming urban residents every year. Today, over 58% of the total population reside in urban areas, surpassing the world average of 55.21%[1]. It is estimated that by 2030, the total urban population of China alone may reach 1 billion people.[2] While urbanization has ushered in opportunities for economic development, it has also brought many new challenges. Urban development to accommodate for rapid population growth has led to increased rates of vehicle-dominated land use, urban sprawl, air pollution, traffic congestion, and consumption and dependency on non-renewable resources. As these trends continue, the share of carbon emissions from China's urban transportation sector will consistently grow. In order to meet global commitments of capping carbon emissions, city management and planning need to embrace more sustainable forms of urban development, and urbanites must adopt greener lifestyle choices.

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Walking and cycling thus play an important role in reducing greenhouse gas (GHG) emissions in daily urban life. Today, the mobility of the Chinese urban resident finds itself at odds with the motorization of transport in cities as pedestrians and vehicles compete for space. This phenomenon is aggravated by the continuous expansion in length and width of roads, further encouraging vehicle-use. As car-dependency grows and vehicles encroach on pedestrian public spaces, fewer errands can be accomplished by foot. In many places, walking has even become troublesome to the average urban resident, forcing an ability we generally take for granted to take a backseat as a minor form of transport.

Walkability refers to the measurement that a space is comfortable, safe, accessible, and pleasant for pedestrian usage, or "walking-friendly". It is one of the most important indicators of a livable city. The integration of walkable spaces into transport systems optimizes land use, decreases urban sprawl, congestion, and emissions, and reclaims public spaces for the people. Moreover, shifting away from car-dependency and toward walking can enhance urban resilience by promoting more sustainable, healthy behaviors with essentially non-existent emissions. Walkable cities contribute to further successful urban development; integrated spaces generate more pedestrian traffic in critical economic hubs, stimulate city competitiveness, and even provide new opportunities to enhance cultural preservation efforts. In Beijing, for example, the hutong pedestrianization program aims to increase pedestrian traffic and economic activity in ancient, narrow alley neighborhoods in congruence with restoration initiatives.

We aim to revive walking as a preferred mode of transportation, create walking and biking friendly communities, reduce the need for driving, and promote the utilization of public transportation. To sustain this type of lifestyle, it is necessary to plan a high-quality pedestrian transportation network that both provides easy access to public transportation and encourages people to walk. In the fourth iteration of NRDC's walkability report, we evaluate the current state of the built street environment to help us understand how infrastructures and facilities can reflect a sense of belonging, comfort, safety, and accessibility for pedestrians. We conducted a virtual built environment audit using street view images that specifically measured the performance of streets in Live-Work-Play Centers. We evaluated these streets using nine pedestrian-centered built environment indicators, the likes of which include street crossing facilities and trees. Built environments are conducive to small, low-cost interventions; thus, once identified, new designs and a change in street management can have almost immediate impact on pedestrians.

Although this report is another advancement in the evaluation methods of walkability, the indicators we currently use still cannot cover all aspects of street walkability. We look forward to more comprehensive studies, continued interdisciplinary collaboration, and new perspectives on walkability in all sectors. We also hope that our continuous effort to promote walkability will trigger more discussions and thoughts on non-motorized transport, so as to build sustainable and livable cities.

1

RECENT POLCIES AND RESEARCH TO PROMOTE WALKABIITY

Since the release of our third walkability report last year, various sectors have made progress promoting non-motorized transportation in Chinese cities. Government at all levels have begun to recognize the positive relationship between environmental health and walkability. Academic researches and social initiatives have both made significant improvements on evaluating pedestrian streets. Private sectors aim to make cities more walkable by launching innovative initiatives. The fourth iteration of NRDC's "Evaluating the Walkability of Chinese Cities" report begins with a preliminary overview that summarizes recent incentives, policies, research, and programs introduced by various levels of Chinese government, academic researchers, and corporations that aim to contribute to improving urban walkability.

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1.1 Increasing emphasis on non-motorized transport in public policies

High-density population and rapid motorization of transport in China have made traffic noises and air pollution even more readily-apparent in cities, posing immediate challenges to the walking in the urban environment. However, at the same time, recent trends in step-counting apps and social media platforms have led to a national fitness boom, displaying an increased willingness to walk and awarenss for environmental health. In order to accommodate for the needs, governments at all levels have already introduced a series of policies to promote non-motorized transport and improve urban environment.

At the national level, policies including guidelines on low-carbon transport and detailed street design standards help direct non-motorized transportation development for various levels of local governments. In June 2018, the central government released "Opinions of the CPC Central Committee and the State Council on Strengthening Ecological Environmental Protection through Pollution Prevention and Control," proposing to lead a low-carbon lifestyle by "developing public transportation and encouraging low-carbon transport options such as bicycles and walking."[3] In July 2018, the State Council issued the "State Council Notice on Printing and Distributing the Three-Year Plan for the Blue Sky Campaign," advocating for all sectors of society to adopt greener, low-carbon lifestyles and improve urban air quality.[4] In October 2018, the General Office of the Ministry of Housing and Urban-Rural Development (MoHURD) conducted a public consultation on the "National Planning Standards for Pedestrian and Bicycle Transportation Systems" (hereafter referred to as the "Standards"), aiming to upgrade the urban non-motorized transportation. The "Standards" offer detailed provisions on the width of pedestrian space, street buffers, bicycle parking, greening, paving, street furniture, street crossing facilities, etc.[5] The National Development and Reform Commission (NDRC) also specifically mentioned in the "2019 Key Tasks in New Urbanization Construction" issued last April to "improve non-motorized vehicles and pedestrian traffic systems, install better pedestrian crossing facilities, and encourage the establishment of bicycle lanes."[6]

To observe policy action at the local level, we compiled a series of planning documents and policy guidelines released in the last year from 34 provinces, municipalities, autonomous regions, and special administrative zones in China (see Appendix 1 for details). Our review showed that in the last couple of years, first- and second-tier cities are making continuous effort to promote walking in cities. Major cities including Beijing, Shanghai, Guangzhou, Shenzhen, Chongqing, Nanjing, Chengdu, and Kunming have issued technical guidelines to direct the upgrading of walking facilities. Other provinces and cities, through the development of local transportation systems, are also beginning to emphasize non-motorized transportation planning and design with gradually shifting focus from broad, general goals to detailed, technical, and sustainable planning. For example, in April 2018, the "Hebei Xiong'an New District Planning Outline" called for a new road network density of 10-15 km/km^2 and 90% low-carbon travel. The outline specifically advocated for a low-carbon "public transportation + bicycles + walking" model and a street network layout that emphasized "non-motorized transportation first," as well as a "high-density road network characterized by narrow roads and small blocks." It also proposed a three-level (regional, city, and local community levels) greenway system that connects parks thorough the city.[7] Meanwhile, Beijing's Municipal Planning Commission's "Beijing Street Renewal Management Urban Design Guidelines" (hereinafter referred to as the "Guidelines") entered feedback phase in September 2018 and similarly demonstrated pedestrian-oriented urban planning. The "Guidelines" incorporated opinions from 2,046 subjects in the "Beijing Pedestrian Walking Experience Survey" and proposed to maintain a "small blocks, high density streets" design in the Beijing city sub-center.

Local governments also react quickly to challenges brought by development of low-carbon transportation such as the sudden booming of bike-sharing and its negative impact on sidewalks. In an attempt to solve the problem without hurting the enthusiasm of biking, local governments have begun to strengthen management and operation of nonmotor vehicles on streets. Cities like Beijing, Shanghai, Guangzhou, Shenzhen, Xiamen, etc. have started to cooperate with bike sharing companies to set up electronic, smart parking facilities to regulate bike parking and make the facilities walking environment more accessible, comfortable, and safe.[8]

1.2 Academia's contribution to evaluating and upgrading cities'walkability

Academic research in the past year on walking-related urban design can be categorized into two main fields: 1) research on evaluation techniques and technologies 2) research on advancements in urban planning and environmental design.

In academic research on street walkability evaluation, Changming Yu and Peiyang Wu (2018) conducted a review on the evaluation methods of walkability in urban green spaces. Methods included assessing street accessibility and connectivity, utilizing big data, and—on a more micro-level—recording and measuring pedestrian behavior, environmental experiences, and behavior-based selection. They noted that most macro-level walking evaluations still largely focus on indicators such as accessibility and connectivity. Micro-level evaluations should consider introducing Pedestrian Environmental Review System (PERS) and Environmental Walkability Scale (EWS), which are highly focused and easy to reproduce.[9] In a different study, Deng Yiling, et al. (2018) demonstrated the shift of focus from traffic to the overall environmental quality and pedestrian experience. Their study categorized and separately reviewed walkability evaluation methods and tools. Types of evaluation methods were divided into manual surveys, map-based data, and crowdsourcing (where a company or organization outsources tasks formerly performed by employees to public volunteers), and their study showed that among the three, uses of map-based data have been consistently advancing.[10] Zhi Li and Ying Long (2018) evaluated the quality of street in Qiqihar using Tencent Street View pictures.[11] Xinyue Gan, et al. (2018) combined manual evaluation and machine learning to formulate a method that identifies and analyzes urban informality using Street View images.[12] Ying Long and Zhejing Cao (2018) proposed a framework for self-feedback urban design using urban sensors and online platforms based on a practice conducted in Shanghai Hengfu Historic District.[13]

In academic research on planning and design, researchers have focused more on the relationship between the urban walking environment and the built environment—specifically on ways the two systems

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can work together to improve walkability. Luoshu Gan (2018) used Chengdu urban planning and design to exemplify factors that affect the quality of streets such as traffic, landscape and physical layout, and then proposes a public-space-building strategy for small blocks in order to create more people-centric urban environments.[14] Guangyu Cai (2018) analyzed the application of the "Shanghai Street Design Guidelines" on the Hongkou District of Shanghai, noting that the new design methods prioritize people's needs and offer specific guidelines for maintaining non-motorized transport and a lively community.[15] Zhugen Wang, et al. (2018) sorted out domestic and foreign urban walkability development theories and proposed a strategy that focuses on integrating pedestrian systems with motor vehicle traffic, public transportation, public spaces, buildings and biking systems base on collaborative planning with reference to examples from Melbourne's walking strategy.[16] Tongyu Sun and Yuling Zhao (2018) proposed spatial reconfiguration measures to improve modern urban centers, including policies for three-dimensional traffic, public transport station positioning, visible and accessible pedestrian nodes, etc.[17] By investigating three case studies of Asian cities with walkable railway stations, Wu Liang et al. (2018) summarized the urban development models for easily walking-accessible railway stations.[18]

1.3 Other examples of active engagement in promoting walkability

The renewed exploration of pedestrian systems has also caught on in the private sector, civil society, and other walks of life. In 2016, Arup released the "Cities Alive: Toward a Walking World" report, which examined the "walking city" through interviews and surveys of various urban studies in 80 countries. The report lists 50 benefits of walking and 50 ways urban changes can be achieved through five primary themes: social, economic, technological, environmental and political.[19] In 2018, the Institute for Transportation and Development Policy (ITDP) issued the "Pedestrians First—Tools for a Walkable City" report to analyze factors affecting walkability from three levels: city, community, and the street. The street level includes security (crime rate, safety of crosswalks), comfort (traffic signals, street width, traffic speed and volume), and pleasure (access to parking, street amenities, transportation nodes).[20]

Many internet companies are similarly in the midst of exploring the potential in big data application. For example, the "2018 Chinese Sports Report" released by QQ Big Data shows that in 2018, China's daily step count per capita reached 6,000 steps per day—an annual increase of 11% since 2016.[21] Other examples of big data application include StreeTalk, which finished in the top ten at the Shanghai SODA Open Data Innovation Application Contest and officially launched in July 2018. By using an urban images database and deep learning technology, StreeTalk was integral in helping produce the Shanghai pedestrian safety map.[22]

2

METHODOLOGY FOR EVALUATING THE WALKABILITY OF LIVE-WORK-PLAY CENTERS

The fourth iteration of NRDC's walkability report evaluates the quality of walking facilities by generating a built environment score for Live-Work-Play centers (LWP centers) in 50 Chinese cities. This chapter starts with a brief introduction of LWP centers and the methodology we used to identify them. It then reviews the methodology behind the vitality score, which was the focus of our third walkability report. Lastly, this chapter explains how we use street view images to examine walking facilities and calculate a built environment score for every street in the observed LWP centers.

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2.1 Study scope

We chose 50 Chinese cities for this evaluation, including 4 centrally-administered municipalities, 27 provincial capitals and autonomous regional capitals, 5 municipalities separately listed on the state plan, and 14 other prefecture-level cities (Figure 1). Within the 50 cities, we identified a total of 71 LWP centers.

As the name suggests, an LWP center is a vibrant area of a city that serves three important functions: live, work, and play. LWP centers are compact, functionally diverse, and have a high population density. They are typically the most prosperous areas in cities and where pedestrian traffic is most active. There are 15 types of "points of interest" (POI) that fall under live, work, and play functions (see Table 1).[i] We utilized these POI to determine the location of LWP centers in cities by identifying areas with highest POI density and variety.

First, we calculated the overall POI density in built-up areas of a city, and then divided the density level into the eight classes by natural breaks (Jenks). Areas larger than 10 ha^2 in size that have the highest density of POIs are then classified as LWP centers of the city.[ii] We found that there are usually 1 to 3 LWP centers within each of the 50 cities chosen for this report, and the 71 LWP centers studied cover a total of 12,740 streets.

For cities with more than one LWP center, we name the centers as the (main) center or sub-center based on the area and its POI density. Typically, the (main) center has the largest area and the highest POI density. In special cases where the LWP center has neither the largest area nor the highest POI density, then we compare the area of the LWP centers. If one LWP center's area is significantly larger than others (more than 20%), then that one is named the (main) center. However, if the difference

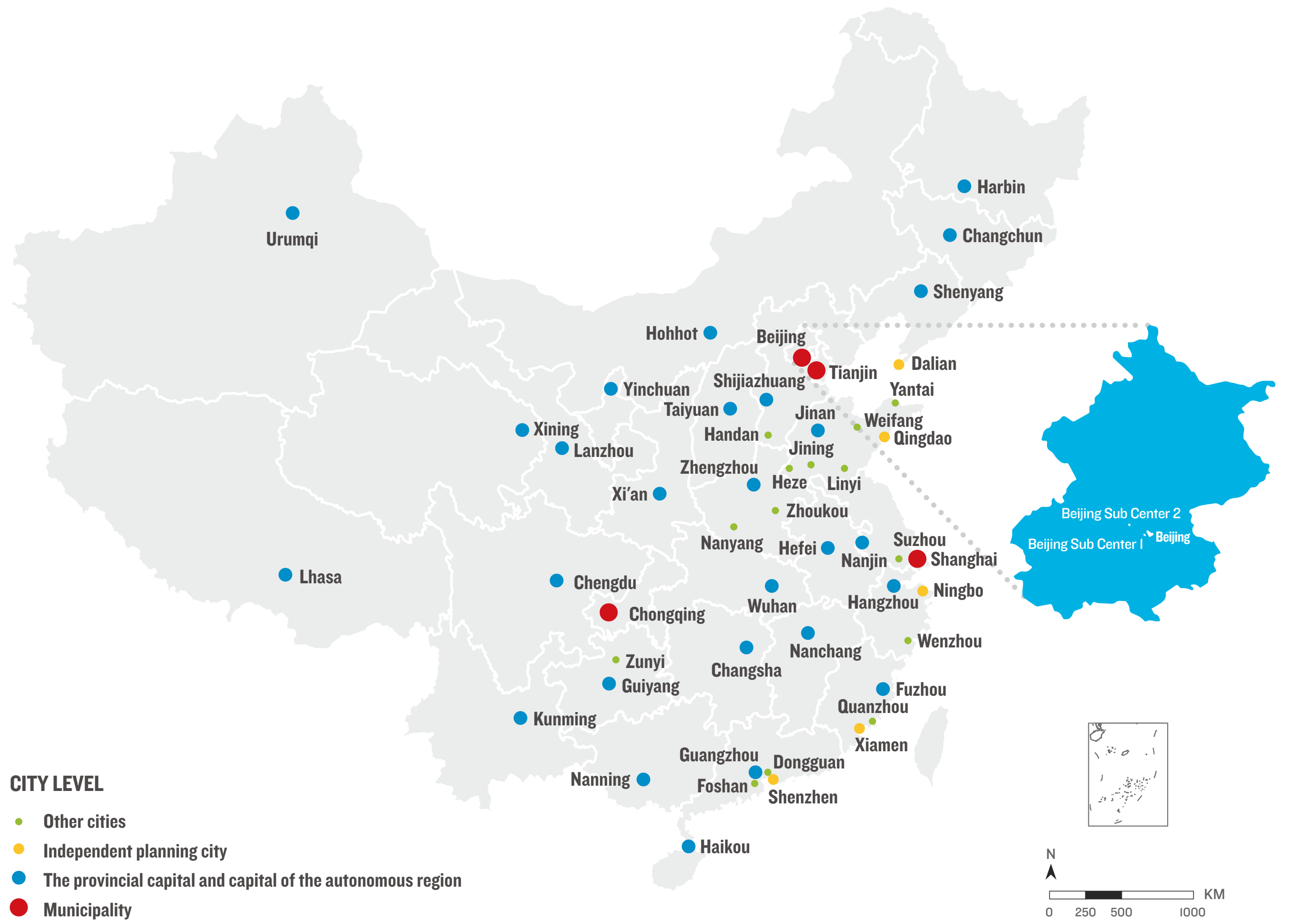
TABLE 1: POI CATEGORIES THAT DETERMINE LWP CENTERS

Live	Residential areas, community centers
Play	Commercial (shopping) centers, dining places, entertainment venues, hotels, tourist attractions
Work	Companies, office buildings, financial services, legal services, government agencies, educational institutions, medical institutions, other facilities

[i] The functions of POIs sometimes overlap and can count for more than one category. For example, commercial, dining, and entertainment sites also account for a certain percentage of employment (work); however, they are generally still considered to have more "play" functions rather than "work" for their main purpose in cities.

[ii] During research, we found that there were some areas with extremely high densities of POI but encompassed very small land areas. In order to avoid misidentification of these areas as city centers, we had to set a threshold of 10 hectares with reference to the basic size of a city center.

FIGURE 1: DISTRIBUTION OF THE 50 CITIES CHOSEN FOR THIS REPORT

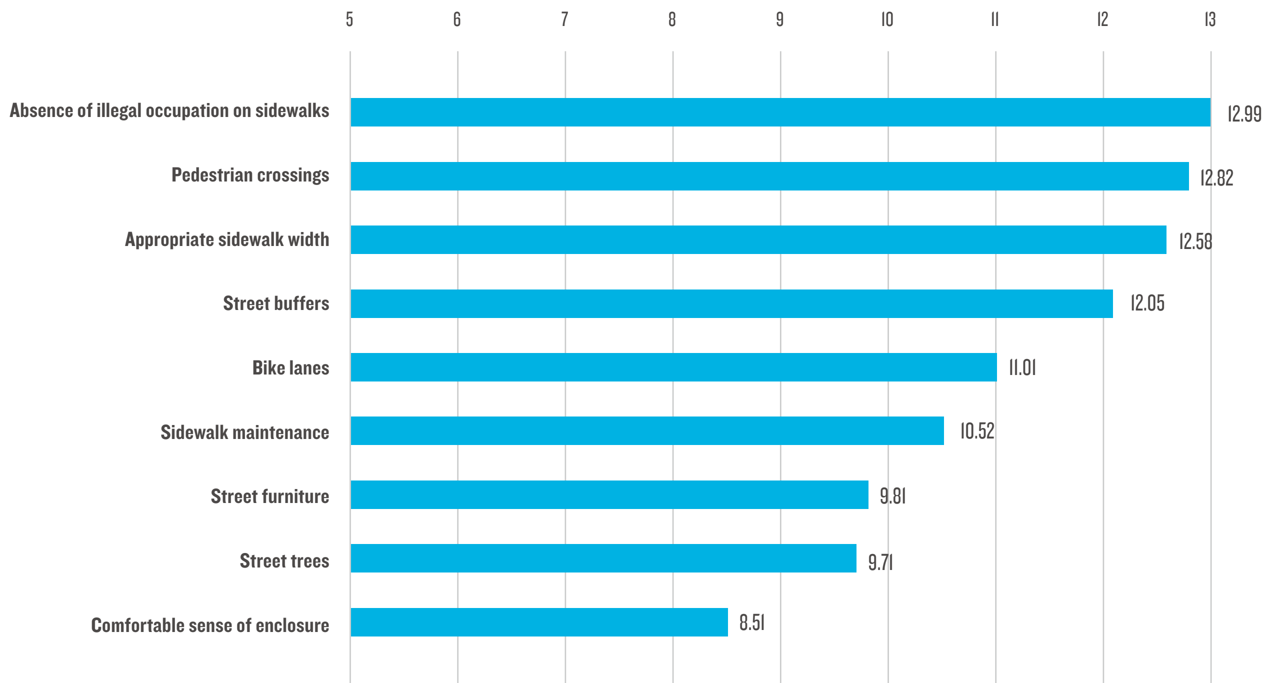


in area is small (less than 20%), then the LWP center with higher POI density will be named as (main) center (location of 71 LWP centers can be found in Appendix 2.)

2.2 Vitality score

The term "vitality score" was introduced in the third iteration of our walkability assessment, for which we also partnered with Professor Long Ying of Tsinghua University's School of Architecture. "The Walkability of Chinese Cities: How Points of Interest Promote Street Walkability" (2017) measures how the vitality and strength of the urban fabric's main service facilities—such as shops, restaurants, schools, and other POI—contribute to the pedestrian's interest and willingness to walk on the street. The POI was determined based on a calculation methodology derived from the Walk Score. It takes into consideration the number, density, and variety of POIs and each type of POI's impact on pedestrian willingness to walk on a street. For example, a restaurant usually attracts people more than a bank, so we assigned it a higher weight when calculating vitality scores. The vitality score of a street is indicated as a number ranging from 0 to 100 the higher the number, the more attractive a street is to pedestrians. We calculated vitality scores for 769,407 streets built-up areas in 287 Chinese cities, which provided the foundational coverage for the study area of the evaluation in this report (see Appendix 3 for more explanation of this methodology).

FIGURE 2: WEIGHT VALUES FOR THE 9 BUILT ENVIRONMENT SCORE INDICATORS



2.3 Built environment score

Vitality score measures a street's attraction to pedestrians—and to some extent comfort—but we also needed a method to assess accessibility and convenience. To do so, our fourth walkability report evaluates the pedestrian environment by measuring the availability and maintenance of pedestrian-specific facilities. To evaluate the quality of the built environment along sidewalks, we chose 9 specific indicators that should be readily common to walkable streets: pedestrian crossings, street trees, comfortable sense of enclosure, street furniture, street buffers, appropriate width of sidewalks, no illegal occupation on sidewalks, sidewalk maintenance, and bike lanes (see Appendix 4 for more explanation of these indicators). Through a virtual auditing for the built environment,[iii] we then used these 9 indicators to evaluate each street in the 71 determined LWP centers.

First, we set an observation point every 50 meters on each of the 12,740 streets, which accounted for a total of 31,226 observation points. Our second step was to extract panoramic photographic shots of all the observation points from Baidu Street View (2017 edition) and evaluate them visually using the 9 indicators as criteria. Since the 9 indicators each have different levels of impact on pedestrian walking experiences, we invited 20 experts in sustainable transportation and urban planning fields to assign weights to the 9 indicators and used the Delphi method to determine the final weight of each of the 9 indicators (see Figure 2).[iv] After applying these weight values to the indicators, we summed the streets' performance of the 9 indicators and calculated the total built environment scores for each of the 12,740 streets.

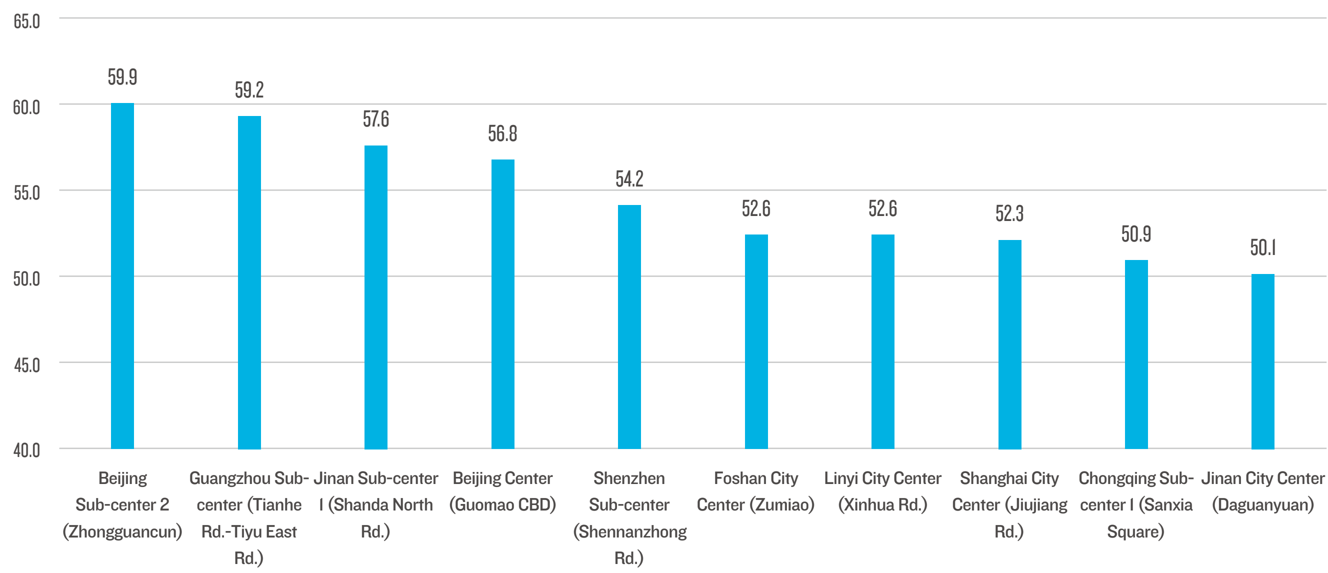
[iii] Virtual auditing is a method to evaluate street environments by counting observations from Street View images. Compared with traditional field audits, virtual auditing offers many more advantages in that it is highly efficient, low cost, adaptable to different spaces, and able to be scaled up.

[iv] The Delphi Method, also known as the expert investigation method, is a structured forecasting method that relies on a panel of experts. Experts answer questionnaires in two or more rounds. After each round, a facilitator collects and summarizes the results and sends this information back to the experts, who are then expected to reevaluate and perhaps modify their own responses in light of the replies of other experts. This process of repetition is intended to gradually converge upon a more consistent prediction result, which is assumed to be the "correct" one. For this study, this process was only repeated twice.

3

EVALUATION RESULTS OF BUILT ENVIRONMENT SCORE

FIGURE 3: TOP 10 BUILT ENVIRONMENT SCORES OF LWP CENTERS



3.1 Low built environment scores of all LWP centers

The average built environment score of all 71 LWP centers is 41.9 points. In fact, only 10 LWP centers scored above than 50 points (Figure 3). These top 10 LWP centers are Beijing Sub-center 2, Guangzhou Sub-center, Jinan Sub-center 1, Beijing Center, Shenzhen Sub-center, Foshan City Center, Linyi City Center, Shanghai City Center, Chongqing Sub-center 1 and Jinan City Center. LWP centers are important indicators of urban development because they are often areas of economic prosperity and highly attract pedestrian activity. The generally low built environment score of LWP centers across the board suggest that there is still much potential and room for improvement in the walking environment of Chinese cities.

3.2 Passable basic built environment scores

We determined that 3 of the 9 indicators specifically demonstrate whether the sidewalks' built environment meets the most basic requirements for pedestrian activity. These three critical indicators were 1) no illegal occupation on sidewalks, 2) pedestrian crossings, and 3) appropriate width of sidewalks. They were assigned the highest weighted values by our experts because of their importance to walking. The remaining 6 indicators are supplemental incremental factors that add to the attractiveness of the sidewalks, differentiating high-ranking streets as not just functional walking environments but high-quality pedestrian walkways. To evaluate the basic walking environment, we used

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the summation of the 3 critical indicators to generate a "basic built environment score" for each street in the LWP centers.

The basic built environment scores of 71 LWP centers are, on average, higher than the built environment scores as calculated with all 9 indicators. As Figure 4 shows, the top 10 LWP centers with the highest "basic built environment" scores all exceed 60; Shanghai Center even reached 77.1 points, placing it far ahead of other LWP centers. This finding shows that most of the studied streets have already provided pedestrians with basic walking facilities to safely cross streets and walk smoothly on sidewalks of suitable width. It implies that the low built environment scores of the LWP centers are due to the low scores of the rest of the 6 indicators. Therefore, to take a closer look at the overall walkability of the streets, we examined the performance of each indicator separately.

3.3 Overview of single indicators

3 of the 9 indicators retained relatively high scores across the board—namely, sidewalk maintenance, appropriate width of streets, and street trees. This means that the width of streets in most of the 71 LWP centers can adequately meet the needs of pedestrians. Streets are also generally in good condition and can provide pedestrians with decent shade. However, the scores of the following five indicators are generally low: bicycle lanes, street furniture, street buffers, pedestrian crossings, and absence of illegal occupation (as shown in Figure 5). Among the 71 LWP centers, bicycle lanes exist

FIGURE 4: TOP 10 BASIC BUILT ENVIRONMENT SCORES OF LWP CENTERS

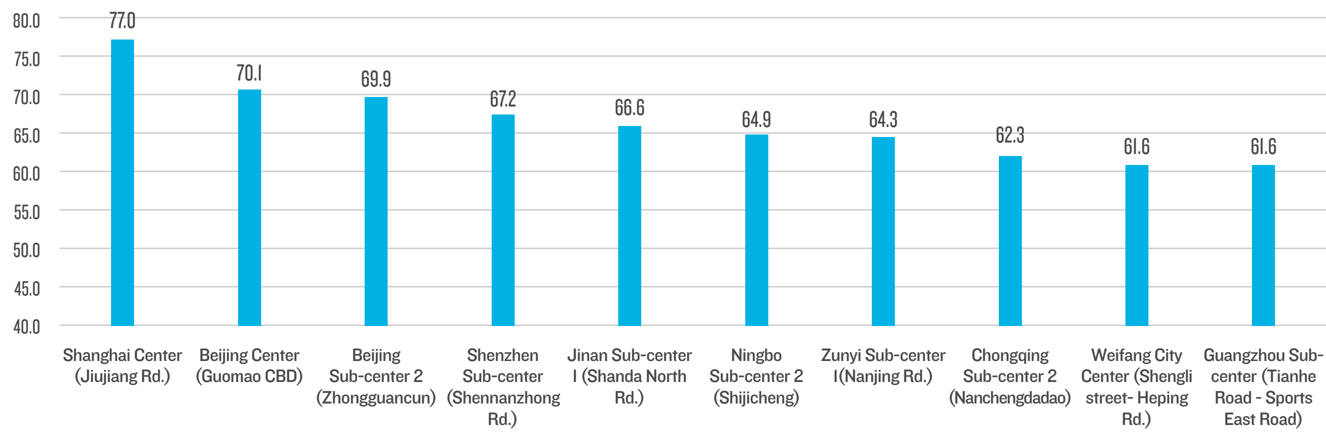


FIGURE 5: AVERAGE SCORE OF INDIVIDUAL INDICATORS IN 71 LWP CENTERS

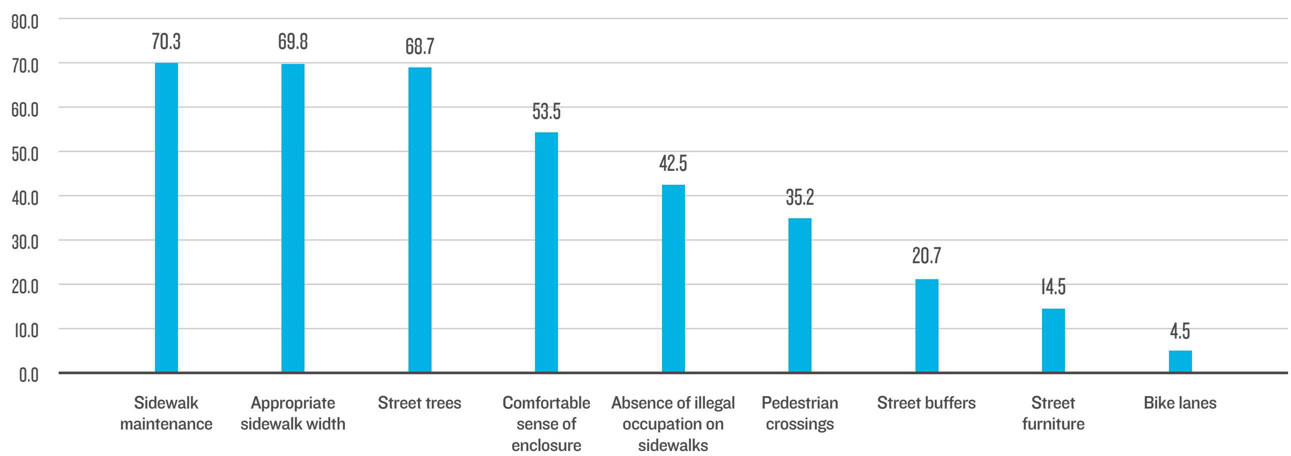
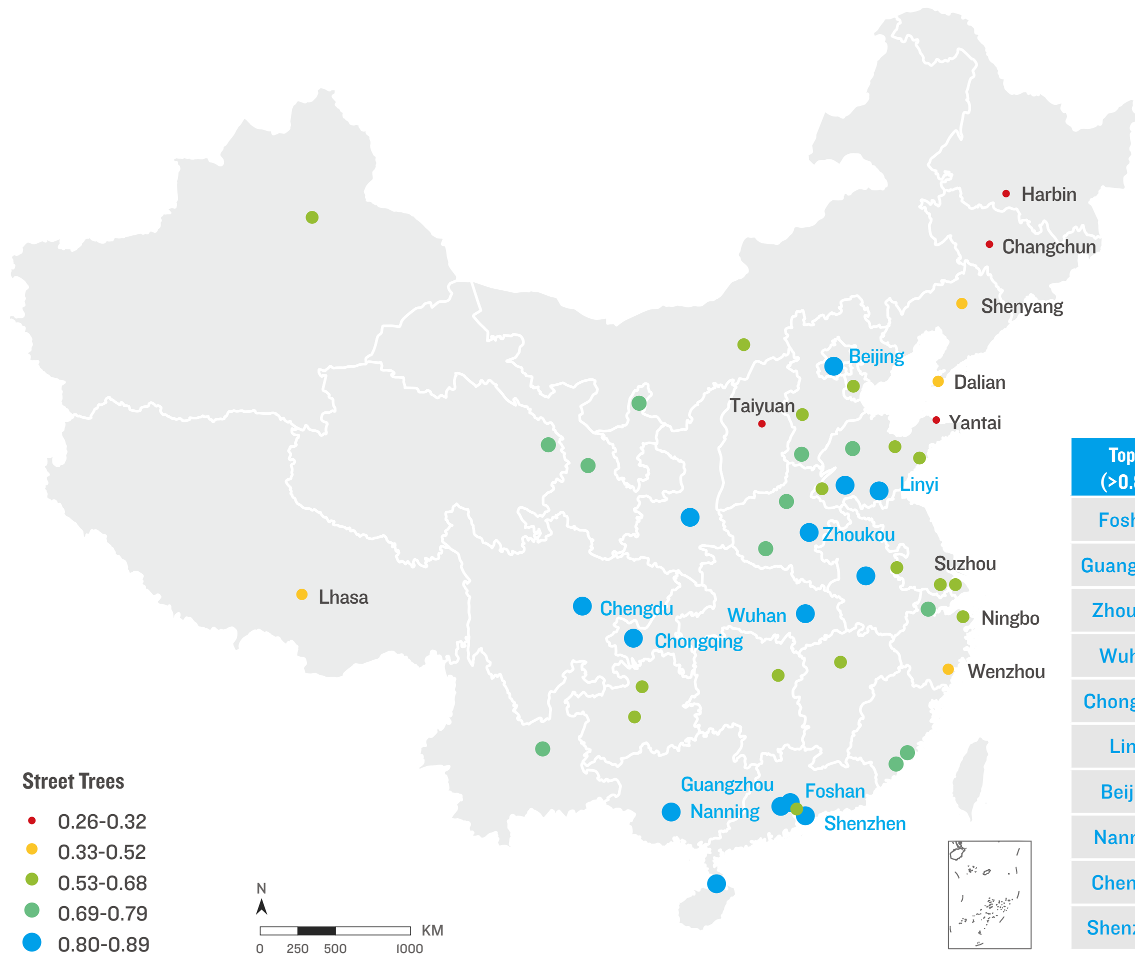


FIGURE 6: STREET TREES SCORES IN LWP CENTERS OF 50 CITIES



Top10 (>0.84)	Last10 (<0.59)
Foshan	Suzhou
Guangzhou	Ningbo
Zhoukou	Wenzhou
Wuhan	Lhasa
Chongqing	Dalian
Linyi	Shenyang
Beijing	Harbin
Nanning	Taiyuan
Chengdu	Changchun
Shenzhen	Yantai

only in a very small number of streets; street furniture is too few and far between to provide pedestrians with enough facilities to rest; crossing facilities and street buffers are insufficient for safety and convenience; and the issue of illegal occupation on sidewalks is severe. Using street furniture as an example, more than 84% of all 12,740 streets in 71 LWP centers scored 0, meaning that most streets do not have any street furniture.

When we looked at the scoring within only poorly performing indicators, we found that there are still some cities that perform notably better than others. Shanghai Center and Qingdao Sub-center both have better crossing facilities than others. Chongqing Sub-center 1, Zhengzhou City Center, and Guangzhou Sub-center have the most street furniture, and Beijing Sub-center 2, Zhengzhou Sub-center and Beijing Center have streets with the most street buffers compared to others. Jinan City Center, Beijing Sub-center 2 and Weifang City Center have fewer illegally occupied sidewalks, and Beijing Sub-center 2 is far ahead of other LWP centers in terms of the availability of bicycle lanes.

Climate and geographic features play an important role when it comes to urban development. We found that LWP centers in southern cities have significantly higher scores in street trees than northern cities. Among the top 10 street trees score (as shown in Figure 6), 7 are located in the south where it is relatively warm and humid, whereas only 3 are located in the north where the average temperature and humidity are lower year-round. Furthermore, based on our evaluation, in some of the cities with the lowest street trees scores, over half of the streets measured do not have any street trees to provide shade for pedestrians. As LWP centers are the most dynamic spaces in cities with the most pedestrian activity, lack of shading is not conducive for further pedestrian attraction. For more rankings of individual indicators, please see Appendix 6.

3.4 LWP centers of centrally-administered municipalities have higher built environment scores than other cities

In comparing cities of various administration levels (as stratified by centrally-administered municipalities, provincial capitals, autonomous regional capitals, municipalities listed separately on the state plan, and other prefecture-level cities), we found that LWP centers of centrally-administered municipalities have significantly higher built environment scores than other cities (Figure 7). The seven LWP centers of the three centrally-administered municipalities—Beijing, Shanghai, and Chongqing—ranked in the top 20 of all 71 LWP centers. The only exception is the LWP center in downtown Tianjin. Its overall low score is due to poor performance in pedestrian crossings, street furniture, illegal occupation on sidewalks, and bike lanes.

When looking at the scores of individual indicators, we found that the LWP centers of centrally-administered municipalities score the highest in all indicators except street furniture. Their scores in street trees, appropriate sidewalk width, and lack of illegal occupation on sidewalks are significantly higher than those of other cities (Figure 8). One reason behind the higher scores of

FIGURE 7: BUILT ENVIRONMENT SCORES OF 8 LWP CENTERS IN CENTRALLY-ADMINISTERED MUNICIPALITIES

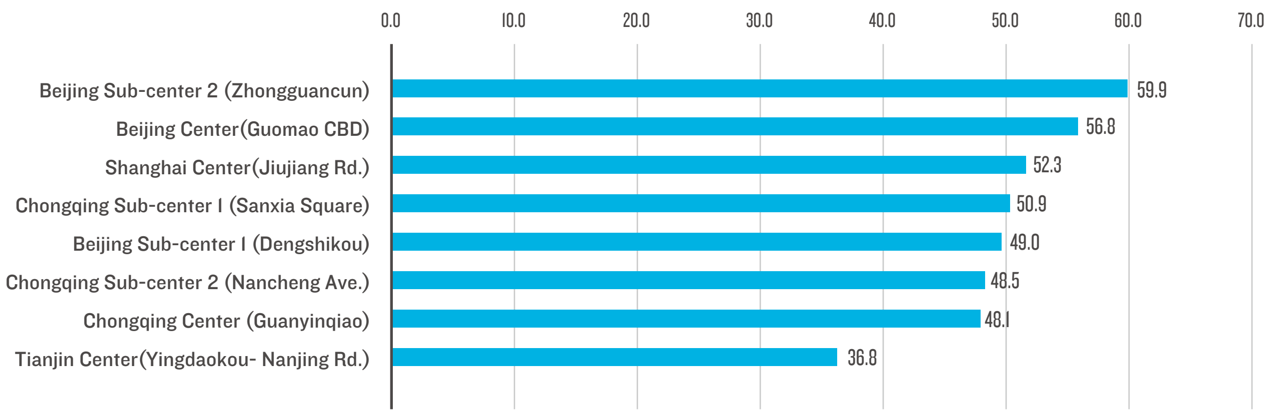
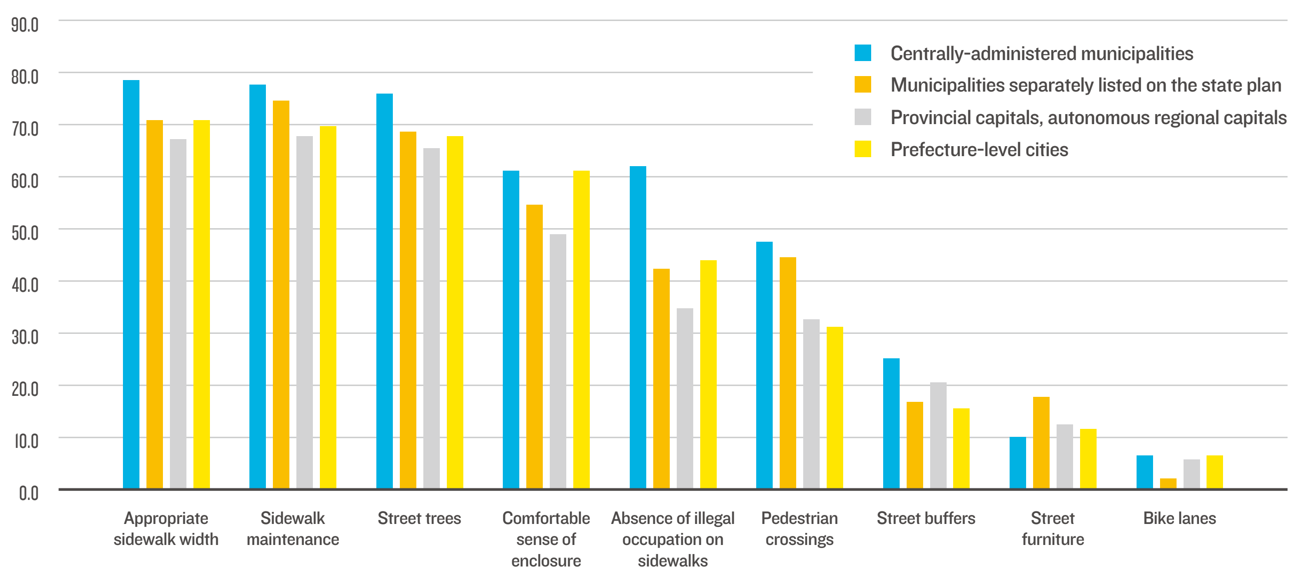


FIGURE 8: INDIVIDUAL INDICATOR SCORES OF LWP CENTERS IN 50 CITIES



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centrally-administered municipalities can be attributed to a more proactive approach toward the development of non-motorized transport systems. For example, the Beijing Municipal Road Administration has drawn up a number of technical guidelines for the construction of pedestrian facilities and bicycle lanes based on the "Code for the Design of Urban Street Planning," which references both international and domestic experiences and combines them with the actual needs of residents. In another example, Shanghai's "City Street Design Guidelines" released in October 2016 marked the first official design guidelines to be released by a municipal government in China. It centered around four key urban transformation principles: road rights, red lines, design goals, and evaluation. The guideline provided a series of specific design requirements and numerical indicators to create walking-friendly, human-oriented streets.

Summary

We found that the overall built environment scores of the 71 LWP centers are low with an average of 41.9 points. Only the top 10 LWP centers scored more than 50 points. When we applied the bare minimum requirements to determine whether the LWP centers can provide pedestrians with simply adequate sidewalks of appropriate width and crossings without illegal sidewalk occupation, the LWP centers become generally passable. The Shanghai Center scored far ahead of other LWP centers when we evaluated only the most basic street facilities.

In regards to the specific individual indicators, although the 71 LWP centers perform well in sidewalk maintenance, appropriate street width, and street trees, there is still much room for improvement primarily in providing bicycle lanes, street furniture, street buffers, pedestrian crossings, and resolving the issue of illegal occupation. We also found that LWP centers in southern cities have more street trees than those in northern cities. By comparing the built environment scores of LWP centers of different administrative levels, we found that LWP centers in centrally-administered municipalities have significantly higher scores, which might be due to a more proactive approach toward the development of non-motorized transportation networks.

4

VITALITY AND QUALITY OF THE BUILT ENVIRONMENT OF STREETS

A walkable street should not only have a pleasant walking environment but also various facilities and services that contribute to everyday livability on the street. High built environment and vitality scores mark just that, respectively. This chapter will combine the street's built environment score with the vitality score. By analyzing the total walkability through both dimensions, we further identify specific streets with urgent needs for upgrades and put forward specific suggestions for their improvement.

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4.1 Using both vitality score and built environment score to assess walkability

The vitality score measures the density and variety of points of interest (POI) on streets. The higher the vitality score, the more types of points of interest and the denser the distribution. Such streets tend to be more attractive to pedestrians because they offer more services that contribute to livability. A higher or lower vitality score measures how appealing the street is to walkers. On the other hand, the built environment score evaluates the quality of the infrastructure and walking facilities on streets. Scores based on 9 indicators related to the walking environment help us interpret whether the street is easy or hard to walk through. Appealing streets are not necessarily easy-to-walk (see the top left of Figure 9), and easy-to-walk streets may be unappealing (see the bottom right of Figure 9). We believe that only by making streets both appealing and easy-to-walk (see the top right of Figure 9), can we most effectively encourage people to travel by foot. From 2017 to 2018, we measured the performance of streets on the dimensions of appeal (vitality score) and ease of walking (built environment score). In theory, there are four possible combination outcomes (see Figure 9).

FIGURE 9: POSSIBLE OUTCOMES WHEN COMBINING STREET VITALITY AND BUILT ENVIRONMENT SCORE COMBINATIONS

APPEALING BUT DIFFICULT-TO-WALK
(high vitality score but low built environment score):

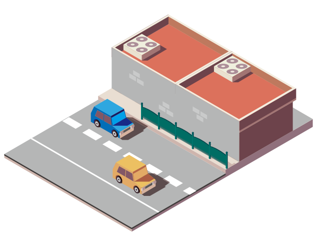
There are enough points of interest on both sides of the street to attract pedestrians, but streets lack properly installed and/or maintained infrastructure and pedestrian facilities to provide a positive walking experience. These types of streets have the potential to improve overall walkability by fixing up the infrastructure along sidewalks.

APPEALING AND EASY-TO-WALK
(high vitality score and high built environment score):

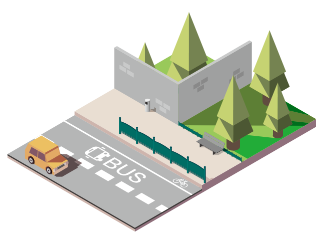
There are enough points of interest on both sides of the street to attract pedestrians, and there are excellent infrastructure and pedestrian facilities to provide people with a good walking experience. These types of streets are the most walkable.

UNAPPEALING AND DIFFICULT-TO-WALK
(low vitality score and low built environment score):

There are not enough points of interest on both sides of the street to attract pedestrians, and there are a lack of good infrastructure and pedestrian facilities to provide a pleasant walking experience. These types of streets are overall least walkable.



UNAPPEALING BUT EASY-TO-WALK
(low vitality score but high built environment score):



There are excellent infrastructure and pedestrian facilities on the street to provide a good walking experience, but there are not enough points of interest to attract people to walk. Depending on land use types and population density of the surrounding area, the walkability of these types of streets may be improved by increasing service facilities and/or commercial development.

4.2 LWP centers with high vitality and low built environment quality

This report reveals several important findings about the walkability of LWP centers. First, because this report specifically studies LWP centers, which are largely characterized by high levels of vitality marked by a dense variety of shops and service facilities, most of the 12,740 streets evaluated in this study have high vitality scores. More than 91% of the streets in this study have a vitality score over 90 points. Therefore, the results reflect few cases of unappealing but easy-to-walk (low vitality score but high built environment or unappealing and difficult-to-walk (low vitality score and low built environment score streets.

Thus, most results in the study belonged to the remaining two cases: streets that are appealing and easy-to-walk (high vitality score and high built environment score) and streets that are appealing but difficult-to-walk (high vitality score but low built environment score). We paid specific attention to the streets that scored in extremes of our scale—with the best built environment scoring 100 and the worst scoring 0. We found that of the total 12,740 streets, only 15 streets scored a perfect 100 on the built environment score. As shown in Figures 10 and 11, all the highest scoring, most easy-to-walk pedestrian streets are located on the sides of either main or secondary roads. Such roads are wide enough to accommodate a higher total of pedestrian facilities including sidewalks, street

FIGURE 10: LUOYUAN STREET, JINAN

Source: Baidu Streetview

FIGURE 11: DONGFENGXILU, KUNMING

Source: Baidu Streetview

trees, street buffers, and street furniture. Moreover, these major streets are often better managed, so the illegal occupation on sidewalks by parked cars and street vendors is less common than at sub-level roads.

In sharp contrast to the small number of most easy-to-walk streets, 1,329 streets had a built environment score of 0. These 1,329 streets account for 8.1% of the total length of all the streets we studied and are categorized as most-difficult-to-walk. From the street view images of these 1,329 streets, there are no observable pedestrian crossings, street trees, street furniture, street buffers, visible sidewalk maintenance, or bike lanes. Moreover, these streets also fail to provide a comfortable sense of enclosure as a result of improper building height to sidewalk width ratio. The most-difficult-to-walk streets do not have an appropriate width of sidewalks fit for convenient pedestrian usage and have serious problems with illegal occupation on sidewalks. As areas that generally attract high pedestrian-traffic, LWP centers should be prioritized in creating walkable urban environment. In the following section, we will discuss the geographic distribution of these streets, the reasons that make them most-difficult-to-walk, and potential opportunities for improvement.

4.3 Streets of lowest built environment

Overall, the distribution of the streets with lowest built environment quality in each of the 71 LWP centers vary significantly. In Jinan LWP Sub-center I (Shanda North Road), Qingdao LWP Sub-center (Fuzhou South Road), Guangzhou LWP Center (Zhongshan Road - Jiefang Road), Guangzhou LWP Sub-center (Tianhe Road - Sports East Road), and Haikou Sub-center (Jinlong Road), there are no such streets that qualify as most-difficult-to-walk. However, in the five LWP centers of Lhasa City (Jokhang Temple), Yantai City (South Street), Suzhou City (Guanqian Street), Changchun City (Renmin Road - Chongqing Road), and Wenzhou City (Renmin Road - Jiefang Street), the combined length of the most-difficult-to-walk streets surpassed 20% of the total length of streets measured in these LWP centers.

4.3.1 "Wide roads and superblocks" v. "small streets and dense road networks"

"Small streets and dense road networks" are usually what urban planners consider good parameters for city development, especially when it comes to walkability. Meanwhile, "wide roads and superblocks" are regarded

FIGURE 12: THE "WIDER" THE ROAD THE HIGHER THE BUILT ENVIRONMENT SCORE

as unfriendly to pedestrians because large city blocks are not particularly designed for the convenience of walking. Nevertheless, we found that the built environment scores of "wide roads"—main streets or secondary streets—are usually higher than "small streets"—minor roads. Very few minor roads have built environment scores above 80, and almost all the most-difficult-to-walk streets are minor roads.

This seemingly counterintuitive result is easy to understand. Pedestrians often find wide roads full of motor vehicles time-consuming and potentially risky to cross. It would require even further travel to walk around superblocks to get to a destination. Therefore, the walking unfriendliness of "wide roads and superblocks" is largely due to a lower rate of accessibility and convenience rather than what the built environment score primarily evaluates: comfort. It should be noted that we are not advocating for "wide roads and superblocks," but this brings to attention the obvious fact that most cities invest far more in planning, implementation, and management on main roads that attract heavy motor vehicle traffic than on minor roads. The largest, most popular streets that make up the skeleton of the urban road network thus tend to be easiest-to-walk (As shown in Figure 12, in our study, there are usually 1-3 main roads in a city's LWP center, and these roads often have the highest built environment scores).

4.3.2 Intrinsic issues and accumulated problems

Some of the most-difficult-to walk streets share similar patterns of traditional streets in historic areas, such as those in Lhasa, Suzhou and Yantai. These most-difficult-to walk streets are very narrow with low possibility to widen because of their unique historic location. We call these "intrinsic issues". Historic preservation often takes

FIGURE 13: LVQIUFANG LANE, SUZHOU

Source: Baidu Streetview

FIGURE 14: JIRI LANE, LHASA

Source: Baidu Streetview

FIGURE 15: SUOCHENGLI STREET, YANTAI

Source: Baidu Streetview

precedence over the safety of pedestrians, as it is not always guaranteed in such walking spaces. For example, the Suzhou LWP is located in the Gusu District, China's first nationally protected historical area known for its many Ming and Qing dynasty buildings, ancient homes, and historic-style communities that were built after the 1980s and 90s (Figure 13). In the built environment evaluation, as many as 37 streets in this LWP were determined to be most-difficult-to-walk.

Located in Lhasa LWP, Barkhor Street is a ring road that surrounds the Jokhang Temple in the center. The area enclosed by Barkhor Street has almost all the most-difficult-to-walk in the entire Lhasa LWP Center (Figure 14), accounting for 30% of the total street length in this LWP. Yantai City serves as another example of a city with "intrinsic issues". In 2018, it was chosen to be one of ten pilot cities in a national campaign aimed at the conservation of historic buildings, which resulted in building preservation and repair in key historical areas of the city. As the historic origin of greater Yantai City, Yantai's LWP center has preserved a large number of traditional residential buildings and historic streets from the Qing Dynasty as well as from the Republic of China. However, due to these small and narrow historic streets, antiquated supporting facilities, and lack of proper street management and maintenance, its built environment score is quite low. In the eyes of many citizens, the Yantai LWP center feels more like a village displaced in a modern city (Figure 15).

The other type of most-difficult-to-walk streets is caused by "accumulated problems." "Accumulated problems" occur in roads that were originally designed and

FIGURE 16: A RESIDENTIAL AREA, WENZHOU

Source: Baidu Streetview

FIGURE 17: A RESIDENTIAL AREA, BEIJING

Source: Baidu Streetview

constructed to have enough space to meet pedestrian needs, but due to poor management, are now just as difficult-to-walk as the ones in narrow, historic areas. The majority of the most-difficult-to-walk streets with "accumulated problems" are located between apartment buildings built in the 80s or 90s (Figure 16), and a small number also appear in community commercial areas (Figure 18). By comparing those streets with easy-to-walk streets, we find that whether on roads between the

FIGURE 18: A LOCAL COMMERCIAL STREET, SHENYANG

Source: Baidu Streetview

FIGURE 19: A LOCAL COMMERCIAL STREET, JINAN

Source: Baidu Streetview

apartment buildings (Figure 17) or in local commercial areas (Figure 19), the most dominant features of these most-difficult-to-walk streets is illegal occupation on sidewalks, which forces pedestrians onto streets with motor vehicles.

4.3.3 Upgrading minor roads with planning and management measures

According to our findings, the streets with lowest quality of built environment are almost all along minor roads, while the sidewalks of main roads in LWP centers are usually of the highest quality. The lack of high-quality sidewalks along minor roads in the urban transportation network provide fewer and less enjoyable walking options for pedestrians. In the long run, it will discourage people to prioritize walking for short trips and could lead to an increased dependence on private vehicles. Therefore, it is important for cities to start paying more attention to minor roads and ensuring that the whole sidewalk network is readily-accessible and pleasant for pedestrian usage. We suggest that cities begin these efforts in travel nodes that connect large, public transportation stations to surrounding residential areas to solve the existing "last mile" issue,[v] which will lend benefits to further optimizing the entire network. Many cities already pride their non-motorized transportation infrastructures that include walking paths and bike lanes in parks on the outskirts of town. However, we want to

[vi] Last mile is a term used in transportation planning to describe the movement of people from a transportation hub to a final destination—most often, the home.

ensure that the inner cities are also fully walkable and bikeable so that residents can adopt non-motorized transportation as a dependable way to meet daily travel needs. We suggest that when assessing non-motorized transportation construction and reconstruction development in a city, evaluation standards should be made more comprehensive. For example, instead of assessing the total "length of high-quality non-motorized transportation roads," it would be more holistic and accurate to evaluate the overall "coverage of high-quality non-motorized transportation networks."

The most-difficult-to-walk streets perform poorly by all nine built environment indicators, so there is obvious room for improvement in all dimensions, from sidewalk paving to street tree planning and placement. However, our studies suggest that the most important and most feasibly accomplished solution targets the problem of illegal parking on sidewalks. In almost all Chinese cities, street vendors, non-motor vehicles (particularly bike sharing and personal bikes), and motor vehicles illegally occupy sidewalks, competing for and often stealing urban spaces from pedestrians. To deal with street vendors, most cities have an urban management department to enforce regulations that clear up illegal vendors on sidewalks, which has shown some progress over the years.

Still, both non-motorized and private vehicles continue to illegally park on sidewalks; therefore, we suggest that cities use planning measures to design sufficient parking areas for vehicles and enforce management measures to guide and/or limit vehicles to parking areas, for example, the management of shared bike parking. The advent of dockless shared bikes in 2015 allowed more people to adopt non-motorized transport options because it became more convenient, but it also led to the overcrowding of sidewalks as users continued to leave shared bicycles in public spaces[vi]. In response, many cities such as Chengdu, the capital of China's Sichuan province, carried out design guidelines and other plans to create designated parking areas for shared bicycles. Establishing a structured, built environment around shared bikes helped reduce the number of illegally parked shared bikes while also making sure that there are enough bikes on the street to continue promoting the convenience of non-motorized transportation.

Heze, a prefecture-level city in southwestern Shandong province, had to adopt innovative regulatory methods to resolve illegal parking problems. Heze, like many other Chinese cities, formerly had an Urban Management Bureau overseeing the management of sidewalks in the city. However, at the municipal government level, Urban Management Bureaus are not authorized to impose penalties on drivers, which is usually the most effective way to deal with illegal parking on sidewalks and in streets. Instead, these bureaus can only install mechanical obstacles to physically prevent cars from parking on sidewalks. Such solutions have been proven largely ineffective as it is unfeasible to install mechanical obstacles for entire swaths of urban areas, and any unguarded part of the street could result in inviting further illegal car occupation along the entire street. In October 2018, after seeing the direct effects of shifting authority management in other cities, Heze reassigned the responsibility of sidewalk management from the Urban Management Bureau to the Public Security Traffic Administrative Department. Since the Public Security Traffic Administrative Department has the ability to impose fines, car owners who illegally park on sidewalks could be fined 100 yuan and—in places where there is a no-parking sign—200 yuan, along with a deduction of 3 points from their driver's license point system.[vii] These regulations have achieved positive results since they have been implemented.[23]

To solve the "intrinsic issues", we suggest that cities with special areas like historic preservation blocks make detailed plans to reconcile the needs of both historic preservation and modern transportation. Our results have shown that the most-difficult-to-walk streets are often distributed in historic areas with narrow pedestrian paths that have little potential for widening. Most design planning for areas like these prioritize the protection and repair of historic buildings. In these areas, streets, which bear the burden of modern transportation and serve as important connectors for site preservation, are unfortunately often neglected. Without clear definitions on pedestrian rights on sidewalks or guidance on how to

[vi] Yellow rides belong to Ofo, orange was claimed by Mobike, BlueGoGo has (you got it right!) blue bikes, green and (tacky) golden are reserved for Kuqi and cyan is UniBike's – companies have multiplied, and so did the colors they monopolized. There were at least 25 bike-sharing companies in China by the end of 2016, and each of them chose a distinguishing color for its brand.

[vii] The Chinese driver's license system gives drivers 12 points a year. Points are deducted for driving violations; minor violations like smoking or talking on the phone are only deducted 2 points, while more major penalties such as running a red light cost 6 points. Severe penalties such as drunk driving can even cost the entirety of the license points.

FIGURE 20: FUXIANG HUTONG BESIDE NANLUOGUXIANG, SEPT. 2015

FIGURE 21: FUXIANG HUTONG BESIDE NANLUOGUXIANG, JULY 2017

use the streets, both residents and visitors in these areas resort to following a first come first served rule, which has created a situation of "contention".

Beijing is a notable example of a city that has reconciled the common historic preservation and transportation development in urban planning contradition. Beijing is known for its distinctive hutong neighborhoods. Hutongs are narrow alley ways in the city center that join together traditional courtyards and neighborhoods; they are unique to northern Chinese cities and trace histories back to the Yuan Dynasty (1279-1368). For the last few decades, hutongs have been steadily demolished for modern building and road development, but in 2014, Beijing began renovating these famous historic areas. The Nanluoguxiang area, for example, has undergone tremendous changes in the hutong revival movement. Not only are shops more in line with city regulations, but the narrow roads in the hutongs have also been redesigned to be more orderly (Figure 21, 22). In 2018, the Xicheng Branch of the Beijing Municipal Planning and Land Resources Management Committee and Beijing University of Architecture's Urban Planning School published the "Beijing Xicheng District Urban Design Guidelines" (hereafter referred to as the Guidelines). The Guidelines specifically propose a series of guidance and control measures to preserve and repair the Beijing hutongs in Xicheng District. In particular, one of the principles in the Guidelines emphasized that pedestrians and bikers are given priority of narrow streets over motorized vehicles. In this case, promoting walking serves as a tool for the historic preservation of a neighborhood.

Summary

This chapter compares the vitality score and built environment score of streets in LWP centers to determine whether sidewalks in these centers are appealing to walk (marked by a high vitality score) and/or easy to walk (marked by a high built environment score). As expected, most streets in LWP centers have high vitality scores, but surprisingly low built environment scores. There were not enough streets with high-quality pedestrian infrastructures and facilities (with a high built environment score of 100) and far too many most-difficult-to-walk streets (with a low built environment score of 0). We noted that the streets with lowest quality of built environment are often along minor roads and hinder the development of an integrated, accessible, and high-quality sidewalk network; therefore, efforts should be prioritized on the fixing up of minor roads. We found that illegal occupation on sidewalks (parking of vendors, non-motorized transport, and vehicles) is highly prevalent in many of these LWP centers. This is important to note because existing low-cost, low-risk solutions could feasibly address these problems and instigate immediate positive change in urban walkability. Furthermore, cities with special characteristics like historic preservation blocks should make locally specific plans to meet the needs of both historic preservation and modern transportation development.

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5

CONCLUSION AND OUTLOOK

This walkability report evaluated the Live-Work-Play centers of 50 cities using 9 indicators that measured the built environment of streets. The study covered 4 centrally-administered municipalities, 27 provincial capitals, autonomous regional capitals, 5 municipalities separately listed on the state plan, and 14 other prefecture-level cities. In total, the study scope involved 12,740 streets in 71 LWP centers.

On each of the 12,740 streets we examined, we selected observation points every 50 meters and captured panoramic photos of them, accumulating a total of 31,226 observation points. Then, we measured and scored the street images according to the nine indicators designed to evaluate the built environment. The average built environment score of the 71 LWP centers is 41.9 points, with the highest score of 59.9 points in Beijing Sub-center (Zhongguancun).

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By comparing the scores of the LWP centers in each city, we found that overall, built environment scores of streets in centrally-administered municipalities rank higher than those in other types of cities. Big cities have larger resource and talent pools, which enables them to generate more abundant and comprehensive research and policies about non-motorized traffic. The high-ranking municipality zones show that, to an extent, city-wide efforts in prioritizing the construction of an efficient non-motorized transport system are directly related to improvements in the quality of the sidewalks. The specific attention municipalities focus on walkability indicates that pedestrian-friendliness is an important factor in urban development. The success of non-motorized transport development in municipalities can then serve as a springboard for more walkability-positive change in other cities and regions.

The combined results of this newest evaluation along with those of the previous walkability report help provide a more holistic analysis of streets in city centers. Conclusions show that, most importantly, cities need to adopt more refined construction and measures to upgrade urban non-motorized/pedestrian systems, and the first of that requires policymakers and relevant city managers to find streets in most need of fixing-ups.

This report attempted to identify streets that need the most improvement and propose policy recommendations. The comparison of built environment and vitality scores found that sidewalks along major roads in LWP centers are both appealing to pedestrians and comfortable to walk. However, sidewalks along minor roads that branch off from major roads have consistent defects. We believe that if we can effectively improve the walking environment of these minor roads and eventually connect consistently high-quality sidewalks into an integrated network, we can better encourage people to prioritize walking for short trips and meet the standard of a fully walkable city.

This report is another exploration into the evaluation of walkability in cities, but there are still shortcomings. In our evaluation, the virtual built environment auditing method that manually scores panoramic street images is subjective and can result in biases. Manual labor is also time-consuming and costly. We expect that with advances in technology, data acquisition methods in the future will be more convenient and consistent, and scoring will be more objectively accurate. The introduction of deep learning algorithms would be an invaluable tool in this study. In terms of our evaluation indicators, we realized that there are far more than just nine indicators needed to effectively measure built environment that affect individual's walking experience. For example, we can also consider indicators such as the length of pedestrian crosswalks and the quantity of pedestrian street signs. As for the existing indicators, we believe that indicator weights can be further classified according to street size and type of land use on both sides of the road, and then assigned accordingly.

This report aims to raise public awareness on the importance of walkability in cities and advocate among city managers about positive impacts of urban redesign and construction. We hope that in the future, institutions and experts in related urban planning fields can implement and fund street design and reconstruction based on our research results. Studies such as this one can help the city fully integrate walkabiltiy into its transportation network in a short amount of time and with low-cost.

APPENDIX I:

LIST OF RECENT URBAN PLANNING AND TRANSPORTATION POLICIES IN VARIOUS PROVINCES OF CHINA

PROVINCE	POLICY DOCUMENT	PUBLICATION DATE	TYPE OF USAGE	SOURCE
Beijing	北京街道更新治理城市设计导则	2018	Guiding standard	http://bj.people.com.cn/n2/2018/0918/c82840-32067445.html
	北京西城街区整理城市设计导则	2018	Guiding standard	http://www.cecssc.com/nd.jsp?id=1080
	北京市实施《中华人民共和国道路交通安全法》办法	2018	Law and regulation	https://baijiahao.baidu.com/s?id=1614344022471015302&wfr=spider&for=pc
Tianjin	中心城区"一环十一园"规划	2018	Statutory planning and design	http://tj.sina.com.cn/news/m/2018-06-01/detail-ihcikcev9216118.shtml?from=tj_cnxh
Shanghai	上海市城市总体规划（2017-2035年）	2018	Statutory planning and design	http://www.shanghai.gov.cn/nw2/nw2314/nw32419/nw42806/
	上海市街道设计导则	2016	Guiding standard	http://www.mohurd.gov.cn/dfxx/201703/t20170308_230898.html
Chongqing	渝中半岛步行系统规划及示范段设计	2018	Guiding standard	http://www.cqghy.com.cn/index.php?s=/articles/183.html
	重庆市山城步道设计导则	2018	Guiding standard	http://www.ccc.gov.cn/xxgk/wjtz/2018-04-11-11247179.html
Hebei	河北雄安新区规划纲要	2018	Statutory planning and design	http://finance.sina.com.cn/china/dfjj/2018-05-08/doc-ihacuuvu7413336.shtml
	河北省小城镇建设标准（试行）	2018	Mandatory standard	https://ebook.chinabuilding.com.cn/zbooklib/book/detail/show?SiteID=1&bookID=108037
	城市容貌管理标准	2018	Mandatory standard	https://baijiahao.baidu.com/s?id=1601292016572266649&wfr=spider&for=pc
Shanxi	山西省黄河、长城、太行三大板块旅游公路设计技术指南（试行）	2018	Guiding standard	https://baijiahao.baidu.com/s?id=1610086761238452057&wfr=spider&for=pc

PROVINCE	POLICY DOCUMENT	PUBLICATION DATE	TYPE OF USAGE	SOURCE
Liaoning	大连市慢行交通系统规划	2017	Guiding standard	http://news.sina.com.cn/c/2017-08-23/doc-ifykiqfe0886890.shtml
	沈阳市慢行交通系统专项规划	2016	Guiding standard	http://www.iecity.com/shenyang/news/detail307100.html
Jilin	长春市步行与自行车交通系统专项规划	2015	Guiding standard	http://www.ciupdchina.com/gh_view.php?id=505
Heilongjiang	黑龙江省城市道路交通文明畅通提升三年行动计划（2018—2020年）	2018	Guiding standard	http://www.nenjiang.gov.cn/system/201808/160591.html
	黑龙江省现代综合交通运输体系发展"十三五"规划	2017	Guiding standard	http://www.hlj.gov.cn/zwfb/system/2017/06/02/010830638.shtml
Jiangsu	江苏省"十三五"铁路发展规划	2017	Guiding standard	http://jtyst.jiangsu.gov.cn/art/2017/10/27/art_41830_6095651.html
	南京市街道设计导则	2017	Guiding standard	http://www.xinhuanet.com/city/2017-03/04/c_129501078.htm
Zhejiang	浙江省全民健身实施计划（2016—2020年）	2016	Guiding standard	http://www.zj.gov.cn/art/2016/10/21/art_12460_286133.html
Anhui	关于合肥市慢行系统规划建设的报告	2016	Guiding standard	http://www.sohu.com/a/110501651_468998
	合肥高新区综合交通规划	2018	Guiding standard	http://365jia.cn/news/2018-04-13/AF4F2856D5A0307E.html
Fujian	福建省城市道路交通文明畅通提升行动计划实施方案（2017—2020年）	2017	Guiding standard	http://www.fujian.gov.cn/zc/zxwj/bmwj/201712/t20171228_1312544.htm
Jiangxi	江西省实施道路交通安全规划2018-2020年工作方案	2018	Guiding standard	http://www.jxsafety.gov.cn/aspx/news_show.aspx?id=15197
	南昌红谷滩城市综合交通规划	2018	Guiding standard	http://jiangxi.jxnews.com.cn/system/2018/03/15/016806140.shtml
	赣州市中心城区步行和自行车交通系统规划（2015-2030年）	2017	Guiding standard	http://www.gzsghj.gov.cn/mobile/news/ghdetail/id/40.html

PROVINCE	POLICY DOCUMENT	PUBLICATION DATE	TYPE OF USAGE	SOURCE
Shandong	青岛市中心城区控制性详细规划	2017	Statutory planning and design	http://house.qingdaonews.com/news/2017-12/16/content_20064972.htm
	滨州市城区步行、自行车交通系统专项规划	2018	Guiding standard	https://baijiahao.baidu.com/s?id=1609670456014416871&wfr=spider&for=pc
	山东潍坊经济开发区综合交通体系规划	2018	Guiding standard	http://wfrb.wfnews.com.cn/content/20181130/Articel04002TB.htm
Henan	河南省县城规划建设导则	2016	Guiding standard	https://www.henan.gov.cn/2017/02-03/248583.html
Hubei	湖北省城市道路交通文明畅通提升行动计划（2018-2020年）	2018	Guiding standard	http://www.hubei.gov.cn/govfile/ezbf/201805/t20180518_1288104.shtml
Hunan	湖南省城市（县城）步行和自行车交通系统规划设计导则及建设标准（试行）	2018	Guiding standard	http://www.hunanjst.com/zjtmh/15/81/370/content_164980.html
	株洲市街道设计导则	2018	Guiding standard	http://ghj.zhuzhou.gov.cn/c11258/20181026/i781005.html
	湖南省城市综合交通体系"十三五"发展规划	2016	Guiding standard	http://www.csx.gov.cn/jtj/jtxw/1765293/index.html
Guangdong	广州市全要素街道设计手册	2017	Guiding standard	http://news.ycwb.com/2017-08/30/content_25440452.htm
	2017年广州市环境提升计划工作方案	2017	Guiding standard	http://www.ccgp.gov.cn/cggg/dfgg/dylygg/201710/t20171018_9008226.htm
	广东省城市基础设施建设"十三五"规划(2016-2020年)	2017	Guiding standard	http://gz.leju.com/news/2017-07-30/08456297225295774924978.shtml
	步行与自行车交通蓝皮书	2017	Guiding standard	chrome-extension://ikhdkkncnoglghljlkmcimlnlhkeamad/pdf-viewer/web/viewer.html?file=http%3A%2F%2Fwww.itdp-china.org%2Fmedia%2Fpublications%2Fpdfs%2Fnmtblue.pdf
	龙湖区慢行交通系统规划研究	2017	Guiding standard	http://www.bikehome.cc/news/20170606/558345_1.html
	罗湖区完整街道设计导则	2018	Guiding standard	http://www.szlh.gov.cn/gzcy/jcjd/201712/t20171229_11638647.htm

PROVINCE	POLICY DOCUMENT	PUBLICATION DATE	TYPE OF USAGE	SOURCE
Hainan	海南省生态修复城市修补工作方案(2018-2020)	2018	Guiding standard	http://www.hainan.gov.cn/hainan/zxxx/201811/abe5314bf6754679a12195dcbddf1908.shtml
	儋州市步行和自行车慢行交通系统规划	2017	Guiding standard	http://www.sohu.com/a/147118906_676719
Sichuan	成都市少城片区有机更新规划导则	2018	Guiding standard	http://scnews.newssc.org/system/20180906/000905328.html
	四川省人民政府关于深入推进新型城镇化建设的实施意见	2016	Guiding standard	http://zcwj.sc.gov.cn/xxgk/NewT.aspx?i=20161222083548-927290-00-000
	成都市中心城区特色风貌街道规划建设技术导则（2017版）	2017	Guiding standard	http://www.msweekly.com/show.html?id=96699
Guizhou	贵阳市"十三五"交通发展专项规划	2017	Guiding standard	http://news.gzw.net/2017/0122/1225060.shtml
	关于着力打造"可步行"城市的建议	2016	Guiding standard	http://www.gygov.gov.cn/zwgk/zdlyxxgk/jyta/zxtawfws/qs/20181019/i1839249.html
Yunnan	昆明市街道设计导则	2017	Guiding standard	https://www.kunming.cn/news/c/2017-09-20/4778102.shtml
	云南省人民政府关于深入推进新型城镇化建设的实施意见	2016	Guiding standard	http://www.yn.gov.cn/jd_1/xzcjd/201607/t20160722_26206.html
Shanxi	大西安"十三五"综合交通运输发展规划	2018	Guiding standard	http://news.xiancn.com/content/2018-05/22/content_3341558.htm
Gansu	兰州市中心城区控制性详细规划	2018	Statutory planning and design	https://lz.focus.cn/zixun/9a9595d54619b30a.html
Qinghai	青海省防治慢性病中长期规划（2017—2025年）	2017	Guiding standard	https://www.qhwjw.gov.cn/zwgk/xxgkml/2018/03/08/1520469967297.html
Taiwan	高雄策略：未来城市交通	2017	Guiding standard	chrome-extension://ikhdkkncnoglghljlkmcimlnlhkeamad/pdf-viewer/web/viewer.html?file=https%3A%2F%2Fecomobility.org%2Fwp-content%2Fuploads%2F2018%2F02%2FKaohsiung-Strategies_ChineseTraditional.pdf

PROVINCE	POLICY DOCUMENT	PUBLICATION DATE	TYPE OF USAGE	SOURCE
Inner Mongolia	内蒙古自治区人民政府办公厅关于 深化城市交通管理工作有关事宜的通知	2017	Guiding standard	http://www.baotou.gov.cn/info/2057/145669.htm
Guangxi	广西壮族自治区人民政府办公厅关于加强城市道路交通管理工作的指导意见	2017	Guiding standard	http://www.gxzf.gov.cn/zwgk/zfwj/zzqrmzfbgtwj/2017ngzbwj/20170325-604196.shtml
Tibet	全面推进拉萨市综合交通体系规划编制工作	2018	Guiding standard	http://www.Lhasa.gov.cn/Lhasa/xwzx/2018-03/16/content_1054110.shtml
Ningxia	宁夏回族自治区城市公共交通"十三五"规划纲要	2017	Guiding standard	http://m.xinhuanet.com/2017-06/13/c_1121132010.htm
Xinjiang	乌鲁木齐市中心城区慢行系统规划(2016-2020年)	2017	Guiding standard	http://www.iyaxin.com/content/201707/10/c146755.html
	新疆维吾尔自治区交通运输"十三五"发展规划研究（征求意见稿）	2015	Guiding standard	http://www.xjjt.gov.cn/index.php/Home/Index/xxgkcon/id/84334.html
Hong Kong	行人环境改善计划	2000	Guiding standard	https://www.td.gov.hk/tc/transport_in_hong_kong/pedestrianisation/pedestrianisation/index.html
Macao	澳门特区五年发展规划（2016-2020年）草案文本	2016	Guiding standard	https://www.cccmtl.gov.mo/files/projecto_plan_cn.pdf

APPENDIX II:
SPECIFIC LOCATIONS OF THE 71 LWP CENTERS

NO.	LWP CENTER	JURISDICTION	NAME OF MAJOR ROAD
1	Shanghai	Huangpu District	Jiujiang Rd.
2	Dongguan	Dongcheng District	Dongcheng Rd.
3	Linyi	Chancheng District	Xinhua Rd.
4	Urumqi	Tianshan District	Zhongshan Rd.
5	Foshan	Dongcheng District	Zumiao
6	Lanzhou	Chengguan District	Nanguanshjizi
7	Beijing	Chaoyang District	Guomao CBD
8	Beijing Sub-center 1	Dongcheng District	Dengshikou
9	Beijing Sub-center 2	Haidian District	Zhongguancun
10	Nanjing	Gulou-Xuanwu-Qinhuai	Xinjiekou
11	Naning	Xingning-Qingxiu District	Chaoyang Rd.-Minzudadao
12	Nanchang	Donghu-Xihu District	Zhongshan Rd.

NO.	LWP CENTER	JURISDICTION	NAME OF MAJOR ROAD
13	Nanyang	Wolong district	Municipal Government
14	Xiamen	Siming District	Jiahe Rd.- Hubin South Rd.
15	Xiamen Sub-center	Siming District	Xingfu Rd.
16	Hefei	Luyang District	Shifu Square- Sipailou
17	Zhoukou	Chuanhui District	Wuyi Square
18	Huhehot	Huimin-Xincheng District	Zhongshan Rd.
19	Harbin	Daoli District	Jingwei St.
20	Harbin Sub-center	Nangang District	Childrens'Park
21	Dalian	Zhongshan District	Zhongshan Square
22	Tianjin	Heping District	Yingdaokou- Nanjing Rd.
23	Taiyuan	Yingze District	Liuxiang-Zhonglou St.-Kaihua Temple-Jiefang Rd.-Wuyi Rd.
24	Ningbo	Haishu District	Tianyi Square
25	Ningbo Sub-center 1	Yinzhou District	Caihong North Rd.- Baizhang East Rd.
26	Ningbo Sub-center 2	Haishu District	Shijicheng
27	Guangzhou	Yuexiu District	Zhongshan Rd.- Jiefang Rd.

NO.	LWP CENTER	JURISDICTION	NAME OF MAJOR ROAD
28	Guangzhou Sub-center	Tianhe District	Tianhe Rd.- Tiyu East Rd.
29	Chengdu	Jinjiang-Qingyang District	Chunxi Rd.
30	Lhasa	Chengguan District	Dazhao Temple
31	Kunming	Wuhua District	Nanping St.
32	Hangzhou	Shangcheng District	Qingchun Rd.
33	Wuhan	Jianghan District	Jianghan Rd.
34	Shenyang	Shenhe District	Zhongjie
35	Shenyang Sub-center 1	Heping District	Taiyuan St.
36	Shenyang Sub-center 2	Tiexi District	Tiexi Square
37	Quanzhou	Licheng District	Tumen St.
38	Jinan	Shizhong District	Daguanyuan
39	Jinan Sub-center 1	Licheng District	Shanda North Rd.
40	Jinan Sub-center 2	Lixia District	Quancheng Rd.
41	Jining	Rencheng District	Municipal Government
42	Haikou	Longhua District	Datong Rd.

NO.	LWP CENTER	JURISDICTION	NAME OF MAJOR ROAD
43	Haikou Sub-center I	Longhua District	Jinlong Rd.
44	Shenzhen	Luohu District	Guomao
45	Shenzhen Sub-center	Futian District	Shennanzhong Rd.
46	Wenzhou	Lucheng District	Renmin Rd.-Jiefang St.
47	Weifang	Huaicheng-Guiwen district	First Ring Rd of Main City（Shengli St.-Heping Rd.）
48	Yantai	Zhifu district	Nandajie
49	Shijiazhuang	Qiaoxi District	Zhongshan West Rd.
50	Shijiazhuang Sub-center	ChanganDistrict	Zhongshan East Rd.
51	Fuzhou	Gulou District	Dongjiekou
52	Suzhou	Gusu District	Guanqian St.
53	Heze	Mudan District	Sanjiao Garden
54	Xining	Chengzhong District	Dashizi
55	Xi'an	Beilin-Lianhu-Xincheng District	Zhonglou
56	Guiyang	Yungang District	Penshuichi
57	Zunyi city	Honghuagang District	Beijing Rd.

NO.	LWP CENTER	JURISDICTION	NAME OF MAJOR ROAD
58	Zunyi Sub-center 1	Huichuan District	Nanjing Rd.
59	Zunyi Sub-center 2	Honghuagang District	Biyun Rd.
60	Handan	Hanshan District	Zhonghua St.-Heping Rd.
61	Zhengzhou	Ershiqi District	Erqi Square
62	Zhengzhou Sub-center	Jinshui District	Huayuan Rd.- Hongzhuan Rd.
63	Chongqing	Jiangbei District	Guanyin Bridge
64	Chongqing Sub-center 1	Shapingba District	Sanxia Square
65	Chongqing Sub-center 2	NananDistrict	Nancheng Ave.
66	Yinchuan	Xingqing District	Xinhua St.
67	Changchun	Chaoyang/Nanguan District	Renmin St.- Chongqing Rd.
68	Changchun Sub-center	Chaoyang District	Jilin University（Xinmin Campus）
69	Changsha	Furong District	Wuyi Ave.
70	Tsingdao	Shibei District	Weihai Rd.
71	Qingdao Sub-center	Shinan District	Fuzhou South Rd.

APPENDIX III:
VITALITY SCORE CALCULATION METHODOLOGY

The methodology for calculating the street vitality score is similar to that for the Walk Score. In order to gauge the strength of the urban fabric's main service facilities, we first select one or more observation points on a street. Then, we measure the diversity and density of shops, restaurants, schools, and other "points of interest" (POI). The street network map used in this calculation was generated from mapping data of Chinese cities in 2014.

First, the POIs most relevant to pedestrian activity are divided into 9 categories according to their functions. They are weighted according to their attraction to pedestrians (see table below). As shown in the following table. The weighting system is adapted from existing Walk Score calculation categories with localization to Chinese cities.

Second, we add a distance attenuation coefficient for POIs of different distances, because the potential impact of the POI's service capacity decreases as the distance increases:

TABLE: WEIGHT OF POIS

POI CATEGORY	WEIGHT	POI CATEGORY	WEIGHT	POI CATEGORY	WEIGHT
Convenience store	3	Coffee shop/Tea	2	School	1
Restaurant	3	Bank	1	Bookstore	1
Shop	2	Park	1	Entertainment Venue	1

(1) Within 400 meters: distance attenuation coefficient of 1, the score is not attenuated

(2) 400-800 meters: distance attenuation coefficient of 0.9, there is an attenuation of 10%

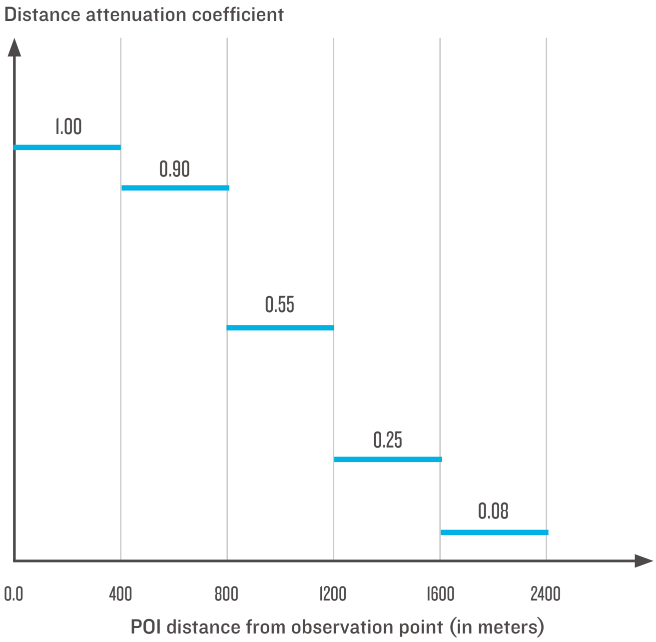
(3) 800-1200 meters: distance attenuation coefficient of 0.55

(4) 1200-1600 meters: distance attenuation coefficient of 0.25

(5) 1600-2400 meters: distance attenuation coefficient of 0.08

(6) 2400 meters away: out of service range, not included in calculations

DIAGRAM: DISTANCE ATTENUATION COEFFICIENT ACCORDING TO DISTANCE FROM OBSERVATION POINT



Thus, the service range of each type of POI is multiplied by the distance attenuation coefficient. Then, by factoring in the weights, we can determine the diversity and functional mixtures of POI within a specific range around each sample point. This calculation shows us the level by which walking facilities can attract people to walk and contribute to the urban vitality of each street. We have provided the formula we have used to calculate street vitality, where *i* indicates different types of facilities, *j* indicates different walking distances, $S_{i,j}$ indicates the service range of certain types of facilities and walking distance, and DD_j indicates the distance attenuation coefficient of the facility.

$$\text{Street vitality score} = \sum_{i=1,j=1}^{m,n} (w_i \cdot S_{i,j} \cdot DD_j)$$

APPENDIX IV:
BUILT ENVIRONMENT INDEX

TABLE I : BUILT ENVIRONMENT EVALUATION INDICATORS

EVALUATION INDICATOR	DESCRIPTION
Pedestrian crossings	Traffic and crossing signs, overpasses, underpasses, crosswalk markings, pedestrian islands, etc.
Street trees	Shading provided by trees on both sides of the street.
Comfortable sense of enclosure	The appropriate building height-to-street-width ratio we use to measure this study is 1:2.
Street furniture	Chairs, stools, and other pedestrian furniture placed on both sides of the street for pedestrians to rest while commuting (includes benches at bus stops).
Street buffers	Pedestrian guardrails, roadside parking lines, street side flower beds, car bumpers.
Appropriate sidewalk width	The width of the sidewalk should be moderate and not too narrow. Too narrow of spaces are generally reflected in the distance of street greening (like tree pits, bushes, etc.) and facilities (such as garbage bins, street lamps, seating, transformer boxes, etc.). Convenient, equitable walking spaces consider whether the width of two people walking side by side is sufficient, making walking spaces accessible for the disabled, elderly, or families with strollers. For now, we are not considering factors that cause pedestrian spaces to be too wide.
Absence of illegal occupation on sidewalks	There is absence of long-term illegal occupation on sidewalks. For example, there are no small business vendors or vehicles occupying sidewalks and competing for pedestrian space.
Sidewalk maintenance	There are no obvious disrepair and maintenance on sidewalks, which can include signs of unkept road paving, damage in sidewalks, cracking on road surfaces, etc.
Bike lanes	Dedicated bike lane with obvious markings, paving, or isolation barriers.

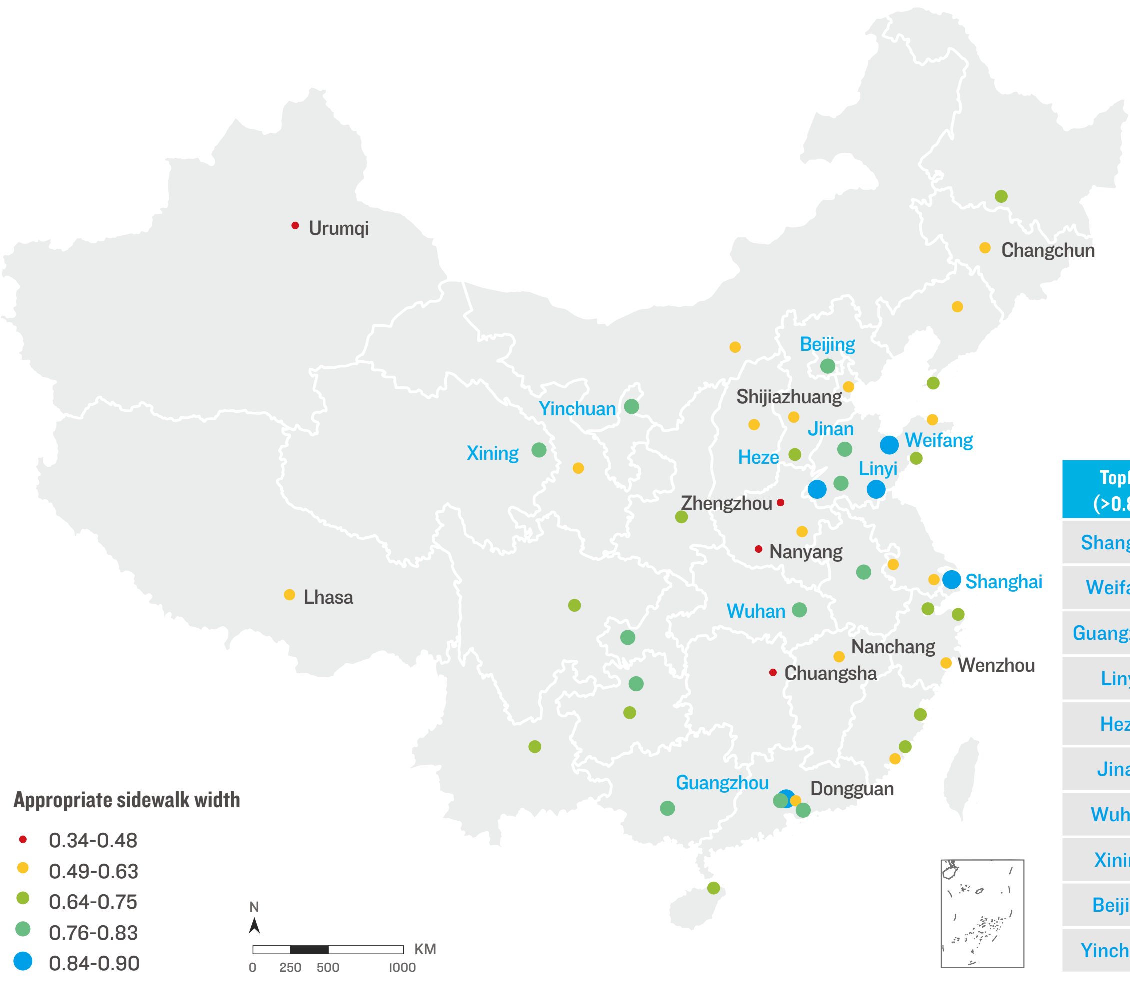
In this study, we selected 12,740 streets in 71 LWP centers. Using Baidu Street Images, we captured a total of 31,226 observation points and collected it all into an online pedestrian evaluation system. The following methods were used to generate the built environment audit based on street view images. The indicators are scored one by one. Table 1 is a detailed description of the evaluation indicators.

Figure 1 below depicts a typical panoramic shot used for evaluating street walkability. The observation score is on the top left of the photo. On the right is an index of the 9 indicators. Indicators are checked if they are met and given 1 point per check. If an indicator is not checked, it means that it does not meet the indicator requirements and are assigned 0 points.

FIGURE 1. STREET VIEW EVALUATION AND INDICATORS

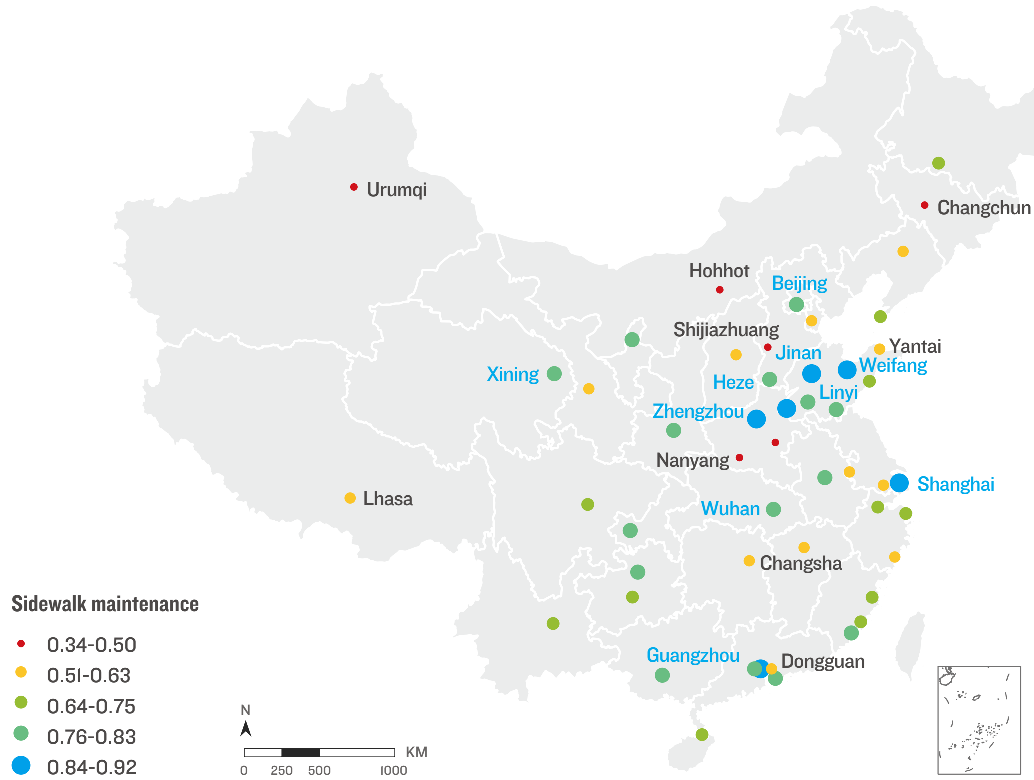
APPENDIX V:
TOP 10 PERFORMING CITIES IN SINGLE EVALUATION CATEGORIES

1. APPROPRIATE SIDEWALK WIDTH



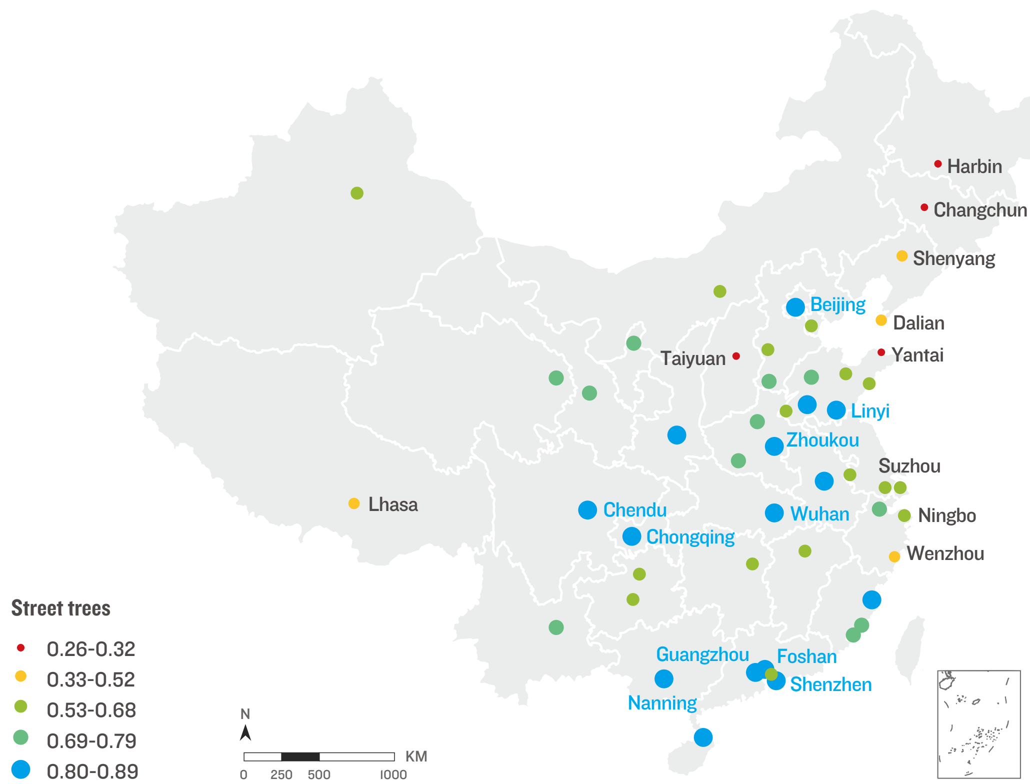
Top10 (>0.81)	Last10 (<0.556)
Shanghai	Changchun
Weifang	Lhasa
Guangzhou	Wenzhou
Linyi	Nanchang
Heze	Shijiazhuang
Jinan	Dongguan
Wuhan	Changsha
Xining	Zhengzhou
Beijing	Urumqi
Yinchuan	Nanyang

2. SIDEWALK MAINTENANCE



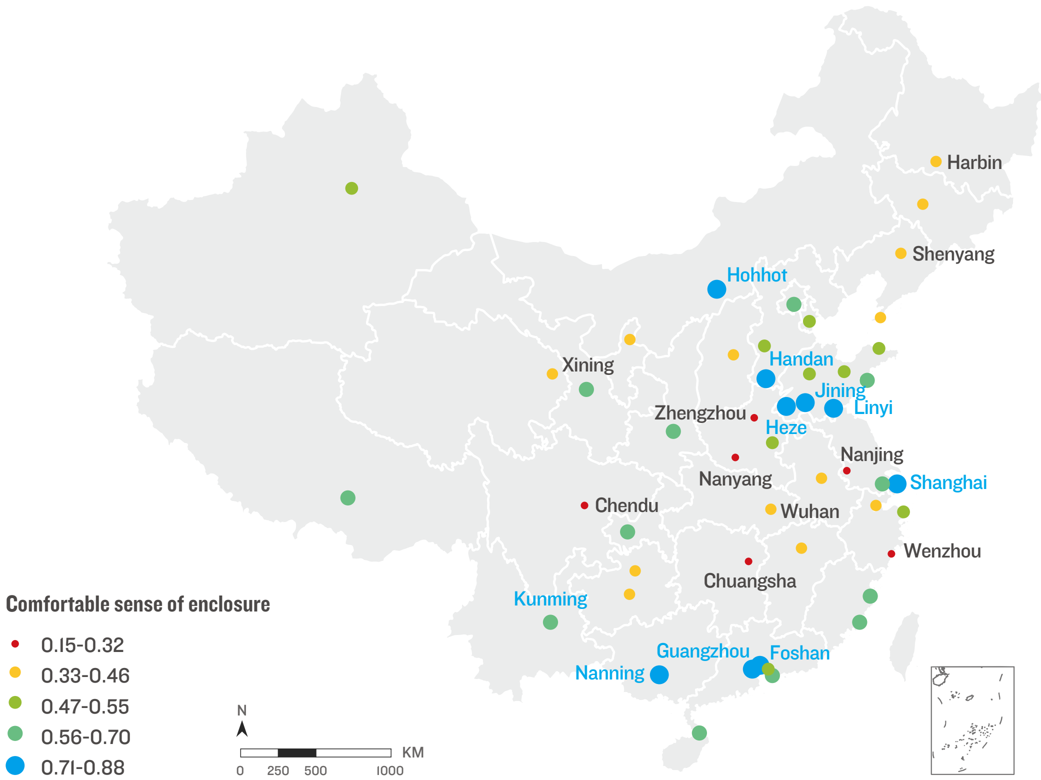
Top10 (>0.812)	Last10 (<0.55)
Guangzhou	Lhasa
Shanghai	Changsha
Zhengzhou	Yantai
Weifang	Dongguan
Heze	Shijiazhuang
Jinan	Hohhot
Linyi	Chuangchun
Wuhan	Urumqi
Beijing	Zhoukou
Xining	Nanyang

3. STREET TREES



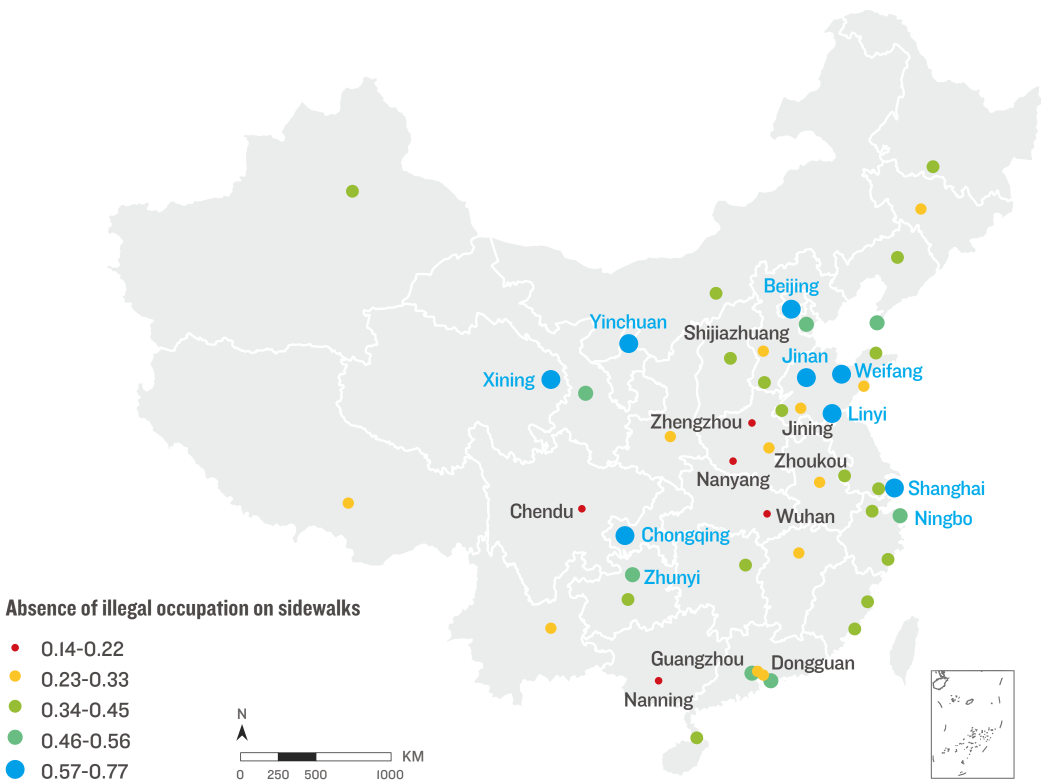
Top10 (>0.84)	Last10 (<0.59)
Foshan	Suzhou
Guangzhou	Ningbo
Zhoukou	Wenzhou
Wuhan	Lhasa
Chongqing	Dalian
Linyi	Shenyang
Beijing	Harbin
Nanning	Taiyuan
Chendu	Changchun
Shenzhen	Yantai

4. COMFORTABLE SENSE OF ENCLOSURE



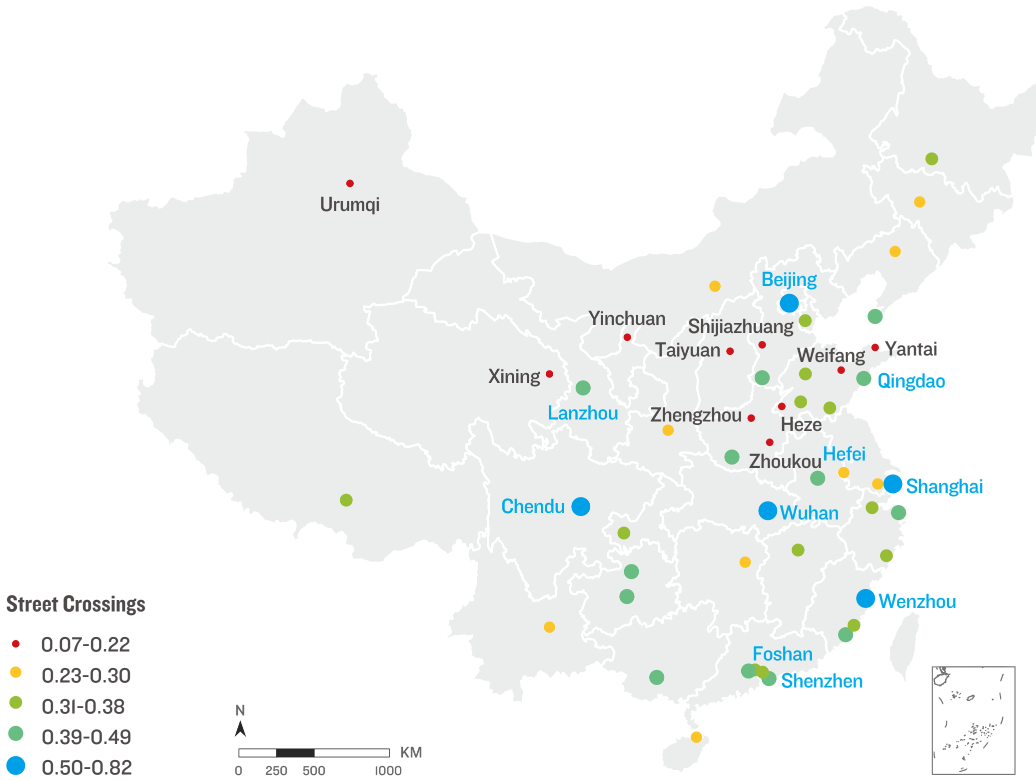
Top10 (>0.75)	Last10 (<0.39)
Guangzhou	Wuhan
Heze	Xining
Shanghai	Shenyang
Linyi	Harbin
Nanning	Nanjing
Jining	Zhengzhou
Handan	Nanyang
Foshan	Changsha
Hohhot	Wenzhou
Kunming	Chendu

5. ABSENCE OF ILLEGAL OCCUPATION ON SIDEWALKS



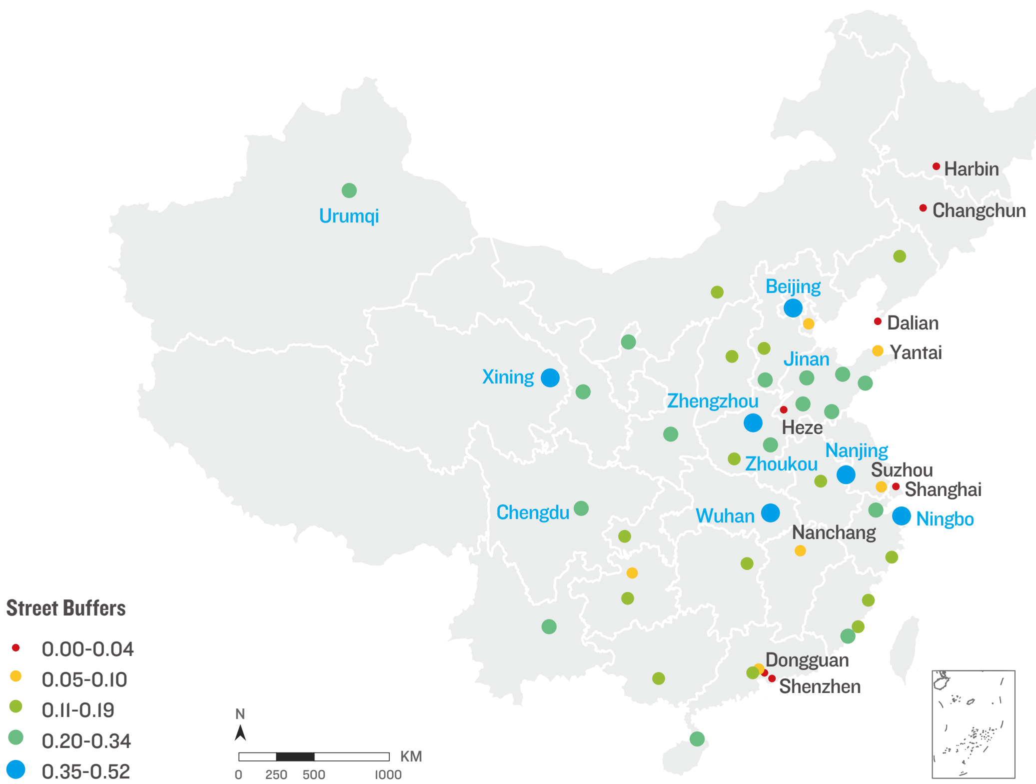
Top10 (>0.55)	Last10 (<0.28)
Weifang	Dongguan
Beijign	Shijiazhuang
Chongqing	Nanning
Xining	Zhoukou
Jinan	Guanghzou
Yinchuang	Zhengzhou
Shanghai	Nanyang
Linyi	Chengdu
Ningbo	Wuhan
Zunyi	Nanning

6. STREET CROSSINGS



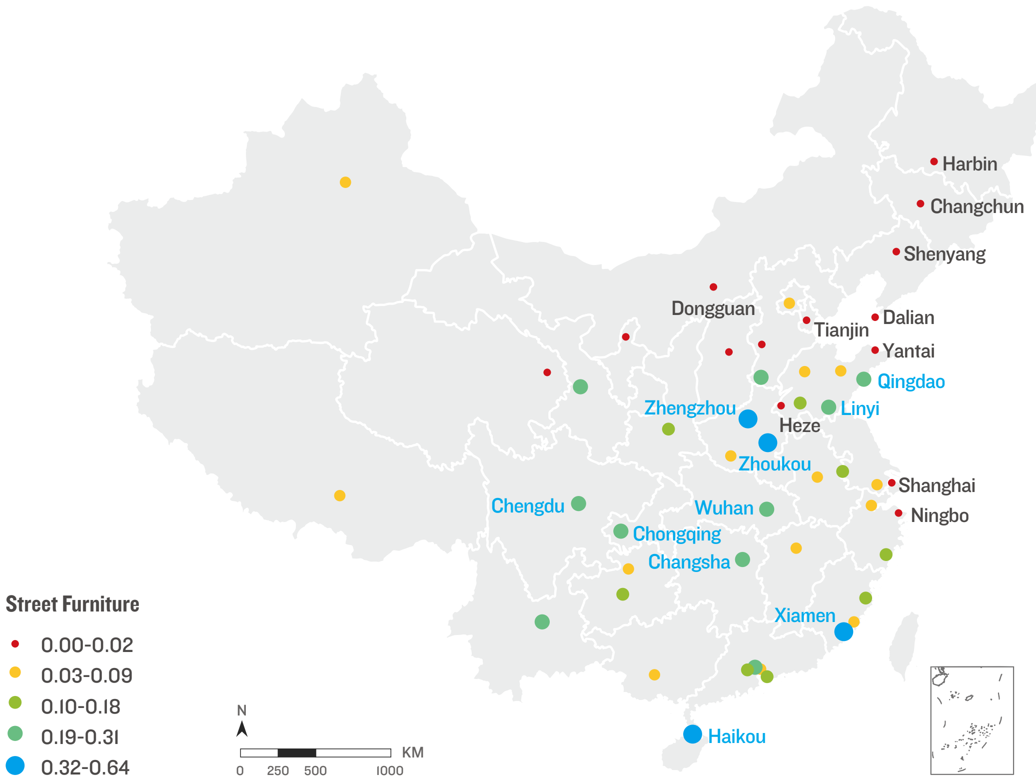
Top10 (>0.43)	Last10 (<0.22)
Shanghai	Weifang
Chendu	Taiyuan
Fuzhou	Yantai
Wuhan	Zhengzhou
Beijing	Yinchuan
Qingdao	Shijiazhuang
Shenzhen	Urumqi
Lanzhou	Xining
Foshan	Zhoukou
Hefei	Heze

7. STREET BUFFERS



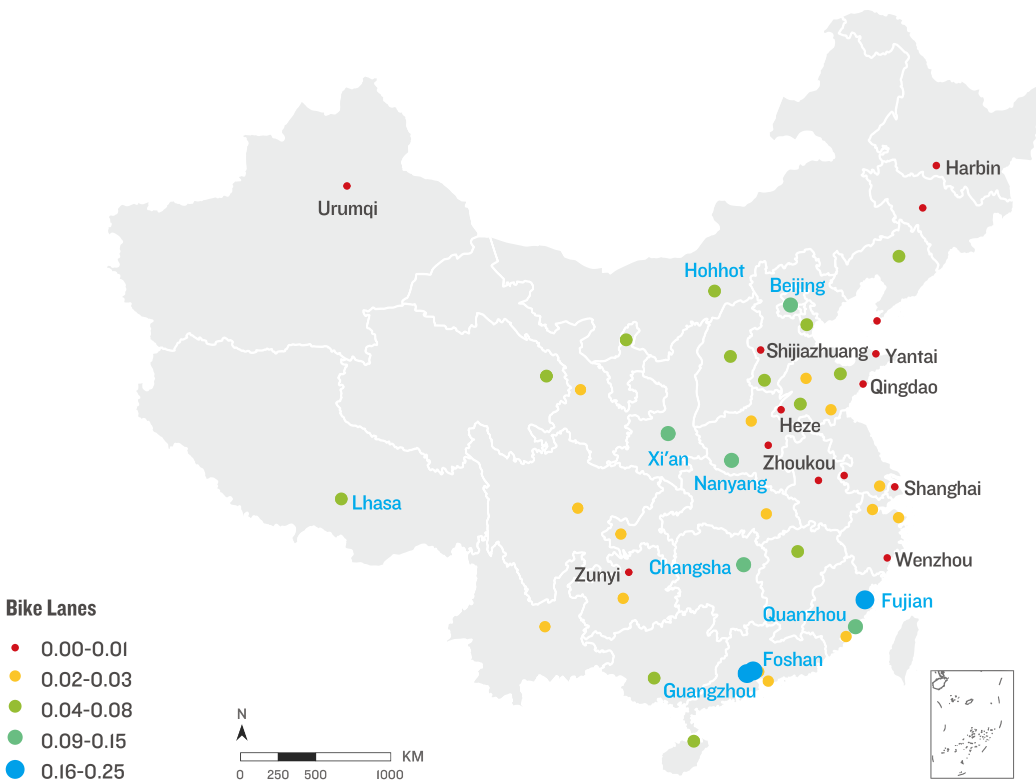
Top10 (>0.29)	Last10 (<0.087)
Beijing	Suzhou
Zhengzhou	Nanchang
Nanjing	Yantai
Wuhan	Changchun
Ningbo	Shenzhen
Xining	Dalian
Urumqi	Shanghai
Zhoukou	Harbin
Chengdu	Dongguan
Jinan	Heze

8. STREET FURNITURE



Top10 (>0.24)	Last10 (<0.01)
Zhengzhou	Ningbo
Haikou	Heze
Zhoukou	Shanghai
Xiamen	Changchun
Linyi	Tianjin
Changsha	Shenyang
Chengdu	Hohhot
Qingdao	Yantai
Wuhan	Dalian
Chongqing	Harbin

9. BIKE LANES



Top10 (>0.066)	Last10 (<0.007)
Foshan	Heze
Fuzhou	Wenzhou
Guangzhou	Shanghai
Beijing	Qingdao
Xi'an	Yantai
Quanzhou	Shijiazhuang
Changsha	Urumqi
Nanyang	Zunyi
Hohhot	Harbin
Lhasa	Zhoukou

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