CITYNET

THE REGIONAL NETWORK OF LOCAL AUTHORITIES
FOR THE MANAGEMENT OF HUMAN SETTLEMENTS

Smart Cities, Mobility, Walkability and Emissions

A report prepared for CityNet by KABC Ltd
(a member of the Intercedent Network)

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About CityNet

CityNet is the largest association of urban stakeholders committed to sustainable development in the Asia Pacific region. Established in 1987 with the support of UNESCAP, UNDP and UN-Habitat, the Network of cities has grown to include 154 municipalities, NGOs, private companies and research centres. CityNet connects actors, exchanges knowledge and builds commitment to more sustainable and resilient cities. Through capacity building, city-to-city cooperation and tangible projects, we help our members respond to Climate Change, Disaster, the Sustainable Development Goals and rising Infrastructure demands.

About Korea Associates Business Consultancy (KABC)

KABC Ltd is part of the Intercedent Network which has representatives in most Asian Cities. KABC Ltd, a partner of Intercedent based in Seoul, has been in the business of making surveys both in Republic of Korea and regional studies since 1989, based on the experience of Dr. Tony Michell and others. KABC Ltd has performed a wide range of surveys for companies and individuals, including an Asia wide forecast for motor vehicles for European Small Volume Car Manufacturers Alliance (ESCA), and a study of the secrets of success of the Korean auto industry for the Malaysian government. Dr. Michell, who mainly wrote this report, is a regional economist who has written about urban transport and worked with Korean planners and international consultants on a series of World Bank, UNDP, Ministry of Transport and Ministry of Construction projects in Asia. Recently he has been involved in LRT design in Africa, Mexico and Asia. He can be contacted through CityNet Secretariat at info@citynet-ap.org.

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Foreword by CityNet Secretary General

CityNet's activities are driven by four clusters, namely climate change, infrastructure, disaster, and the SDGs. Following a very successful Infrastructure Cluster Meeting held in Kuala Lumpur from 23-26 July, 2018, the CityNet Secretariat conducted a survey among CityNet members on the topics of Smart Cities, Mobility, Walkability and Emissions. The collected information was analyzed to better assess member needs in developing innovative solutions to their urban challenges.

Populations among Asian cities are growing rapidly, and along with their growing economies the demand for high quality infrastructure is intensifying. Our citizens are demanding access to affordable and efficient public services, and city governments find it very challenging to expand infrastructure fast enough to keep up with rising demand for improved infrastructure, environmental and social services. Whenever there is a gap between urban services citizens demand and the actual supply an environmental crisis ensues, notably in the form of very visible uncollected garbage, untreated waste water and air pollution from the rising usage of privately owned cars and poorly maintained public buses. These problems exacerbate carbon emissions that contribute to global warming.

As emphasized by the Deputy Mayor of Kuala Lumpur Datuk Mahadi bin Che Ngah, during the Infrastructure Cluster meeting, data collection is critical to developing demand-responsive programs for our members. This survey enabled us to collect the information. The survey design incorporated the recommendations of the CityNet Medium Term Plan 2018-2021 and CityNet member inputs to focus on three top priorities identified at the meeting: smart city development, urban mobility and sustainable management of city emissions. The study describes our findings based on the data collected.

The next step is for cities to develop action plans which are operationally relevant and cost effective within each city's specific economic and political context. Equally significant, the city needs to customize or localise good practices, improve human resources, and engage communities in a dialogue that shares not only the success stories but also failures to avoid repeating the mistakes made by their peers. A second point is to explore how best big data analytics using digital technology can support the process of dialogue and future planning, with the people living in the city as the principal agents of change.

Seoul Metropolitan Government and Kuala Lumpur City Hall have played leading roles within CityNet, as President and Vice-President city respectively of the Executive Committee, and as Infrastructure Cluster Leader and Co-leader. We are grateful for their support and encouragement.

Vijay Jagannathan
CityNet Secretary General

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Smart Cities, Mobility, Walkability and Emissions

1. Key Findings

Some of the cities in the sample equal "best in class of 2018"

- A review of the smartest city surveys and technical surveys show that some cities in the Asia Pacific network are amongst the best in class in 2018 as regards smartness in mobility. But about half the cities are well behind in their thinking.
- The Smart City Awards at the 2018 Smart City Expo and World congress suggests that there is a leap in "smartness" which is coming soon, which the Asia Pacific cities are not yet working on.
- Across the region, those cities which are good today are challenged by the new trends of ridesharing, electric vehicles (EVs), e-mobility device and ridesharing.
- In the US, Europe and our sample, smartness is held up because of not sharing enough data between different parts of the city's administrative agencies, so the smartness remains "locked" in particular areas.
- Most cities are not calculating their emission footprint, and consequently failing to develop achievable carbon emission savings in the mobility sector, or other sectors (in Asian cities mobility accounts for about 20% of emissions).
- About half the cities have difficulty pushing pedestrianisation.
- About half the cities have unlinked traffic signals (a problem they sharing with Boston, Massachusetts).
- Most of the best in class smart cities failed one test.

"Without smart citizens we cannot make smart cities"

- There is a divide between making smart citizens and making smart cities.
- Cities exist for the residents and visitors and not for themselves.
- Indonesian cities have Qlue and other cities such as Seoul have developed apps for communications with citizens, ahead of many western cities. Both need to be developed and deployed in more circumstances.
- Taipei City has accepted large numbers of suggestions from its citizens and businesses for smart experiments (or "proofs of concept" as jargon puts it).
- There is a gap between economic proof of concept – e.g. that ridesharing is economically viable – and regulatory proof of concept – acceptance by the city – which ought to be bridged by smart citizen participation.
- But not all citizens have smart phones and, in the race, to create smart cities a digital divide must not be created. The smart card continues to be important and could become smarter.
- Due regard for the equitable needs of all citizens young and old need to be considered.

The search for good practice

Discussion with the think tanks / CityNet Associate members suggested studying the following:

- Bus Rapid Transit (BRT) in Ahmedabad
- Last mile cycle rental Delhi
- Qlue software in Jakarta and other Indonesian cities
- Smart card rental systems (as opposed to smart phone systems)
- City management in a heritage city Galle
- Chinese cities experiments
- Bus lanes in Seoul linked to ease of pedestrian mobility
- Binh Duong smart city conference

The survey suggests other advanced practices to be studied further:

- Central bus lane, pedestrianisation and green links along watercourse in Seoul
- Digitalisation in Bogor
- The many citizen suggested experiments of Taipei City
- Yokohama's experience in transit and emission reduction
- Narayanganj and Tarlac's experience with driverless cars (and that of the 11 cities that are testing the process)
- Various cities experience with electric scooters and e-mobility (including docking and dockless experiments)
- Nepalese cities experience with electric vehicles

Potential for group interaction to raise the level of walkability, transit use and emission reduction in the CityNet cities

- A high degree of improvement is possible through the spread of conventional good mobility planning which the leading cities have developed over years, but which could be instantly shared with other cities.
- The calculation of emission footprints of Jakarta can be adopted by other cities to advantage. Yokohama's success in removing emissions deserves to be studied.
- New techniques of linking traffic signals with "smart poles" rather than Local Area Network (LAN) systems can improve traffic movement in about half of the sample.
- The development of joint study tours and training can allow the sharing, and encouragement, of the best practice, including the training of those who must make decisions and those who act as expert advisors.
- There is also a need to share experience with advanced digitalisation and big data usage, soon driverless cars, and one day Artificial Intelligence (AI) experience as this grows. The work of advanced cities needs to be shared with those which are only starting the journey.

CityNet's future role

- CityNet has an important role to play in this processes given the different levels of the cities surveyed in arranging not only a study tour, but also a workshop process for smart city advisors to develop a uniform level of understanding and close monitoring of experiments and proof of concept in one city by all other interested cities.
- CityNet needs to help interested cities monitor on going experiments and experiences, and act as a resource for all cities.

- Smaller cities appear to need more assistance. Their expectations of the level of smartness in five years' time is only that of where medium-sized cities think they are now. They need the shared experience which CityNet can offer, and due attention to them is required.
- Binh Duong's smartness in organising an annual conference which made concrete proposals for the city's future evolution was recommended by one associate member. The idea inviting all interests to a specific city conference to gain recommendations sounds like something that CityNet could organise.
- Smartness is accelerating in 2019 and CityNet could consider keeping an on line database of recent developments.

2. Introduction

This report consists of a state of the art review of progress towards liveable, sustainable, smart cities with particular respect to eco-mobility, with examples of key developments, coupled with a survey of 28 cities within the CityNet membership, and the opinion of eight major associate members of CityNet.

Cities today are 2% of the earth surface; 50% of world population; 75% of global energy consumption; and 80% of global CO2 emissions. Cities are growing: by 2050, they will be 70% of world population – this means that across the Asia Pacific we must build the same urban capacity in the next 40 years as in the past 4,000 years, and while in Korea and Japan urbanisation is almost complete, in much of the rest of the region the pace matches the global average. Although most urban growth will take place in emerging economies, urban challenges are the same all over the world: congestion, unemployment, crime and a high carbon footprint.

The aim of this research is to provide a platform on which CityNet members can share a debate about the creation of liveable and sustainable cities, and the application of smartness to enhance the process, and how to apply the lessons learned to allow best practice within the network and beyond. Since the progress towards smartness is still in its early stages, the network can share experiments and policies for the future as well as lessons already learnt.

The 2018 Smart City Expo and World Congress, held in Barcelona as this report was being completed, showed a leap in smartness as cities began to deploy AIs on an experimental basis to solve complexity issues. As explained in this report, there are many degrees of smartness possible before AIs are required, and many tasks to prepare for AI involvement especially the pooling of existing data within each city's urban functions.

Our survey shows that aspects of the best cities surveyed are level with the current world standard, and therefore there is a high potential for CityNet members to practice self-help in which the leading cities help cities not yet so advanced in the process. The meeting held in Da Nang in November 2018 which discussed the draft findings of the survey agreed on some immediate measures and discussed further joint activities.

Especially our cities can demonstrate that putting the citizen first is most important. As one associate member interviewed put it, "without smart citizens we cannot build smart cities". The survey shows that citizens have high expectations from smartness, but it requires the leadership of Mayors to ensure these expectations are met.

However, CityNet cities need to be aware of the next generation of smart cities now being planned which will shortly be developing pilot studies through the Association of Southeast Asian Nations (ASEAN) Smart Cities Network. Without enhancing the present systems, cities will find it difficult to make the next jump.

The survey

The survey of CityNet members was conducted in October and November against a deadline to present key results at the meeting in Da Nang November 21st. Thanks to the tireless effort of CityNet staff, 33 replies were received, 28 from cities and five from associate members plus eight interviews conducted with experts in those associate members, in Delhi, Jakarta, Taipei City, Kuala Lumpur, Galle and Hanoi. Five of these experts as well as contributing their opinions in an interview, submitted a questionnaire about their city. Their answers were combined with others from the big cities, and Galle was added to the small cities category. Thus while there was a single response from most cities, there were three from Delhi and three from Jakarta.

The full tabulated responses from all cities is contained in the appendix and individual answers analysed in appropriate places in the report. More detailed results are available from CityNet. The results were divided into three categories, small cities up to 500,000, medium-sized cities from 500,001 to 10,000,000 and those above 10,000,000, Delhi, Jakarta and Seoul.[1]

1 The compilers of this report are aware that alternative divisions such as four rather than three divisions by size might show interesting alternative results. Analysis was complicated by the existence of completed questionnaires from associate members, all from the three large cities. We are happy to discuss these results further with members via the principal contact at CityNet Secretariat at info@citynet-ap.org.

3. What is a Smart City?

3.1. How it all began

The term smart city began to be used about 2010 as part of the promotion of work that IBM had done in Stockholm. At this time, it was all about linking different sets of data and using real time streaming analytics to help ease congestion. IBM announced that the resultant congestion management system has reduced traffic in the Swedish capital by 20 percent, reduced average travel times by almost 50 percent, decreased the amount of emissions by 10 percent and the proportion of green, tax-exempt vehicles has risen to nine percent.

IBM worked with the KTH Royal Institute of Technology on a further series of service linkages including water management.[2] Sustained by this success, IBM went on to work in several cities and Nice first applied the IBM Intelligent Operations Centre for Smarter Cities as a core point for aggregation and processing of information supplied by city services. IBM continues to promote its AI IBM Watson to think further into the future and find solutions to unsolvable problems.

Like Stockholm, the smart cities process was usually collaborative, IBM teamed up with Cisco and usually involved a local university or technology institute. Frequently a city will use different suppliers to provide different fractions of smartness. Smaller cities have largely used their own researchers to provide the solutions.

Smarter Cities are a journey, not a destination. Even the most advanced cities in smartness feel they are just beginning. London scores highly in most world rankings, but in June 2018 London launched a new comprehensive plan under a typically English quasi-official body the Smart London Board, which elaborated on a smart plan with five missions.[3] These five missions explain the current breadth of thinking about what a smart city can provide – far beyond the mobility experiments of IBM in Stockholm.

The missions are given in full because they define current thinking about smart cities:

Mission 1: More user-designed services

- Leadership in design and common standards to put users at the heart of what we do
- Develop new approaches to digital inclusion to support Londoners' access to public services
- Launch the Civic Innovation Challenge to spur innovation from the tech sector
- Explore new civic platforms to engage citizens and communities better
- Promote more diversity in tech to address inequality

Mission 2: Strike a new deal for city data

- Launch the London Office for Data Analytics (LODA) programme to increase data sharing and collaboration for the benefit of Londoners
- Develop a city-wide cyber security strategy to coordinate responses to cyber-threats to businesses, public services and citizens

2 Source: https://www-03.ibm.com/press/us/en/pressrelease/29903.wss

3 Source: https://www.london.gov.uk/sites/default/files/smarter_london_together_v1.66_-_published.pdf

- Strengthen data rights and accountability to build trust in how public data is used
- Support an open ecosystem to increase transparency and innovation

Mission 3: World-class connectivity and smarter streets

- Launch a new Connected London programme to coordinate connectivity and 5G projects
- Consider planning powers, like requiring full fibre to the home for all new developments, to enhance connectivity in the future
- Enhance public Wi-Fi in streets and public buildings to assist those who live, work and visit London
- Support a new generation of smart infrastructure through major combined procurements
- Promote common standards with smart tech to maximise benefits

Mission 4: Enhance digital leadership and skills

- Enhance digital and data leadership to make public services more open to innovation
- Develop workforce digital capability through the Mayor's Skills for Londoners Strategy
- Support computing skills and the digital talent pipeline from early years onwards
- Recognise the role of cultural institutions engaging citizens in the digital world

Mission 5: Improve city-wide collaboration

- Establish a London Office of Technology & Innovation (LOTI) to support common capabilities and standards for future innovation
- Promote MedTech innovation in the National Health Service (NHS) and social care to improve treatment
- Explore new partnerships with the tech sector and business models
- Support better Greater London Authority (GLA) Group digital delivery to improve effectiveness
- Collaborate with other cities in the UK and globally to adopt and share what works

Perhaps a smart city's goals can be summarised as:

- Energy-efficient, resource-efficient and scalable – in that case a smart city is one which is able to provide all the services its citizens need in the most efficient way, while creating jobs, fostering new ideas, being respectful with the environment and taking into account its citizens opinions
- More than just sensors and technology

3.2. Smart cities or smart citizens? – a bottom-up view

Looking at the five missions, while many of them profess to be for the users, the framework looks as though it is what administrators think users want, rather than through groups of users developing needs and asking a smart city infrastructure to provide what they need.

But while top-down smartness was proceeding in which the citizen normally benefited as a user, but did not have much input, smartness was increasingly in their hands as the mobile phone became the smart phone, and in homes the initial introduction of AI's was observed, so a second trend has developed. This is Smart Citizens telling the city what they want to do and identifying problems to be solved by the city government. Jakarta and several other cities led the way in this respect.

When IBM worked in Stockholm only taxis had interactive software that could stream to the centre.

Now most citizens who own cars also have navigation devices in their phones or fixed systems in their cars. So using bottom-up data is clearly a way to move towards smart cities, especially in developing countries where funds for complete central systems are not available. The evolution of Wi-Fi also offers a way of linking equipment where LAN was required in the past. In the North Avenue Smart Corridor of Atlanta, which also won an award in Smart City Expo 2018, this 2.3km experiment in the most congested city of the US will have messages given by smart phone to cyclists and other motorists, and use the connected cars to feed many of the information services.[4]

In a sense the idea of London stated above, about putting fibre into all new developments seems an extension of old think, in that if the city consists of people, then the mobile phone using Wi-Fi is an extension of that person (and may in future technology become more internal to the person). While we will look at it in more detail later Jakarta developed a smart app Qlue, which allows each citizen to communicate to the Mayor (or Governor) and which sends a message to each concerned department. Essentially this allowed each citizen to send discontents and (we hope) satisfaction to those who worked in the city.[5] Seoul and other cities have such systems but with much lower utilisation.

Smart Citizens are why the English scheme puts more user-designed services as step one. In Baltimore the officer in charge, Shonte Eldridge, began with a user survey on mobility. Eldridge's first step was to contact businesses, not for money, but for advice, on what a smart city is and to broaden her understanding. She said Baltimore needed a solid roadmap based on its needs and the needs of its residents, who suffer from inequity between neighbourhoods and poor transit options. She also said while some may view being a smart city as embracing some of the more cutting-edge technology, that won't quite work in Baltimore, where she still has colleagues adjusting traffic signals by hand.[6] About half the cities in our survey still were in this situation.

Baltimore survey takers said they want features that help them save time while driving. 62% of respondents expressed a desire for potential time-savers such as connecting to prepaid parking. Also, 60% of respondents said they would like the vehicle to convey other travel options based on traffic conditions such as walking distance, bus stops or subway routes.[7]

3.3. Citizen-focused definition[8]

UK citizens tend to consider a smart city as clean, friendly and have good transport connections. Other words they associate with smart cities (although less frequently) include "technology", "connected", "internet" and "modern".[9]

According to the Manchester Digital Development agency, "a 'smart city' means 'smart citizens' – where citizens have all the information, they need to make informed choices about their lifestyle, work and travel options".[10]

4 Source: https://www.atkinsglobal.com/en-gb/projects/renew-atlanta-north-avenue-smart-corridor

5 Interview with Yoga Adiwinarto, Indonesia Country Director of Institute for Transportation & Development Policy (ITDP)

6 Source: https://www.smartcitiesworld.net/news/news/turning-baltimore-into-a-smart-city-3126

7 Source: https://www.smartcitiesworld.net/news/news/turning-baltimore-into-a-smart-city-3126

8 Source: https://www.centreforcities.org/reader/smart-cities/what-is-a-smart-city/

9 Source: Duckenfield T (2014), What people want from their cities, Connected Cities 2014, London: Steer Davies Gleave

10 Source: https://cityverve.org.uk/what-is-cityverve/ - cityverve is the site of Manchester's smart city demonstrator

But citizens also wanted efficient cities. This function is partly if not wholly administrative driven. Schneider Electric one of the commercial providers of smart capability defines the process as follows. “At Schneider Electric, we define a smart city as efficient, liveable and sustainable.

Efficient means improving the efficiency of a city’s underlying urban infrastructures – its water network, its gas network, its electricity network, its transportation systems, its emergency response systems, its buildings, its hospitals, its public services, etc.

Liveable means becoming a more pleasant place to live, work and play – for its residents as well as for its visitors and commuters. Attractiveness matters – it means building the talent-pool the city needs, the housing market its people needs, providing the cultural events that bring the spotlights.

Finally, sustainable means reducing the environmental consequences of urban life – reducing the city’s carbon emissions, regenerating some districts, planting trees, creating parks, planning the city differently.”[11]

The UK Department for Business, Innovation and Skills (BIS) considers smart cities a process rather than a static outcome, in which increased citizen engagement, hard infrastructure, social capital and digital technologies make cities more liveable, resilient and better able to respond to challenges.[12]

The British Standards Institute (BSI) defines the term as “the effective integration of physical, digital and human systems in the built environment to deliver sustainable, prosperous and inclusive future for its citizens”.

3.4. Data-driven definitions

Other definitions are data driven. IBM defines a smart city as “one that makes optimal use of all the interconnected information available today to better understand and control its operations and optimize the use of limited resources”.[13]

Cisco defines smart cities as those who adopt “scalable solutions that take advantage of information and communications technology (ICT) to increase efficiencies, reduce costs, and enhance quality of life”.[14]

London’s Mission 2 is a “new deal for data.” In completing our survey, most respondents found that basic summary information across the framework of mobility, walkability, emissions and smartness was not available easily. Perhaps most surprising was the lack of emission information and either the city’s or citizen’s carbon footprint. A city that does not know its footprint is ill prepared to measure emission reduction as a result of the smart revolution.

Scalability and interconnectivity of data are common phrases in the smart literature. It is essential that measurements of improvement can be made to ensure that the right decisions are taken.

11 Source: https://www.schneider-electric.co.in/en/work/solutions/for-business/inclusive-smart-cities/

12 Source: https://www.centreforcities.org/reader/smart-cities/what-is-a-smart-city/1-smart-cities-definitions/; https://www.ibm.com/smarterplanet/us/en/smarter_cities/overview/

13 Source: https/www.ibm.com/smarterplanet/us/en/smarter_cities/overview/

14 Source: https://www.cisco.com/c/en/us/solutions/industries/smart-connected-communities.html

3.5. Conclusion

Both citizen's desires and the connectivity of data are core elements in the drive to create smart cities. Without data interconnectivity, cities hold it in silos or on paper or which they fail to record at all, plus the data that can easily be collected, the optimal, efficient solutions cannot be created. For the future real time data cannot be streamed into solutions.

4. Smart Cities and Mobility Case Studies

4.1. Examples of smart cities

The search for smart cities case studies extended from India to Mexico and from the Netherlands to Australia. Some 1,000 cities have elements of smartness, but there is no city which has yet mastered all the smart activities – many opting mainly for building energy control (33% of carbon emissions come from buildings, whereas mobility contributes only about 20% except in the US and cities with low density and high personal transportation desires where it can mount towards 40%).

This report mainly identifies smart segments as state of the art, rather than complete cities. We have limited the case studies to seven, representing the global best, seeking Asian examples wherever possible. Some estimates put the number of smart city pilot schemes at over 1,000. Further, ASEAN has just announced a 26 city pilot study (ASEAN Smart Cities Network cities). This includes about three of the cities in our sample below.

4.2. Seoul

Seoul entered the smart mobility city phase early in 2005 with a massive overhaul of the city bus system which was losing ridership fast. A system of central reservation bus lanes, still being incrementally expanded, was developed, plus a Bus Enterprise Management System (BEMS) which immediately restored ridership to the buses and through the new interchange smart ticket between bus and ever expanding subway system. The changes were able to speed bus journeys and restore lost transit ridership and feed the subways. Interchange became free within a 10km distance on buses, and from bus to subway and subway to bus for a minor charge. Bus speed improved from 9kph to 30kph. Ridership which had fallen from 4.29 million in 2000 to 3.9 in 2004 (as new subways opened) rose to 4.5 million and has retained that level although the subway network has continued to grow.[15]

However, 24% of trips remain with car users, more than twice that of Tokyo. Seoul estimated that 84% of car trips were by single users. In Seoul, rideshare programmes have been largely fought off by the power of the taxi drivers who also have a uniquely high share of the modal split. Electric vehicles remain very rare.

Driven by successive mayors, the city has become greener with keynote waterways providing walkability and for many cycling paths in a healthy environment. Pedestrianisation and sidewalk widening have grown, and policing of pedestrian only streets enforced. A city driven cycle rental scheme has been rapidly rolled out in 2017-18. Modern buildings increasingly have sensor parking information at entrance and lights marking vacant spaces overhead inside.

In 2016, apps to communicate problems to the city administration were introduced. It also allows citizens to vote on how the US$43 billion city budget should be used. One million citizens (about 10% of the total) voted.

15 Source: https://seoulsolution.kr/en/content/2595

Seoul has evolved many of the elements of a smart city over the last decade. As yet, as in nearly every city, the components do not connect. Most recent parking lots have placed sensors that tell the driver which places are still available with a green light indicating an empty space – important for some of the 1,000 place car parks. The BEMS system tells passengers when the next bus comes, and access to BEMS is possible with a smart phone. The smart travel card allows interchange between bus and subway. This is managed today by Transport Operation and Information Service (TOPIS). This has evolved to become apps from local mobile carriers, chiefly SK Mobile inform passengers of routes and modes to different destinations. Rental bikes are released by phone app. The Area Traffic Control (ATC) which is fairly advanced did not yet connect with the BEMS, but has done so under the third stage of TOPIS but bus only signals are still on timers, not reflecting need.[16]

To step up to the next level two things are required:

1) Decisions by citizens on what connectivity should be pursued and the principles
2) Establishment of interconnectivity

This is a massive step, with both extensive investment and an agenda which needs to be developed to explain how citizens can develop principles.

Figure 1. Seoul Digital Plan 2020

Source: https://oascities.org/wp-content/uploads/2018/01/Seoul-Smart-City-Initiatives-Cases-_Dr.-Jungwoo-Lee.pdf

4.3. Taipei City

To realise the idea of developing a smart city, Taipei City government founded the Smart City Committee in 2015. To implement the idea, the Department of Information Technology of Taipei City Government proposed to assist the citizens of Taipei City to conduct field experimental pilot programmes in Taipei City for potential solutions, and then provide assistance in the development of

16 Source: http://topis.seoul.go.kr/eng/page/about_1.jsp

a smart city industrial business model, expansion of urban and international marketing, and further enactment of “Taipei Smart City Industrial Field Pilot Programme” to boost communicative output value.[17]

The Taipei Smart City Industrial Field Pilot Programme hopes to help smart city and Internet of things (IoT) related ecosystems take root in the city and to open up the experimental field of innovative city solutions. By opening up smart city application-related proof of concept (POC) to people’s proposal to the city government, the city government can in turn provide those interested with empirical evidence to serve as backup forces, thereby furthering operation models and example experiences. After receiving the proposals submitted by members of the public, the Taipei Smart City Project Management Office (TPMO) conducts discussions on the content of proposal based on innovation, feasibility, public welfare, and legality.

The key smart city directions are developed mainly under the following five themes: Smart Transportation, Smart Public Housing, Smart Healthcare, Smart Education and Smart Payment. Also, by adopting the POC model, Taipei City opens up its fields to all kinds of innovative solutions for trail. Since TPMO has established, over 130 POC projects have been initiated, and more than 300 ICT vendors have been in contact with one another and the city. The development of Smart Taipei is intended to lead to new smart city solutions and better services for citizens as well as new business possibilities for the companies. Ultimately, the aim is to build Taipei City into a smart city brand in Asia.

Projects in mobility include a smart parking project so availability of space in parking is available to cell phones and a ride sharing programme.[18]

Figure 2. Smart Parking in Taipei City Using IoT

This diagram shows the connection between LoRa (Long Range) digital network for IoT, parking and related interactions in Taipei City.
Source: https://smartcity.taipei/project/119

Taipei Mass Rapid Transit (MRT), bus, YouBike and other green transportation services are being perfected, mass transportation has become the nation's first goal, in order to reach the Taipei City Government's goal of increasing the proportion of green transportation. It is proposed to provide a

17 Source: https://smartcity.taipei/posts/16

18 Source: https://smartcity.taipei/project/119

full friendly environment, more green equipment, and better choice of incentives to allow the public to have better choices under more green gear. Taipei City works in conjunction with the central government to promote green transportation policy resources, build a friendly environment for electric vehicles, and combine civil power to build shared cars and motorcycles with high recognition and actual driving experience to promote green transportation policies.
The services planned for this case are as follows:

- Building electric vehicle charging facilities. There are 80 public parking lots in Taipei City equipped with charging poles for the general public electric motorcycles and shared electric vehicles to charge. Taipei City offers free charging when the registering number of electric vehicles was under 1,000.
- Public-private partnership promotes shared vehicles and motorcycles service. Provide administrative assistance for sharing electric vehicles and motorcycles, encourage many operators to invest in the Taipei City electric vehicles and motorcycles sharing plan, and assist in publicity.
- Construction of public bicycle rental stations. By the end of 2017, 400 rental stations had been completed in the city, so that people can walk to the rental station in 5-10 minutes.

Compared with Seoul, the composition of traffic on the street is very different with scooters and bikes playing an important role in personal transport and this has led to the rapid rise of e-scooters and other personal e-mobility devices.

4.4. Bogor Municipality

In our survey of Bogor, a city of 1,100,000, has one of the strongest intentions to apply smart systems. It does this by putting digitalisation first. In 2017, it announced a comprehensive Smart Masterplan, and is now working with Cisco to improve the measures already achieved by the Office of Communication, Information, Statistics and Coding (*Diskominfostandi*)[19]. From 2014, it has worked on digitisation to connect, monitor, control various resources in the city more effectively and efficiently to maximise services to its citizens and support sustainable development. The Bogor City Government won the 2016 Indonesia Digital Economy Award (IDEA) award. In 2017, *Diskominfostandi* announced plans to build 18 application support programmes towards a Smart City. The three priority programmes were pedestrian and parks, transportation and mass transportation, and garbage services, city cleanliness and public space.[20] The socialisation of information dissemination for smart city development is considered important so that all participants understand the concept. In the future, participants are expected to be able to create a smart city masterplan as the foundation for development for the next 5-10 years.

As noted in the Bogor Masterplan Smart City 2017-2021 (2nd book), this masterplan plays a vital role as a material foundation and guidance for current and future urban development. It can also help local governments in setting policies, regulations and direction of urban development priorities.[21] As a first step, Bogor Municipality is said to have had several supporting factors. Among them are the intranet and internet network infrastructure that connects all regional devices. It has an ATC system, bus lanes, pedestrianisation and sidewalks divided into pedestrian and cycle zones.

19 Source: http://www.beritasatu.com/jakarta/445733-kota-bogor-kembangkan-18-aplikasi-penunjang-smart-city.html

20 Source: http://www.beritasatu.com/jakarta/445733-kota-bogor-kembangkan-18-aplikasi-penunjang-smart-city.html

21 Source: buku-2.-masterplan-smart-city-kota-bogor.pdf

4.5. Jakarta

As part of its smart city development, Jakarta launched Qlue – "the smart city app". Qlue is a social media app which allows users to report problems directly to the local government and businesses, as well as sharing information with other citizens. Reports sent through Qlue are dispatched in real time to the relevant local authorities. Each report status can be monitored using the app and Qlue's dashboard online.

The app promotes civil participation and bottom-up engagement, encouraging citizens to complaint about poor or lack of services, bring suggestions forward or share data through different platforms, including Smart Government Dashboard, Smart Environment, Smart Mobility, Smart Media Analysis or Smart Safety. The promotion of city officials partly depended on the speed of application. Qlue was adopted by several other mayors in Indonesia.

One of Jakarta's future smart city projects is the development of OK OTrip, an integrated transit cashless payment system. The project consists on integrating all of the city's transport payment systems into one cashless platform to improve urban mobility, enhance modal share and reduce travel time, while keeping travel affordable.

4.6. Hanoi

Hanoi has been working on its smart city planning since 2016. With a population of 7.6 million, Vietnam's capital aspires to be a green, culturally-rich, civil and modern city with sustainable development to create a better life for its inhabitants by 2030. As a thriving city, Hanoi has one of the fastest Gross Domestic Product (GDP) growth rates in the world.

On the technology front, Ericsson affirms that the country will be adopting 5G within two years, something which would give a huge push to the development of Hanoi's smart city infrastructures. Hanoi's Smart City Action Plan includes the establishment of a Smart Operations Centre which will contain a number of functional hubs, including a support centre for the city's IT staff, a data analysis centre and a centre for traffic supervision, traffic control and crime prevention.[22]

In the education sector, 2,700 schools and universities are being integrated into an online system where school reports and enrolment data can be easily accessible online by students and teachers. When it comes to transportation, the city is working on a digital traffic map to ease traffic congestion. Hanoi, together with Ho Chi Minh City, is using the iParking app in some districts. Thanks to this app, drivers can find free parking spaces and pay from their smartphones easier and quicker.

4.7. Hangzhou applications

Hangzhou is not CityNet member but is added because of its regional technical importance with the use of AI. Launched in 2016, the Hangzhou "City Brain" project, created by Chinese retail and tech company, Alibaba, uses cameras systems and sensors across the city to collect data on road conditions in real-time. The data is fed to an AI hub, which then manages traffic signals at 128 intersections, and helps city officials make better decisions at a faster rate.

22 Source: https://www.mobileworldlive.com/featured-content/top-three/ericsson-to-open-iot-hub-in-hanoi/

By pulling from traffic and weather data, the City Brain analyses real-time traffic flow to regulate traffic signals at over 100 intersections. For instance, the system tracks ambulances en-route to hospitals and turns all red lights in its path to green, allowing patients to receive timely emergency care. The City Brain has since halved travelling times for ambulances and commuters, and cut travel times on highways by 4.6 minutes.

The programme has also allowed the city's traffic police to work more efficiently. They use data from the AI hub to arrive at accident sites and respond to traffic violations faster. "The City Brain can detect accidents within a second, and we can arrive at the site in 5 minutes." according to Zheng Yijiong, China's first traffic policeman to control traffic flows with an AI partner.[23]

Still AI can do much more than this and Hangzhou is approaching the system cautiously.

4.8. Singapore

Singapore won first prize in the 2018 Smart City Expo, having already been ranked sixth in the 2018 world smart city index, Singapore is at the forefront of the digital economy, digital government and digital society, and with its autonomous vehicles, smart sensor platform and use of AI.[24]

One of the elements which places Singapore ahead of its neighbours when it comes to smart city development is the government's strong commitment on tech-friendly legislation and a massive investment in its smart city infrastructure. According to International Data Corporation (IDC) data, Singapore leads the way in government IT spending among ASEAN countries. Singapore's advantage is that it is both a city and a national government which combines security data with urban data.

Singapore has undertaken a series of innovative projects over the past few years, some of them are within the standard realm of known smart city applications, and others that were more radical and largely untested in other cities. It has prepared for autonomous vehicles (AVs), allowed drone delivery testing and started developing a 3D map of its subterranean spaces for possible future underground development. The city also has forged technology partnerships to advance innovation, such as with Microsoft on machine learning and artificial intelligence projects in ride-hailing and mobility.[25]

Singapore also is the current chair of the ASEAN, which just entered a partnership with the United States to create opportunities for American companies to develop digital infrastructure in ASEAN member cities.[26]

4.9. Case study conclusion

The case of Seoul illustrates the ability of the fifth largest conurbation in the world to manage its systems efficiently without spending on the scale of Singapore. Bogor shows how a medium-sized city at a significantly lower per capita income than Singapore or Seoul can proceed by putting digitalisation first. Seoul and Taipei City are achieving high degree of smartness, largely through their own efforts

23 Five cities in China are developing AI applications to advance smart cities. This is believed to be the leading application, developed in conjunction with Alibaba. Source: https://govinsider.asia/security/five-chinese-smart-cities-leading-way/; https://www.wired.co.uk/article/alibaba-city-brain-artificial-intelligence-china-kuala-lumpur

24 Source: https://www.citi.io/2018/07/27/the-top-50-smart-cities-in-the-world-2018/

25 Source: https://news.microsoft.com/en-sg/2018/09/26/microsoft-ai-singapore-and-nus-to-develop-and-reinforce-singapores-ai-capabilities/; https://www.smartcitiesdive.com/news/singapore-takes-top-honors-at-smart-city-expo-world-congress/542516/

26 Source: https://www.smartcitiesdive.com/news/singapore-takes-top-honors-at-smart-city-expo-world-congress/542516/

by creating systematic plans and by encouraging citizens to participate with proposals. It is important to stress that smartness is not an end in itself. The smartness is used to improve transit, reduce congestion and promote a green city in which emissions are lowered. Substantial steps towards many of these goals can be achieved by straightforward city planning, through putting these priorities first.

5. The Cloud, Computer Systems and Data

5.1. The cloud

The cloud, subject of a previous CityNet's study by Intercedent in conjunction with Microsoft, is essential to this process.[27] Without use of the cloud the city must provide a server farm or link individual computers. Even as IBM was working on Stockholm in 2010, it also introduced the first "complete cloud." On March 1, 2011, IBM announced the IBM SmartCloud framework to support Smarter Planet. Among the various components of the Smarter Computing foundation, cloud computing is a critical part. On June 7, 2012, Oracle announced the Oracle Cloud. This cloud offering was poised to be the first to provide users with access to an integrated set of IT solutions, including the Applications (SaaS), Platform (PaaS), and Infrastructure (IaaS) layers. Since then Microsoft has rapidly developed a leadership in Cloud technology.[28]

The cloud in this sense is not just a server and storage replacement. The goal of cloud computing is to allow users to take benefit from all of these technologies, without the need for deep knowledge about or expertise with each one of them. The cloud aims to cut costs, and helps the users focus on their core business instead of being impeded by IT obstacles.

The main enabling technology for cloud computing is virtualisation. Virtualisation software separates a physical computing device into one or more "virtual" devices, each of which can be easily used and managed to perform computing tasks[29]. With operating system-level virtualisation essentially creating a scalable system of multiple independent computing devices, idle computing resources can be allocated and used more efficiently. Virtualisation provides the agility required to speed up IT operations, and reduces cost by increasing infrastructure utilisation. Autonomic computing automates the process through which the user can provision resources on-demand. By minimising user involvement, automation speeds up the process, reduces labor costs and reduces the possibility of human errors.[30]

So from a technical point of view many designers see "cloud computing as the Smart City". All city administrations have numerous departments dedicated to the management of a variety of metropolitan services. Typically, these departments offer services independently of one another, and as the city expands, duplicated effort and inefficiencies emerge.[31]

To attain smart city status, it is better to think of cities as complex systems with departments as subsystems sharing resources and assets smartly. For example, a typical department of transportation models traffic patterns in order to plan new roads or align traffic lights for optimum mobility. In a more systemic approach, city streets are a shared resource requiring a new perspective:

- The education department contributes to peak traffic according to school schedules;
- the sanitation department influences traffic with low speed vehicles collecting garbage; and
- the environmental department estimates pollution levels via the density of traffic;

27 Source: Citynet Whitepaper "City Cloud: Cloud Adoption for Asia's Cities"

28 Source: https://www.forbes.com/sites/bobevans1/2018/08/03/1-microsoft-widens-lead-over-2-amazon-in-cloud-revenue-6-9-billion-to-6-1-billion/#3a8cb99e3fc0

29 Source: Fintech: the New DNA of Financial Services by Pranay Gupta and T. Mandy Tham

30 Source: https://blog.sysfore.com/cloud-computing-introduction-part1/

31 Source: [PDF] Smart Cities Technology Roadmap

- delivery of supplies to retailers and other businesses can be scheduled to cause the least problems;
- roads can be cleared for emergency vehicles as in the Hangzhou example.

The smart city as the inevitable next phase of urbanisation remains dependent on the use of ICT/cloud infrastructure, but accents the role of human capital and education, social and relational capital and environmental awareness."[32]

Put simply, the cloud removes the necessity of an army of IT technicians with bewildering choices of software and hardware and should save a smart city's budget. But at the core of the cloud vision of the city described above is the sharing economy as an answer to eco-mobility – except it is road and pedestrian and cycle space which is being shared. Although joy riding exists, the main purpose of using roads is to get somewhere whether it is "round the corner" or to the other side of the city, or to a terminal to travel to the next city or across the world.

5.2. Software and sensors

The cloud consists of data storage and software solutions. But each software solution is important. Tata Consultancy Services (TCS)'s interconnective software is one example, ATC software is another. All of them are to be linked by a microwave system such as LoRa, or SigFox.

Data designers are looking for intelligence described as forms of intelligence in smart cities have been demonstrated in three ways:

- Orchestration intelligence
- Empowerment intelligence
- Instrumentation intelligence

5.3. Data

In theory, the Smart City could do what road charges cannot, which is create the use space equitably according to need – to get school children home as quickly and safely as possible in the instance above, to get an ambulance to an accident faster. But a cloud has no value without data as the London smart road map suggests. Putting data first is a task as soon as pilot schemes are fully implemented and citizen goals developed.

Every city has more data than it realises. In proof-of-concept Belfort case in France, the city thought the only transit data it had was the total number of tickets (or swipes of cards) in a day. It could not track which bus the cards were swiped in, where the passenger alighted or even the average load of the bus at different legs of its journey nor the congestion points. Clever software from Tata Data Systems used in Belfort, aligned with a travel card which was much smarter than people thought, gave the city much more information.[33]

32 Source: https://www.citymetric.com/horizons/how-can-you-measure-citys-sustainability-here-are-three-options-854; [PDF] Smart Cities Technology Roadmap

33 Source: https://digitalempowers.com/build-smart-city-transport-system-four-weeks/

Data sits in silos throughout the city, sometimes not even digital but on paper, and never used except to make a few formal statistics. Although much of the data may be collected on computers soon after the time of issue, it is not “live”. Integrative software and cloud storage solves these problems.

Bogor shows how digitalisation of data at an early stage can prepare the city for more sophisticated systems whereas cities which were slow to integrate data will be held up when the need for big data arises.

5.4. AI (Artificial Intelligence)

Until now, AI’s have made slow progress because an AI has to be trained to understand what is required of it. This process is known as machine learning (ML). Amazon, like Alibaba, while supplying the consumer with all that could be ordered on line, has been working on this problem and has developed the following products. The following is taken from an Amazon sponsored advertorial in ZDNet, but gives the clearest view of how AI can be made to work in cities and the jargon that goes with it. In the future similar devices from Amazon, Alibaba, Microsoft and other suppliers can be expected to be available.

“Amazon SageMaker: Machine learning has been challenging for most developers, because the process to build and train models, and then deploy them into production, is inherently complicated and slow. Amazon SageMaker is a fully managed machine learning platform provided by Amazon Web Services (AWS), which removes the complexity that holds back developer success. Amazon SageMaker includes modules that can be used together or independently to build, train, and deploy your machine learning system. It includes algorithm and model authoring tools, simplified connections to internal and cloud-based data sources, and a library of pre-built algorithms that are optimized to run on cloud resources. Simply put, SageMaker is the tool that will allow your existing developers to become machine learning developers.

AWS Greengrass: IoT is transforming the world we live in. Across industries, in both the public and private sector, IoT is connecting people and making data more accessible. AWS Greengrass is software that lets you run local compute, messaging, data caching, sync, and ML inference capabilities for connected devices in a secure way. Meaning, you can not only connect and manage your devices easily, you can also generate meaningful insights. Retailers, cruise lines, and amusement parks are investing in IoT applications to provide better customer service. Cities will follow.

For example, you can run object detection models at amusement parks to keep track of visitor count. Cameras locate the visitors and maintain a running headcount locally without having to send massive amounts of video feed to the cloud. This solution can predict wait times at popular theme park rides and help improve the customer experience. AWS Greengrass, running on Intel technology, delivers a secure, intelligent 'edge' that allows developers to create new applications easily from edge to cloud.

Amazon Elastic Compute Cloud (EC2): Defining how AI and ML can benefit your business is just one part of the equation. Building and running the computing infrastructure with the power needed to support ML applications is complex and costly. Amazon EC2 is a web service that takes these pains away. EC2 provides secure, resizable compute capacity in the cloud. It is designed to make web-scale cloud computing easier for developers, and it offers a variety of compute instances optimised for many ML use cases. Amazon EC2 C5 instances, for example, run on highly customised and powerful Intel

Xeon Scalable Processors and bring great price for performance value for training a variety of ML models and inference functions. AWS also offers GPU-based instances for ML training."[34]

In the future similar processes to these may become as common as loading windows or office onto a new computer. The results may be surprising, Elon Musk warns that the rate at which an AI, once operational, can develop itself beyond the conception of the original designer is enormous, and he thinks this is something which urgently requires oversight.[35]

34 Source: https://www.zdnet.com/sponsored-article/tech-brief-intro-to-ai-for-business/; http://i.zdnet.com/whitepapers/CBSi_AWS_Intel_Demystifying_AI_for_Business_tech_brief.pdf

35 Elon Musk warns that the rate at which an AI once operational can develop itself beyond the conception of the original designer requires oversight. Source: https://www.etftrends.com/robotics-ai-channel/elon-musk-last-warning-about-artificial-intelligence/

6. Mobility

6.1. Concerns about mobility

The concerns of smart mobility stretch in several directions:

- Reduce delays due to congestion
- To improve journey times
- Increase share and profitability of transit
- Sharing the road and pavement space
- To reduce emissions
- Concern for air quality and space taken by roads
- Increase safety and reduce emergency support time lapse

Our survey shows that about half the cities replying are still concerned about expanding road and parking space to the conventional automobile. The other half are working towards a new model which supports public transport transit, walking and the revival of cycling, while preparing for a more sharing, eco-friendly urban experience. These progressive cities are also beginning to witness shared vehicles from cycles to e-cycles to e-scooters to shared cars and ultimately driverless cars. (Two cities in our survey claim to allow driverless vehicles and 14 are testing them. The other 13 are banning them.)

For those cities following the old paradigm, the justification remains the rise in private car ownership, weak public transit systems and usually smaller populations. But in many cities of Asia, scooters and motorbikes make up a sizeable proportion of the modal split. In Taipei City, the side streets are cluttered with parked two wheeled vehicles making walking difficult.

Why shouldn't these vehicles have proper facilities just as a car requires parking facilities? For two wheeled vehicles whether powered on not, we call this docking. For the new for-hire options docking is considered desireable, but all old style driving is dockless.

From Galle in Sri Lanka to mega urban areas such as Seoul, Jakarta and New Delhi, there is a recognition that unless the private motorist is offered attractive alternatives, cities will deteriorate. Seoul tested its first central busway in 1990, but it took the initiative of the Mayor to make it a major part of the bus transit system from 2004-05. Despite confusing the public by introducing new routes and numbers at the same time, riders rapidly discovered that buses move faster than cars and car drivers learnt the same by watching buses go past, as they sat waiting to crawl to the next intersection.[36] Ridership which had fallen from 4.29 million in 2000 to 3.9 in 2004 (as new subways opened) rose to 4.5 million and has retained that level, although the subway network has continued to grow.[37]

Ahmedabad is regarded as a good example of a bus system using BRT. The city has a population of more than 6.3 million and an extended population of 7.2 million. It is the sixth largest city and seventh largest metropolitan area of India. The early criticism was that despite its widely regarded success the

36 Had Seoul had a bottom-up communication system in place, the confusing bus rerouting would not have taken place at that time, since it was partly driven by what many considered a mistaken idea of how a bus line should work as opposed to users needs. At the same time, smart travel cards introduced the integrated fare system of the bus and subway networks.

37 Source: https://www.seoulsolution.kr/en/content/reforming-public-transportation-seoul

buses carry only 18% of passengers in the city.[38] Further extensions of the network have taken place and it is now claimed that 42% of trips are by transit.[39] As a result of early criticism, many Indian cities are said to be building metros, despite the expense, because they do not believe buses can be the answer. A further criticism is that to serve the system with air conditioning, liquid gas was abandoned for diesel fuel for emissions rose sharply.

The core issue in most cities is of course limited road space and high density utilisation of the land, and in the pre climate-change and exclusive world, where the needs of the well-to-do came first, the answer was to widen roads and spread out functions over a wider urban area. Today we have to be more inclusive.

A lot of problems of congestion can be solved by the earliest of smart city inventions, the ATC system. Automatic linkages of connected signals were first introduced in Texas in 1922. Once computers became available from 1952, systems could be further advanced with pressure sensors in the roads at each intersection (Denver), and with advanced computers in 1967, a wider area with better sensing was implemented in Toronto. About half the smaller cities in our survey still have unlinked traffic signals and few are using advanced responsive systems.

In theory, the ATC system could have been extended to give traffic smartness much earlier by linking to other data. In practice, generally, ATC staff have tended their limited kingdom of traffic lights and did not always join in discussions with other planners.

6.2. Transit Utilisation

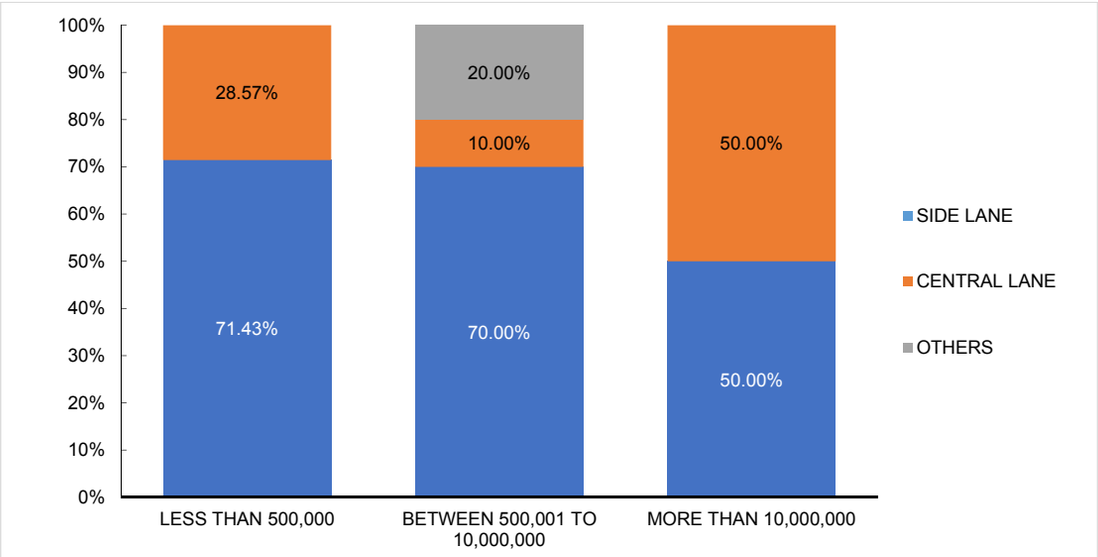
Historically, there has been a cycle of development in which public transit gives way to private transport. Many cities regarded this as inevitable in the US in the 1940s-1970s, Europe 1955-1975 and Asia as each city developed its own systems with the rise in per capita income. In Indonesia, Chinese Taipei and other Southeast Asian cities the scooter and motorbike preceded the passenger car, and still have a sizeable share of the modal split. A rule of thumb first identified in London is that if cars run faster than buses and trains, then there is a drift to private transport occurs, but as congestion slows cars, trains pick up passengers. By providing busways, buses can also reverse the decline as in Seoul.

The first step to faster buses is to provide a dedicated bus lane. Six of the 28 cities had no exclusive road space for buses. The cities were divided between the use of central lanes and side lanes.

38 Another issue was that emissions were increased due to switching to diesel buses. Source: https://www.unescap.org/sites/default/files/4.2%20Institutional%20issues%20and%20coordination%20in%20sustainable%20transport%20-%20CEPT.pdf/

39 Janmarg – BRTS Ahmedabad Bus Rapid Transit. Source: https://www.unescap.org/sites/default/files/4.2%20Institutional%20issues%20and%20coordination%20in%20sustainable%20transport%20-%20CEPT.pdf

Figure 3. Bus Priority System Type



Bus Lanes Approach in the 28 cities 6 cities have no bus lanes (Others include bus only roads)

Central lanes seem to work best where space allows for four reasons:

1) No parked vehicles delay the buses
2) The central lane requires more pedestrian crossings to the bus stop increasing ease of all pedestrian trips
3) For the passenger both sides of the road are equally accessible[40]
4) Traffic signals can prioritise transit vehicles at intersections

Without bus lanes, and bus priority systems, it is hard for transit to compete effectively with other modes of transit.

6.3. Single occupancy vehicles, rideshare and driverless cars

The major cause of congestion and emissions remains single occupancy cars. While Tokyo and London have reduced this problem, partly with fixed rail systems and restricting parking, and more recently a road charging system, for most cities this remains the problem. Rideshare options appear to reduce single occupancy trips, and in the future driverless cars are expected to reduce car ownership itself. An AI system will allow a more sophisticated road charging system than simply putting a circle round the city as in Singapore and London, in which single occupancy could also become a factor. This is an issue which remains to be solved.

40 When the first central lane was introduced in Seoul in 1990, Dr. Tony Michell had concerns about pedestrian safety. In practice, traffic signals and discipline of pedestrians and cars means more safety rather than less (Dr. Tony Michell and partner Dr. John Tough worked on aspects of Pedestrianisation, Bus Lanes and Bus Operation and Traffic Safety for the World Bank 4 Cities Project series 1980 to 1990).

7. Walkability

Nearly all public transit trips begin and end with what is called the first and final mile, although most starting and final trips are likely to be one kilometre or less and not a mile. This is normally a walking leg.

7.1. First “mile”

This is the leg of the journey from house to transit. It may be a walk or if longer than a “mile” by car (drop-off or park and ride), cycle (Japan in particular provides good storage for cyclists at rail and metro stations). Collapsible e-mobility devices may be taken on the transit vehicle especially rail.

7.2. Final “mile”

For transit passengers this is likely to be walking, although for those taking a longer “mile”, taxi, local bus, bike or e-mobility rental may be used. Interviews suggested that cycle or e-mobility devices are increasing in popularity in those cities in which they are available (Taipei City and New Delhi were mentioned).

The question is whether the walk is difficult or easy. Crowded streets, no side walk and a long diversion to cross walks or bridges were frequently mentioned. Seoul, prior to bus reform in 2004, was notorious for making a pedestrian walk two kilometres to reach a destination one kilometre away. Walking in many Asian cities has been an arduous task. Many streets are crowded, obstacles from kiosks and sellers to street poles and signs are often added to the street, crosswalks are not conveniently placed, timing of pedestrian crossings awkwardly phased or the pedestrian is expected to either climb up a bridge or descend into an underground crossing.

7.3. Pedestrianisation

Final mile trips are normally rush hour events. But in most cities areas of all day high pedestrian density exist. We regard more than 1,000 people passing per hour as high density but in markets, side streets and tourist areas the flow may rise to 10,000 per hour. Manuals state that at around 3-4,000 people per hour the line, if unidirectional, comes to a halt if the passage is one metre wide.[41] Three metres width is required for the same number of people moving in both directions.

During the 1970s and 1980s, the aim in Seoul was to allow cars to go faster and therefore pedestrians should all go over or under the street wherever possible. While a change of heart may have been present earlier, the central bus lanes provided a great leap in convenience for pedestrians in that there were more grade crossings and the planners recognised that a crossing regardless of bus stops should be given every 800 metres or so.

41 Weidmann, U., Transporttechnik der Fussgänger. Literature research, Institut für Verkehrsplanung und Transportsysteme, ETH Zürich, ETH-Hönggerberg, CH-8093 Zürich, 1993, in German. 5.4 people per square metre is total capacity of a space.

Pedestrians have a habit of clustering and spilling over onto the road in narrow streets. They do this at sporting events, at the entrances of schools, at the edge of places of worship and other locations. Control of traffic, often trying to pick up some of the departing or deliver arriving children and adults is a special case where smart systems can help.

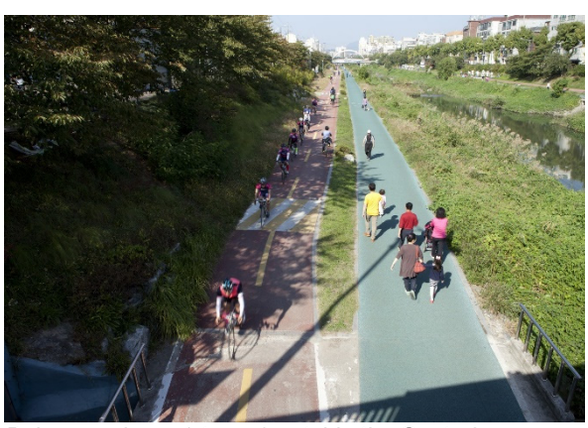
Longer walking distances are also desireable as they are emission free and contribute to individual health, and some cities including Seoul have begun to achieve the dream of connected green paths through the city.[42] In Seoul, a landmark move was to tear down an elevated highway and rediscover the river that had been paved over.[43] Rapidly throughout the city waterways which had been sewers or covered up to make roads or parking lots were reclaimed as walking and cycle paths. Since all waterways flow downhill and connect, a green path network rapidly grew in many parts of the city.

Cheonggyecheon (stream): before the removal of elevated highway

Photo by the Seoul Research Data Service

Cheonggyecheon (stream): after the removal of elevated highway

Photo by Lifeforstock, Freepik



Bulgwangcheon (stream) outside the Central Business District (CBD) adapted for walking and cycling, Mapo-gu

Photo by the Seoul Research Data Service

Disused railway line (current express railway line is underneath the park), Hongdae

Photo by Daehwan Han, Seoul Metropolitan Government

42 Dr. Tony Michell proposed this in 1983 in the pedestrian study of Seoul which was part of a series of World Bank funded studies. The idea developed rapidly in the 2000s.

43 The most celebrated example is Cheonggyecheon which set off many imitations throughout urban Korea. Source: http://www.preservenet.com/freeways/FreewaysCheonggye, html; https://www.theseoulguide.com/sights/public-spaces/cheonggyecheon-stream/; http://www.seoulsolution.kr/en/content/seoul-urban-regeneration-cheonggyecheon-restoration-and-downtown-revitalization

Seoullo 7017, Seoul: elevated road becomes pedestrian way

Photo by Ossip van Duivenbode, Seoul Metropolitan Government

Hong Kong elevated walkways network, the roof provides shelter from rain and sun; Bangkok has now adopted this kind of network

Photo by Pelikh Alexey, Shutterstock

Weather is another factor to take into account. Most of Asia is hot to walk in during the summer and most of Asia has monsoon seasons. Hong Kong offers cover for its walkways. Sendai has a perfect example of a back street converted into a covered arcade network stretching several kilometres where retail buildings remodelled their back entrances to become pedestrian entrances. This provides cover from the sun and rain.

Entrance to Sendai Japan arcade complex: on the left is escalator to railway station and elevated walkway

Photo by Korkusung, Shutterstock

No room for walkers, road markings would help

Photo by Hung Chung Chih, Shutterstock

But pedestrianisation has to be accepted by the citizens – and traditionally retailers resist. Bogor reports that its citizens are strongly in favour of pedestrianisation, but Jakarta, Balanga and Muntinlupa reported luke warm support.[44] About half the cities in our survey have citizens who fully support schemes and half who support with reservations.

44 Q.3.9 The choice of four levels of support was given. Luke warm is the third lowest.

7.4. E-mobility

Again, in rainy seasons or very hot periods cycling is unpleasant, and e-mobility devices offer a cooler way to travel. Cities are unsure on how to treat these new forms of transport. In Taipei City, they flourish, in Seoul, they must keep to the roadway and riders must have driving licenses (excluding a younger generation). In Korean parks, they are prohibited. Cities are divided on whether they should keep these devices on pavement or roads. This is an area where CityNet could assist cities in making the right policy.

E-scooters in Gangnam Business District, Seoul

(used on the side walk)

7.5. Conclusions

Walkability does not require smart technology. It requires planning priorities, and implementation, sometimes against the wishes of local retailers, who have, throughout the world, found that they gain rather than lose customers after implementation.[45]

It does however involve policy about the air quality of the city since the air the walker breathes should not damage his or her health.

45 Source: https://www.smartcitiesdive.com/ex/sustainablecitiescollective/putting-ecomobility-test-suwon/179181/

8. Emission Reduction and Air Pollution

8.1. Measuring pollution

The answers to the survey on emissions was surprising in that most cities did not measure emissions or have emissions easily available to the respondent, or have a clear idea of levels of emissions from transportation. It might be expected that after the Paris Climate Agreement everyone would be a carbon footprint counter.

The carbon footprint rises from 2 tonnes per annum for a city dweller in a less developed country through 4 tonnes for Jakarta, 4.3 for Taipei City, 6-7 tonnes for Seoul (about the same as the national average in the UK) up to 14 tonnes for a US city dweller.[46]

Transport as a source of citywide emissions peaks around 40% in US cities and falls to about 20% or lower in most Asian cities depending on the degree of motorisation. Seoul's method of calculation put transport at 30% in 2011. Of the 16,958 Tonne of Oil Equivalent (TOE) of energy consumed in Seoul in 2011, 5,228 TOE (30.8%) came from transport sector, of which cars took up 55.7%. Cars also account for the greatest portion of air pollutant emissions in Seoul, representing 57.5% while emitting 4-9 times more Greenhouse Gas (GHG) than bus/subway (198.3 grams per passenger km). The data suggests that cars are the main culprit behind Seoul's higher fine dust (PM10) concentration levels higher than the global average.[47]

Most professional providers of smart assistance promise a 20% reduction in emissions from adopting basic smart arrangements. That is probably 20% in most cities – so that would be 4% of the total emissions of an Asian city, reducing per capita emissions from say 4 tonnes per person to 3.84 tonnes.

How is this done? Chiefly by reducing journey times for all vehicles through smart control of congestion, and by replacing individual car trips with transit trips, or with non-mechanised trips.

Taipei City has taken this further with a project which will be able to identify individual sources of emissions. Air pollution mainly comes from incinerators, coagulation plant service providers, and transportation vehicles. Taipei City Government is able to further understand the causes and sources of pollution in the city, combine industrial innovation and technology to promote Taipei City's smart city pollution source tracing programme, integrate environmental information such as Volatile Organic Compounds (VOCs) road conditions, and weather conditions, and use AI to make preliminary judgments on high-polluting hotspots, and set up monitoring points in the district to analyse the composition of VOCs on site and complete the positioning of pollution sources. Air quality observatories can monitor sulfur oxides (SO_2), nitrogen oxides (NO_X), hydrocarbons (HC), carbon monoxide (CO), ozone (O_3), suspended particulates (PM10) and fine suspended particulates (PM2), etc. It is hoped to use this data analysis to assist Taipei City in improving the air condition of the environment.[48]

While air quality has been an issue for a century and action to improve, starting with the introduction of smokeless coal in London in the 1950s has been continuously discussed. However, the combination

46 Source: https://www.centreforcities.org/reader/cities-outlook-2017/city-monitor-latest-data/17-total-co2-emissions-per-capita/; https://phys.org/news/2018-05-carbon-footprints-cities.html

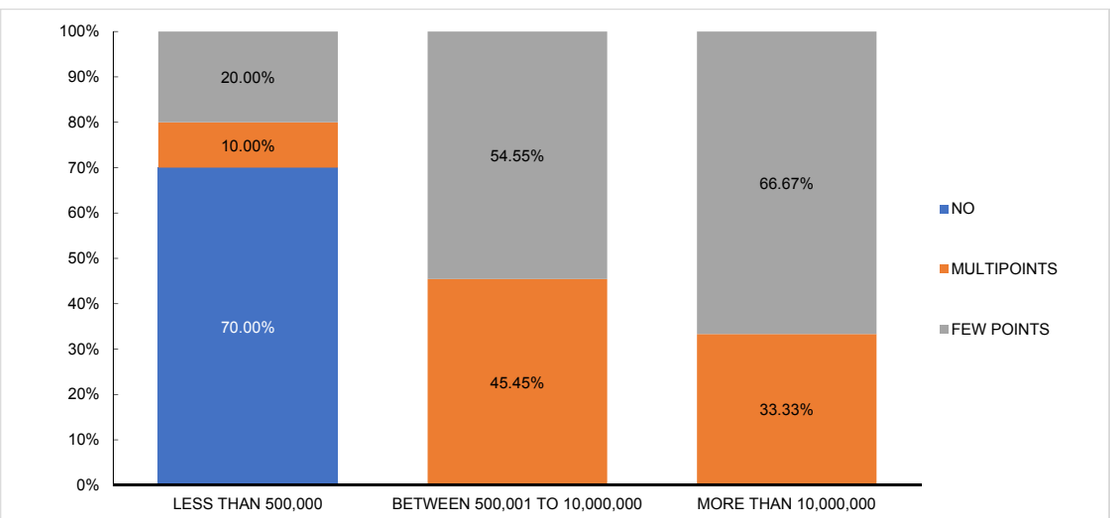
47 Source: https://www.seoulsolution.kr/en/content/building-pleasantly-breathable-city-green-transport

48 Source: https://smartcity.taipei/project/57

of diesel particles and other particulate and chemical pollution has produced a fog in some cities, notably Beijing that rivals London in the 19th century.

Particulate and chemical pollution is a major threat to health and a smart city should find ways to monitor and reduce the pollution. Some cities such as Copenhagen have already banned diesel engines. Seoul is talking about banning old diesel vehicles. German cities are more advanced in this process and supported by a recent court case, but 70 German cities have nitrogen oxide rates twice that of the EU standard.[49]

Figure 4. Do you monitor air quality 24 hours



8.2. Electric vehicles

A further reduction will occur when electric vehicles replace gasoline vehicles (or hydrogen if this becomes a trend), providing that the source of electricity is renewable or at least not coming from coal. It is an increasing trend of countries to announce a date after which gasoline or diesel cars cannot be sold. Of the countries in the sample only China and India have talked about such a date, India in 2030 "if economical" and China is researching the date – expected to be in 2040. Chinese Taipei will ban internal combustion driven motor cycles first in 2030 and cars in 2035. South Korea has a goal of 30% of new vehicles being electric driven by 2020 which seems unlikely at the present rate, although the city plans to take the lead in purchase of EVs.[50]

Surprisingly only Nepalese cities seem to expect the growth of electric vehicles in the next five years, and then by 10-20%. But most cities that answered the question, (and about 50% gave no answer), had a low expectation of future growth. Seoul plans to have 11% by 2020 but has less than 1% in 2018.[51] The low expectation is concerning because it means that there will be a lack of charging stations in those cities. It is universally understood that a lack of charging stations is a major deterrent to EV ownership.

49 Source: https://www.dw.com/en/german-court-paves-way-for-city-bans-on-diesel-cars/av-42752605

50 Source: https://climateprotection.org/actions-by-countries-phase-out-gas/

51 Source: https://www.seoulsolution.kr/en/content/building-pleasantly-breathable-city-green-transport

8.3. Conclusion

Emissions and air quality are major issues. Quite apart from greenhouse gases, having restricted cigarette smoking in most countries on the grounds of health, cities need to consider the health consequences of bad air derived from vehicles more seriously. This starts with better data and then, perhaps following Taipei City's lead, developing smart solutions.

9. Smart City Survey – Forward-looking Results

9.1. The survey results

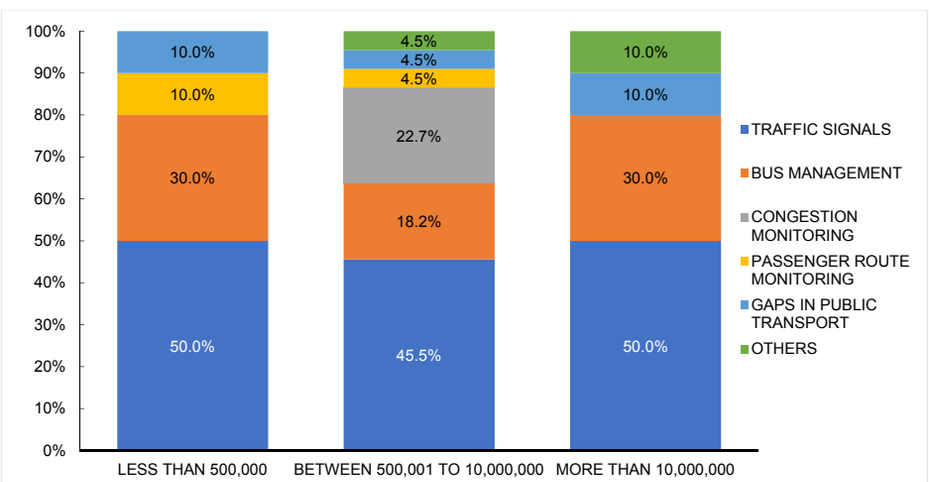
The survey was intended to take a snapshot survey of both attitudes to smart city development, future intentions and also of the components out of which smart mobility could be constructed. The hope was, with the help of the associate members that examples of good practice could be identified.

The survey respondents covered 28 cities with additional interviews of eight think tanks / CityNet Associate members. The results are classified into three categories – cities below 500,000 inhabitants, cities between 500,001 and 10 million, and cities above 10 million. There is general agreement amongst traffic experts that the complexity of a city grows around the 500,000 mark. In general, it is considered that above one million is the point at which a metro might be considered.[52] The decision to go for a lower population as the threshold for a medium-sized city, was decided partly to include Colombo and Bogor in the middle category.

Relevant results are used throughout the report, but the main forward-looking answers are given in this section. More results are given in the appendix.

9.2. Current status

Figure 5. Current Level of Smart Application

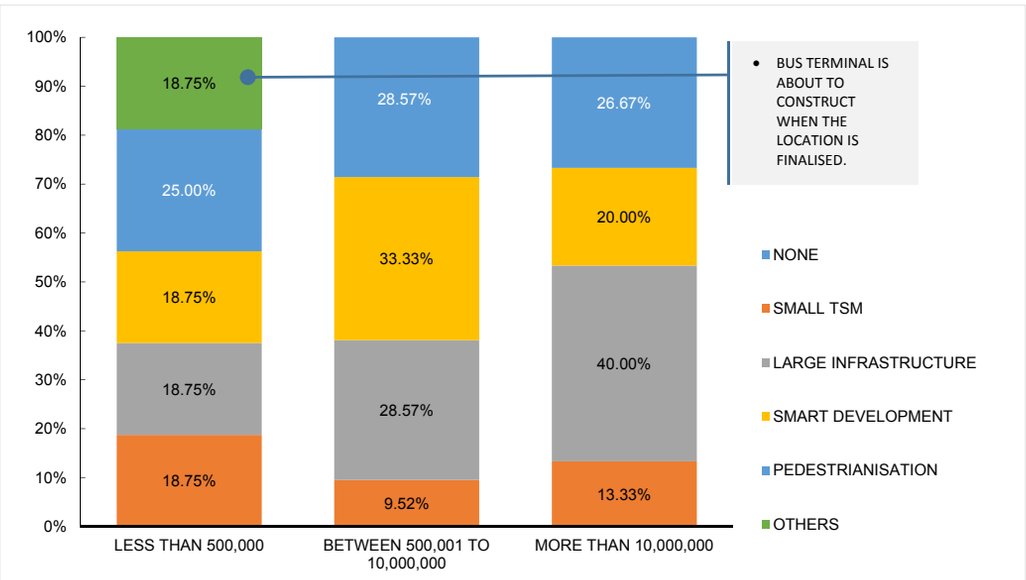


The multiple answer question on what is monitored in real time at present picks out the special feature of a group of medium cities, which is congestion monitoring. The cities have an equal degree of traffic signal management, medium cities manage buses less, but monitor passengers routes, although small cities monitor this more. Big cities have similar functions but for metros. All watch for gaps in the

52 Technically the complexity is a function of density of people and economic activities. The survey included questions which could calculate the density function, but this was not analysed.

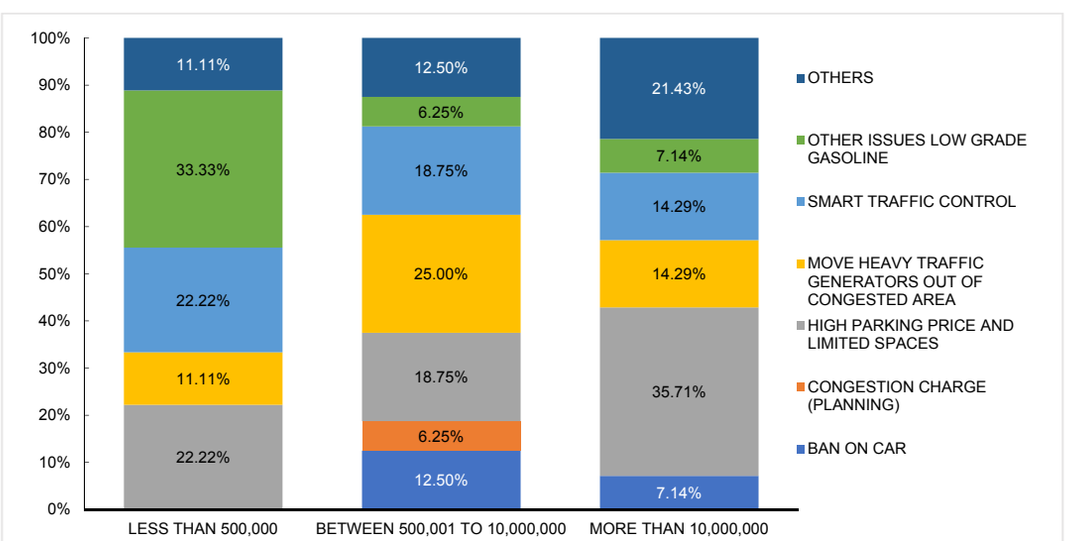
public transport system, meaning a failure to supply public transport interchange, or deliver an adequate service to destinations or residential areas.

Figure 6. What current measures are being taken to improve mobility?



In order to improve mobility, all sizes of cities are investing in large infrastructure projects, the large cities putting more faith on them than small or medium cities. Despite the value of small transport systems management (TSM), it gets a minor response except from small cities, while medium-sized cities are putting more effort into smart development, and large, medium and small cities are equally putting 25-28% of effort into pedestrianisation.

Figure 7. Measures to Reduce Emission to Benefit Air Quality Control

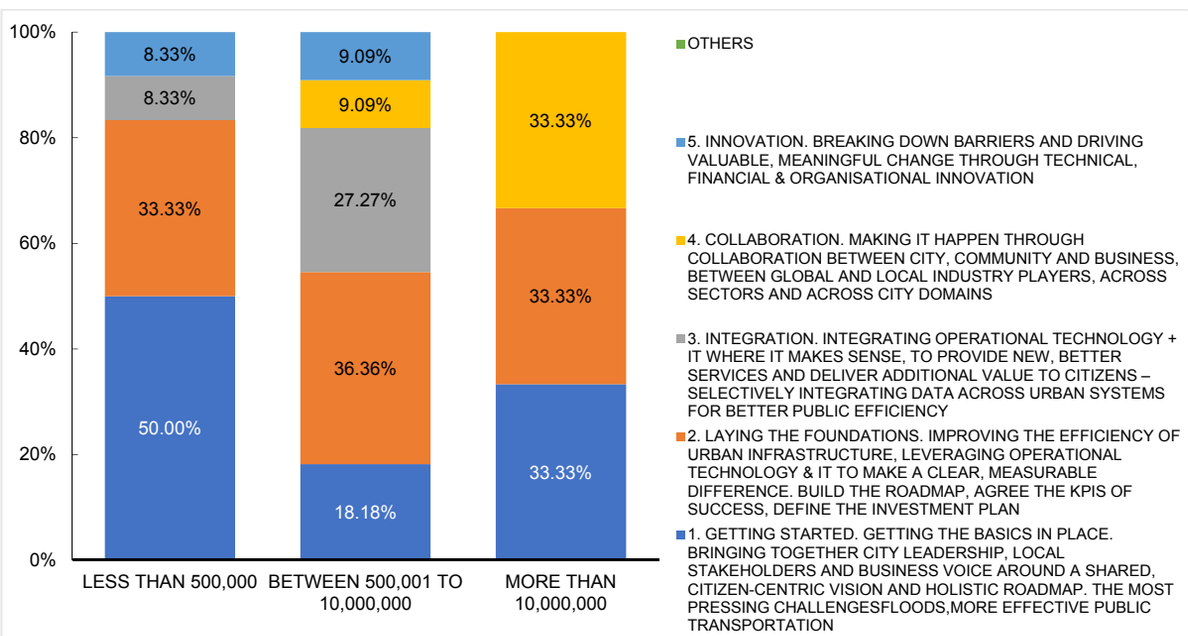


All cities are putting efforts into controlling emissions and air quality. There is a greater diversity of efforts ranging from the quality of petrol in Nepal, India and Indonesia coupled with a desire to replace two stroke engines on scooters and bikes with e-bikes and scooters, relocation of heavy generators of traffic out of the congested area is popular but the bigger measure is seen as control of parking places and higher parking charges and bans on cars (including odd and even systems). While half the cities are still trying to make more parking places available this data shows that half are trying actively to use parking as an emission control. The final stage would be a congestion charge. The city proposing congestion charges has not yet completed the consultation process.

9.3. Forward-looking results

Each city was asked to envisage its present policies and future expected shape. These results are given in this section. If there are five institutional stages (as defined by Tata India[53]), the first is getting started, 50% of small cities, 19% of medium cities and 33% of large cities felt they were at that stage. Delhi and Yokohama felt they had reached collaboration, Taipei City, Kaohsiung and Balanga thought that they were at stage five of innovation. The rest who were not at the starting phase, were at the integration level.

Figure 8. Current Level of Innovation



We also asked about the level of technology being deployed. For the questionnaire, we devised seven levels of development of the smart city in terms of technology. The medium-sized cities felt that, on average, they were ahead of the small and large cities and expected to keep that lead in five and 10 years progressively. The eight stages are described below.

53 In 2019, Tata India has revised its prescription since the survey and removed some statistical goals. Source: https://www.tatacommunications.com/wp-content/uploads/2017/06/Tata-Communications-Smart-Cities.pdf/; Arup adds two more steps. https://theurbantechnologist.com/seven-steps-to-a-smarter-city/

The small cities lacked ATC and some CCTV, the large cities were between stage 3 and 4, while medium cities rated themselves between stage 4 and stage 5 with connectivity but no real big data function. Small cities felt that they would only reach the present stage of medium cities in five years' time, and would remain behind medium and large cities in 10 years' time. Medium cities believed they would have connectivity, big data feeds and smart algorithms rather than AI functions. In fact, AI is likely to accelerate its applications in the coming five years which may change the outlook.

Figure 9. Future Expectations of Level of Development

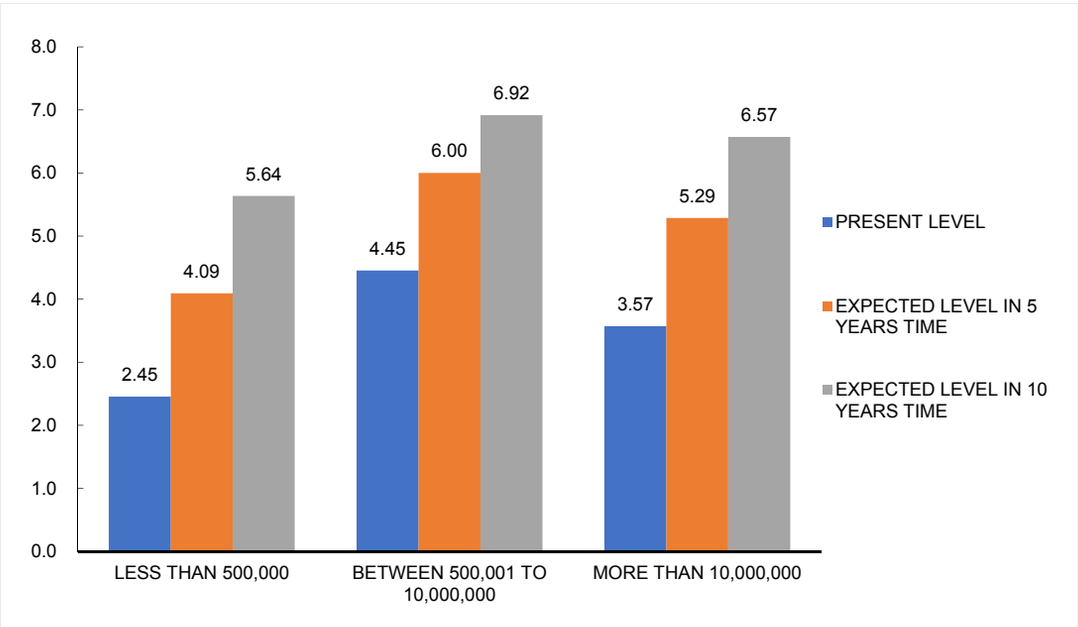


Figure 10. The Eight Technological Stages of the Smart City as Defined in 2018[54]

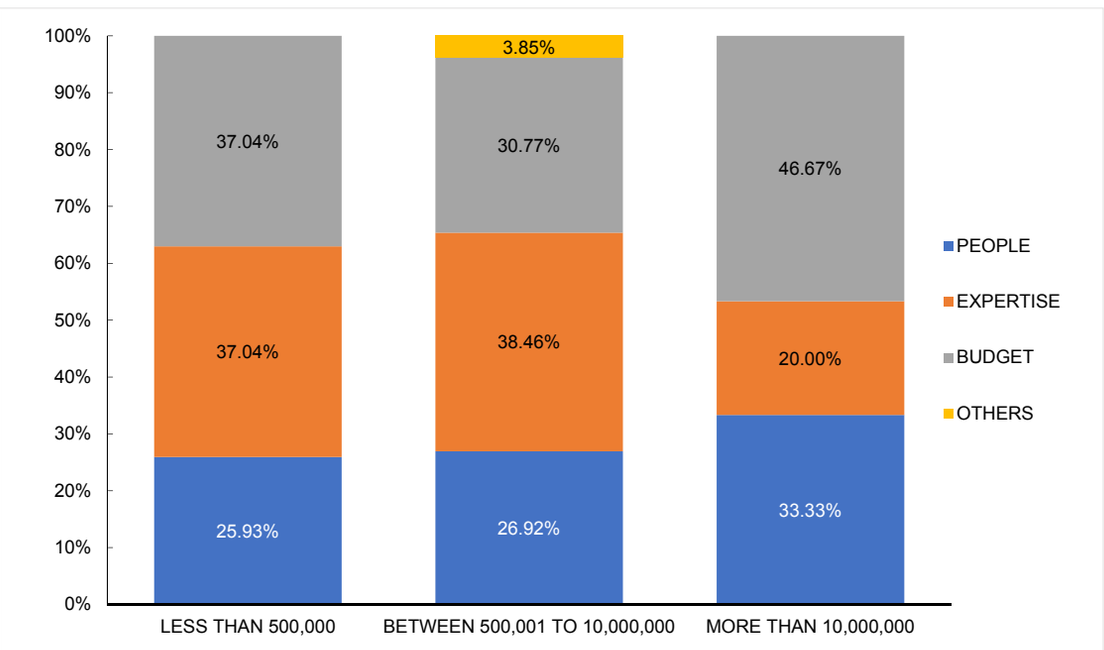
Smart 1	Smart 2	Smart 3	Smart 4	Smart 5	Smart 6	Smart 7	Smart 8
Not even an ATC	ATC	ATC	Infra power, water	Smart Infra some connectivity but no big data function	Smart infra, connectivity and big data feeds	Smart 6 and algorithms that work	Smart 7 and AI
No integrated transit	No integrated transit	Some CCTV Some bus lanes	Traffic systems but not connected and not smart	Transit connected but not linked to ATC	Transit and ATC connected	Transit and ATC have advisory warning algorithms	AI works to reroute traffic to relieve transit
No renewables	Few renewables	Disconnected Renewables	Navigation helps user but not feeding into system	Navigation offers traffic situation to user	Real time traffic speed and information	Digital Warnings and advisory to users and city	Renewables feed system and emissions monitored by AI

54 These levels were devised by KABC Ltd based on a literature and smart blog material at the present level of technical applications in urban functions.

The final question was about constraints in creating a smarter city and achieving the city's goals in mobility and emissions.

It is natural that budget is the major item, and more important for large cities than small and least of all medium cities. Large cities are less concerned about expertise but medium and small cities both see 37-38% of the problem is expertise. People are another problem of equal difficulty across all the cities. We distinguish people from expertise in that the city needs to hire the right people to design and carry out suitable policies but they can hire experts for those technical issues which local people cannot solve. Again large cities feel the lack of people more than medium or small cities.

Figure 11. Constraints in Increasing Smartness



9.4. Conclusion

The final question indicates that what is needed more than anything are inexpensive ways to move in the right direction. This suggests that CityNet might organise a study group to look at the most inexpensive and effective ways to cure the major urban problems. Our final section proposes ways to be more effective for less money.

10. Good Practice – Building a Smarter City

10.1. Expert advice

As part of this study we identified six technology providers globally involved in smart cities, IBM, Cisco, Siemens, Schneider Electric, Tata Data Systems, LG CNS who are involved in supplying services to the surveyed cities.[55] There are probably 20 more active around the world and more than one thousand suppliers of components of mobility smartness such as smart transport card suppliers, traffic signal controllers, sensors for sharing devices, various forms of integrative software, CCTV networks who work alongside traditional mobility suppliers of buses, metro systems, taxis, traffic signals, ticket machines and bicycles and new suppliers of e-scooters, driverless cars and other new mobility devices.

Building a smart city usually includes one or more mobile network, all these component suppliers, the local city planning institute, local universities and one or more of the big system integrators, or a local company or institute which plays the role. Of 28 cities two used IBM, one Tata Data Systems and one Cisco. The rest used more local resources or used the smart engineers for small sections of work.

10.2. Designing a smart city – the need for smart citizens

While the technology providers and other partners can design smart cities, and certainly improve existing operations, the design must come from the local leaders and local citizens. In Jakarta, an NGO built a system to let citizens communicate with the city administrators for quick remedies, which was quickly adopted by five mayors including the former governor of Jakarta. Seoul has a more traditional top-down app which serves the same function. Most urban dwellers across the Asia Pacific have smart phones which allows them to respond to issues easily and potentially could answer questions from the planners sent to every citizen with a smart phone.[56]

The degree to which citizens can take control of much of the city's activities in the same way that they have control over their lives has yet to be tested. As early as 2000, the US Vice President Al Gore envisaged the "super highway" as changing town hall life. "We can design a smart city of Things but cannot predict how citizens will use it." Or, as Dr. Pham Bo of the Academy of Managers for Construction and Cities based in Hanoi has already been quoted as saying, "If there are no smart citizens, we cannot build smart cities."

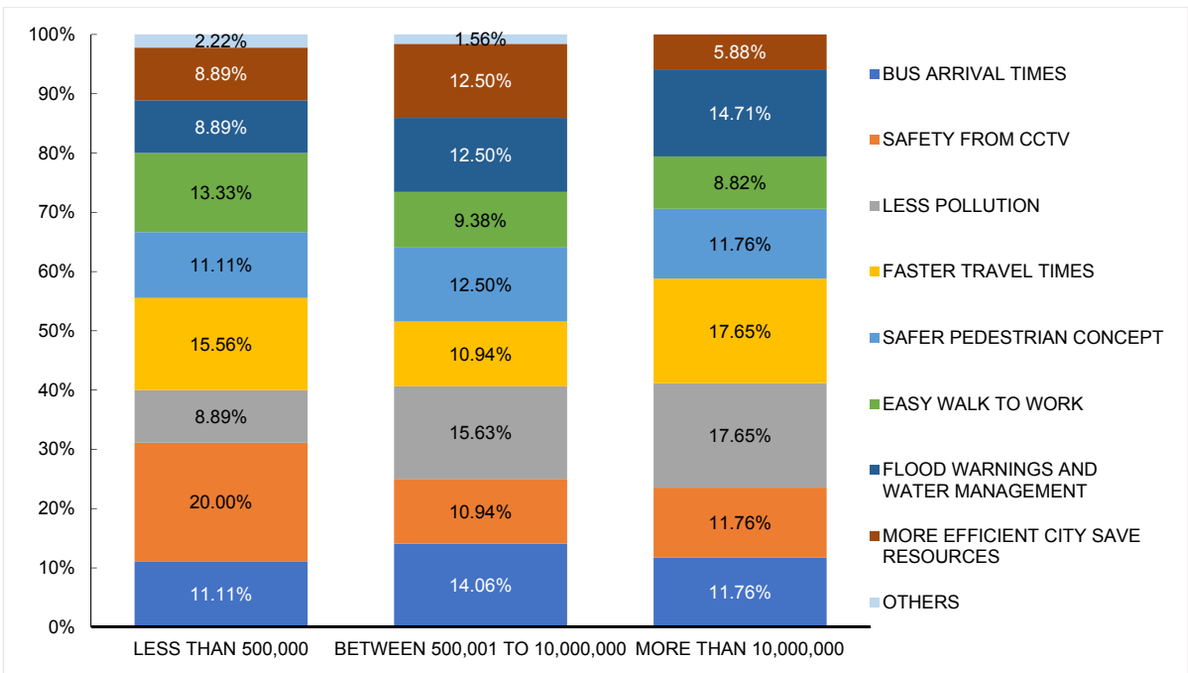
Our survey shows that citizens are thought to have a wide range of expectations about smart cities. In a multiple choice questions shown below, we see a difference between small cities and medium and large cities. In the medium and large cities, faster travel times and less pollution get equal scores of 17%, but this shrinks to 16% in small cities and increased safety by use of CCTV gains 20%, while less pollution sinks to 3%. Large and small cities expect more pedestrian safety, but few expect smart cities to make it easier to walk through the city.

55 Also mentioned in smart city presentations are Microsoft, ABB, GE, Samsung SDS, SAP, Accenture, Atos, Toshiba, Hitachi, CapGemini and Oracle.

56 In India, it is estimated only 66% of the population have mobile phones (not necessarily smart).

Citizens in large and medium cities would value flood warnings. Those in medium cities expect more efficiency than smaller or larger cities. This is citizen opinion at a crude level as seen by administrators. It is important that administrators do not make up the minds of citizens however, but genuinely seek their opinions, perhaps through a texted questionnaire (A real Al Gore moment).

Figure 12. What do citizens expect from a smart city?



10.3. What can we expect?

The IBM Stockholm achievements do not seem to be surpassed almost 10 years later in terms of time saved. How much time saved depends on the level of congestion and the level of congestion depends on transit use and smart cities. The implementation of the first ATC in Seoul in 1980 eliminated numerous congestion points (more bridges across the Han river were also built).

The target numbers given by commercial suppliers as a target for a smart city with 2018 technology are:

- 20% reduced travel time (depending on level of congestion)
- 20% drop in transport related emissions
- 40% drop in air pollution
- 30% drop in street crime (again depending on street crime levels which are almost non-existent in Korean cities but much higher in some Southeast Asian cities)
- 15% drop in operating costs of buildings
- 30% more energy savings
- 20% reduced water losses
- 15% drop in operation costs
- 45% fewer power outages (if this is a problem in the city)

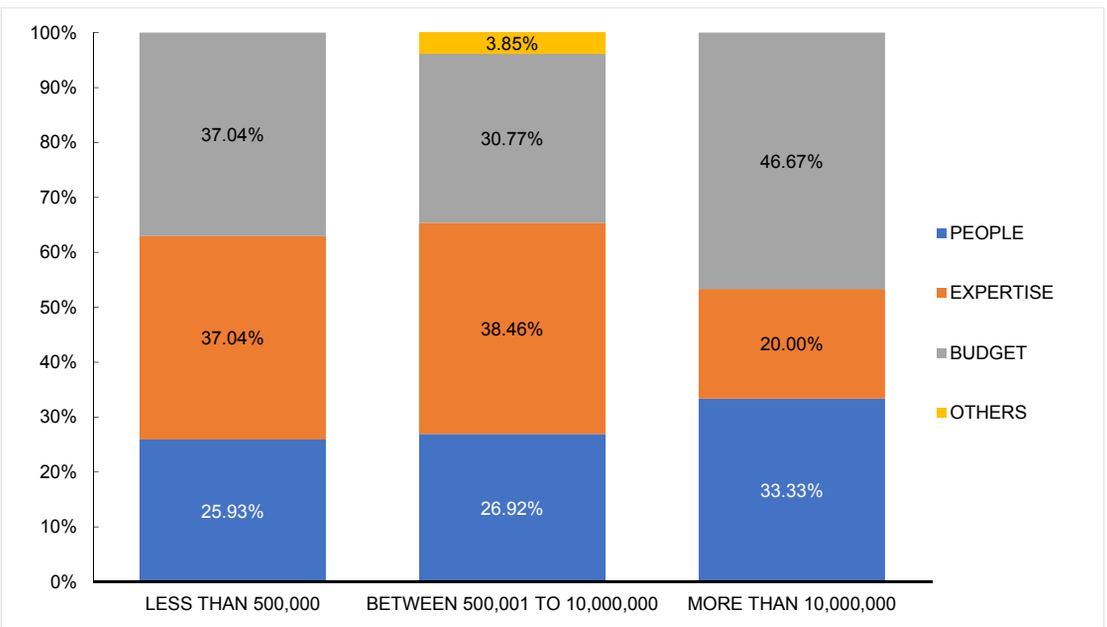
- A phased programme for the integration of new infrastructure with the smart city.[57]

The projection for Indian cities is lower than that achieved in Stockholm, and we should expect considerable variation depending on the characteristics of the city.

10.4. How do cities start to be smart in eco-mobility?

The final questions in the survey were about present constraints.

Figure 13. Constraints



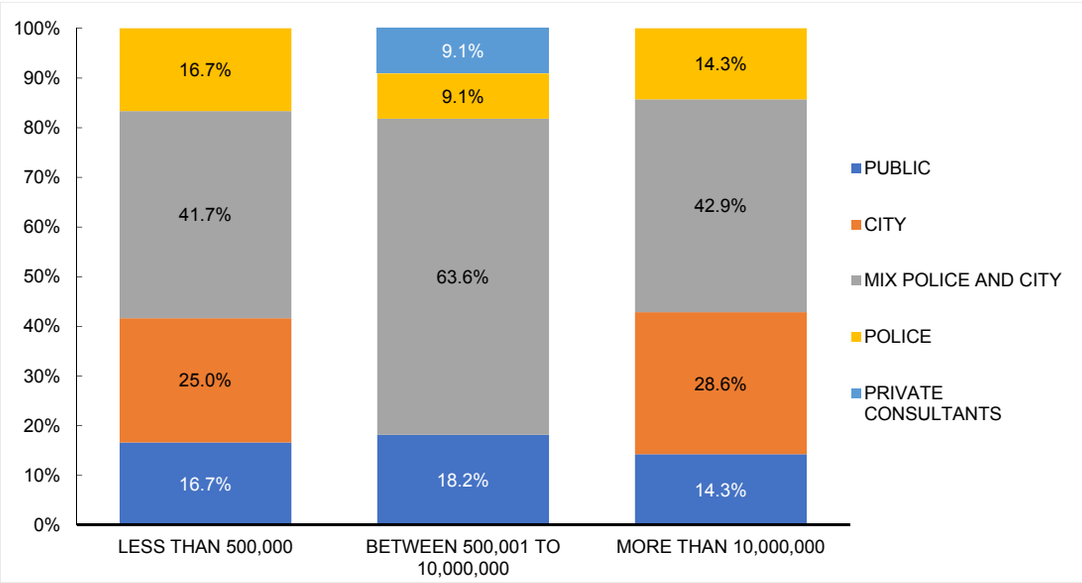
Big cities felt the problem of budget even more than small cities 46.67% to 37.04%.

Big cities felt that expertise was less of a problem than small and medium cities who both felt that it was 37.04-38.46% of the problem. Big cities felt a lack of suitable employees more than either of the other two groups.

There is also an organisational constraint. In different cities, different authorities are responsible for traffic planning, the city, the police, a mix between the two and the public which we take to mean the council assisted by public opinion.

57 This is a compilation from different sources and is certain to vary from city to city.

Figure 14. Organisational Contraints



The use of advisors is common, though only one medium city claims to be using private consultants. The reliance on local advisors suggests that CityNet has a role to play in organising workshops for advisers. Sorting out the framework of who will plan and run the mobility functions needs to be undertaken and training developed for the different actors. For a diverse group a study tour is an excellent tool for developing a consciousness of what is possible.

Getting started and getting quantifiable results have not always been easy. For eco-mobility it is important to understand what can be done by conventional planning, and where smartness needs to be injected. Bus lanes are conventional, but a BEMS or TOPIS is smart. Further integrating the BEMS with the ATC system is smarter to give buses a further advantage.

What the passenger sees at the bus stop – the time of the next bus – helps ridership, but the data in the bus information system contains big data information which can identify bus delays, bus bunching and other effects when smartly added to other information. Pilot studies show how much more information is available. A good example is the bus system verification study done in the French city of Belfort (a city of only 50,000). The only smart element was the smart travel card that paid for bus rides (and released rent bikes and paid parking). Belfort thought that all they knew about buses was the number of riders in the whole system, and lacked information of where passengers boarded and got off, the speed of the bus throughout the links in the journey. Tata Data Systems brought their interactive software to Belfort to show that all these things were possible with minor adaptation. Belfort thought it needed more buses at 250,000 euros per bus (a Eurobus is expensive). The demonstration showed that buses could be redeployed at busy times and the city saved half a million euros. This was efficiency through smartness in action.[58]

If the pilot scheme had continued, the city would have amassed information on origin-destinations and possibly rerouted bus lines to improve the service to those who had to change.[59]

58 Source: https://digitalempowers.com/build-smart-city-transport-system-four-weeks/; https://www.smartcitiesworld.net/news/news/big-data-optimises-transportation-in-belfort-1321

59 Source: https://safesmart.city/en/bus-allocation-belfort-france/

All successful green eco-mobility requires increasing the transit ridership providing this reduces car usage or increases the convenience of the citizen. An increase in pedestrian, cycle or electronic mobility devices is equally desireable.

Physical separation of transit through bus lanes, etc. and cycle lanes are generally desirable with narrow streets in historic city centres converted to bus and pedestrian or pedestrian only require no smartness only a better framework for city planning.

Smartness begins with traffic signals where priority to public service vehicle can be applied centrally or locally with sensors on vehicles and receptors on signal equipment. If an ATC exists then upgrades can be applied.

Public transit ride increase begins with non-smart moves moving bus stops to facilitate interchange or pedestrian destinations. Many cities already have bus information at stops, and this is seen as essential to increase rides. Fares also need to allow interchange with fare cards. The Belfort proof of concept took just four weeks, three organisations and pre-existing data and smart card system to create and prove the concept.

Already vehicles can be connected to navigation advisory networks, but will one day offer the driverless option. The single occupancy full size vehicle may become a thing of the past, but a housewife doing a weekly shop at a hypermarket is using the car to carry goods she cannot carry by herself by public transit. She may take kids to school. We can imagine communal alternatives to this – only digital shopping plus delivery, driverless school vehicles, but these are too far in the future. Some cities built from below ground up like Songdo can dispense with garbage trucks, but for many cities the dream is that garbage is collected and treated in an ecological way. Even when a new city is built from the ground upwards – for example Songdo in Korea the system is complex in terms of underground connections which raises hygiene problems so much that when the system was copied in a new district of Seoul Eunpyeong-gu, the trash entrances were not in individual apartments but outside in the grounds.

10.5. How do citizens get smart?

As noted, citizens have the basis of smartness in a digital age in their pockets, and all that is needed is a series of apps that feed the citizen information and choices. In Belfort, the citizens had another simpler kind of smartness – a prepaid smart card. They had even more smartness which was not employed in this proof of concept, the smart phone.

Ownership of smart phones varies by country – according to Newzoo's Global Mobile Market Report 2018 puts Korean ownership at 72.3%, Malaysia at 66.5%, PRC at 55.6%, 52% for Japan, 44.6% for Thailand, Vietnam at 30.1%, India at 28.5% and Indonesia at 23.4%. These numbers are imprecise, and Pew Survey, now dated, gives generally lower figures.[60] Assuming that urban dwellers have a higher ownership than rural dwellers except in Korea and Chinese Taipei, the ability of the citizen to respond using a smart phone is limited. This also argues the need for using a smart card more in more cities and a smart phone less. The internet has brought a sense of impatience which also has to be factored in.[61]

60 Source: https://newzoo.com/insights/articles/newzoos-2018-global-mobile-market-report-insights-into-the-worlds-3-billion-smartphone-users/

61 Source: https://www.youtube.com/watch?v=z5O4Yl6ZB4k (Mobility beyond transport in smart cities)

Ideally the smart card and the phone combined for contactless technology as plastic cards are now employed in some countries. Thus the phone pushes out the smart card, but (subject to privacy) trades more information about the user into the system.

10.6. Getting smart and the digital divide

Even in Korea, 25% of the population do not have smart phones, rising to 65-70% in Indonesia. For the next ten years the smart card has an important place. But studies prepared for cashless public transport suggest that in the US and probably in most other countries, poor people do not have the money to buy a card. The number is put at 20-25%.[62]

It is important in the rush to be smart that equity needs are also considered, whether that is by a city issued smart card to the elderly or low income or other means.

10.7. The search for good practice

Asked to identify good practice in their countries, the associate members did not do more than identify components of good practice. The experts felt that cities were just beginning in their smart journey, especially in mobility. As shown in the survey, the cities were more confident about their efforts than the associate members.

Discussion with the associate members suggested studying the following:

- BRT evolution in Ahmedabad
- Last mile cycle rental Delhi
- Qlue software in Jakarta and other Indonesian cities
- Smart card rental systems (as opposed to smart phone systems)
- City management in a heritage city, Galle
- Chinese cities experiments
- Bus lanes in Seoul linked to ease of pedestrian mobility
- Binh Duong smart city conference
- The survey suggests other advanced practices to be studied further
- Central bus lane, pedestrianisation and green links along watercourses in Seoul
- Digitalisation in Bogor
- The numerous citizen suggested experiments of Taipei City
- Yokohama's experience in transit and emission reduction
- Naranyanganj and Tarlac's experience with driverless cars (and that of the 11 cities that are testing the process)
- Various cities' experience with electric scooters and e-mobility (including docking and dockless experiments)
- Nepalese cities' experience with electric vehicles

62 Observation of bus passengers in Seoul suggest 10% of riders use cash; https://www.rfidjournal.com/articles/view?12137 – on benefits in Hong Kong; Source: http://theconversation.com/why-a-cashless-society-would-hurt-the-poor-a-lesson-from-india-79735.

10.8. CityNet's role

CityNet has an important role to play in this process, given the different levels of the cities surveyed in arranging not only a study tour, but also a workshop process for smart city advisers to develop a uniform level of understanding and close monitoring of experiments and proof of concept in one city by all other interested cities.

11. Conclusion

A smart city is not like a smart factory, smart hospital or other limited purpose smart function. A city is a living breathing organism made up of hundreds of thousands of people each with their own needs, even if their personal goals and visions are lost in the daily struggle. Smartness should allow the city to offer more for less, and in the mobility sector it should increase leisure while reducing emissions by making public transit faster than private transport. But it should also encourage carbon reducing activities including less emissions, more walking, and allow for new models such as ridesharing.

But most systems would be based round a logical decision tree. This requires priorities to be set in which any algorithm will search for the optimum benefit in terms of lowering emissions, shortening journey times and reducing congestion. In terms of overall time this requires concentration on the first and last mile for transit passengers. It may also require not just ridesharing, but driverless vehicles.

It is also important to remember that a smart city will be reducing building and other emissions, maximising the use of renewable energy, improving air quality, saving water, and improving emergency services. Some of the demand for emergency services will be reduced by a rise in safety.

For a number of cities in the survey, disaster warnings and disaster recovery are ranked more highly than other benefits. Schneider-Electric is claiming that it can restore power cuts after disasters in minutes rather than days in Australia, mainly because of the ability to pinpoint failure points instead of road crews searching for them. Where tidal surge amelioration measures exist, connectivity and sensor data should greatly improve reaction times.

In the interviews, it is evident that there is a debate about the track to becoming a smart city, which can be summarised as either smart citizens or smart cities. There also seems an age gradient where millennials can only think about smart citizens, but an older generation wants to connect up urban systems and let the systems make the decisions (which will tend towards optimisation rather than citizen service).

- The survey shows that within CityNet membership there are sufficient examples of every good practice in one city or another to raise the standard of every other city.
- The consultants have collated the best examples as described in the survey, and CityNet secretariat may request more details.
- Based on this list it is suggested that the committee create a study tour and city-to-city cooperation in which members can inspect the examples of good practice and discuss them with the designers or implementers.
- We discussed whether CityNet could develop city-to-city advice or mentorship, in which the leading cities can supply the advice and expertise to cities which are less advanced and discuss with the cities interested in collaborative projects how this can best be achieved.
- About half the cities have doubts about pedestrianisation, cycles, e-mobility, ridesharing and are still accommodating all motor vehicles (e.g. provide parking for everyone). Those cities which have experienced the advantages of a transit and eco-mobility model should consider how to create a debate with the cities which have doubts and their citizens.

How to achieve inexpensive smartness?

All cities described the constraints as budget, expertise and people. It is therefore important for CityNet to form a committee to achieve inexpensive smartness.

The idea of Binh Dong in Vietnam of holding an annual conference in which participants were invited to critique the city's level of smartness is extremely attractive and points to the way to increase expertise.

But the real way is to encourage institutes to offer courses in smart cities to supply the young people with up-to-date knowledge on how to achieve this, to work in the cities and as consultants.

As a final concept it may be helpful to compile a list of low cost activities:

1) Raise parking fees to discourage cars from entering congested areas.
2) Create park and ride facilities in uncrowded area for bus and rail transit (one of the ways that Tokyo achieves such a low modal share of cars; parking can be for cycles and e-mobility).
3) Tax parking spaces in buildings where commercial rates are not charged.
4) Use simple Transport Systems Management methods. Sometimes just painting a line or moving a line on the road or sidewalk is enough. About half the cities use the Japanese concept of dividing the sidewalk into a pedestrian and cycle path, though this requires a wide enough sidewalk for the volume of passersby. In general, lines that narrow the road way increase traffic speed as merging traffic from irregular widths is a common cause of congestion.[63]
5) Linking unlinked traffic signals with smart poles.[64]
6) Building a simple ATC with smart poles and small server and web storage.
7) Use life streaming from the ATC to other agents – e.g. buses.

Perhaps Binh Duong has the right approach. Dr. Pham Van Bo recommended studying Binh Duong. While most cities in Vietnam have been ordered to make smart city plans, he considers Binh Duong to be most advanced.

Binh Duong holds an annual smart city conference together with foreign embassies to bring in foreign advice and asks the speakers to offer contributions towards improving Binh Duong. The 2017 Smart City Summit included five events targeting a wide range of stakeholders thereby increasing the awareness and advocacy and active engagement of the public, communities, social and political organizations, businesses, academia, scientists and students promoting the Vietnamese concept of the triple helix – state, academia and business, and strengthening cooperation with international organisations.

The 2018 topics were:

1) Develop Smart City policies
2) Share knowledge about the development of Smart Cities
3) Digital infrastructure and ICT in Smart Cities

63 The author proved to the World Bank that the ROI from painting a line could be several 1000% in some traffic and pedestrian situations. Seoul Transport Project 1983.

64 Intelligent light poles can increase urban efficiency while reducing energy costs. Intelligent, or multifunctional light poles, can help solve many urban problems due to their ability to incorporate software controls, electronics and sensors that can receive and transmit data. They can improve parking and traffic management through real-time data, leading to a reduction in congestion and emissions. Intelligent poles can also monitor air quality, detect and notify officials about street flooding or be turned into charging stations for electric vehicles. The smart poles have been designed from conception with modular multi-functional components. There is no limit to the potential features and functions that can be integrated into the intelligent light poles. They can easily retrofit a myriad of new and evolving technologies and devices as they become available. Source: https://www.hydroextrusions.com/en/industry/infrastructure/poles/smart-poles/

4) People's engagement
5) Green buildings

Put together the city hoped to get better insights on the projects they are developing.

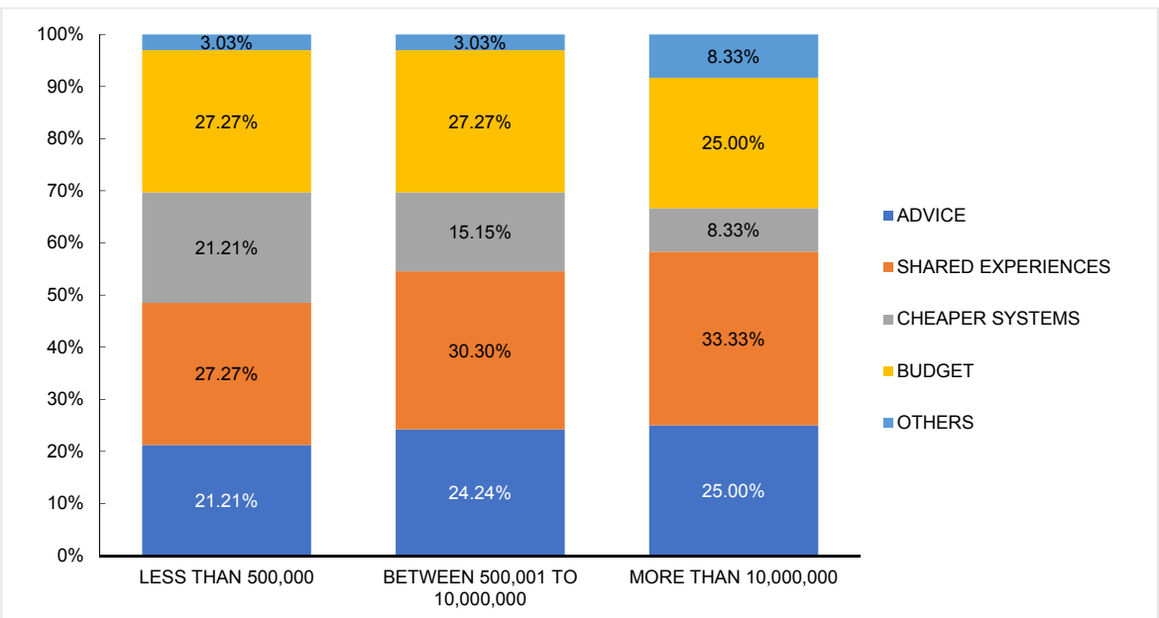
Essentially the city is getting annual input from local and international advisers brought together with local citizens. This may be the most inexpensive process of all.

CityNet might consider creating an annual conference in a different city each year, not as a trade fair but along the model of Binh Duong.

This might also meet the desire for shared experiences hoped for from all sizes of cities.

The cities answered in the following way when asked what they needed most right now. Advice, shared experiences and budget were the main responses, with cheaper systems strongly desired by smaller cities, and less by larger cities.

Figure 15. What do you need most?



The fact is that there is a lot of experience to be shared. For cities which are reluctant to adopt pedestrianisation or limit parking space, the experience of the incremental development in this respect taking the most congested area first or the area with highest population density first and allowing the assessment of the results of the first steps by citizens. Using smart apps to poll citizens is another shared experience of value.

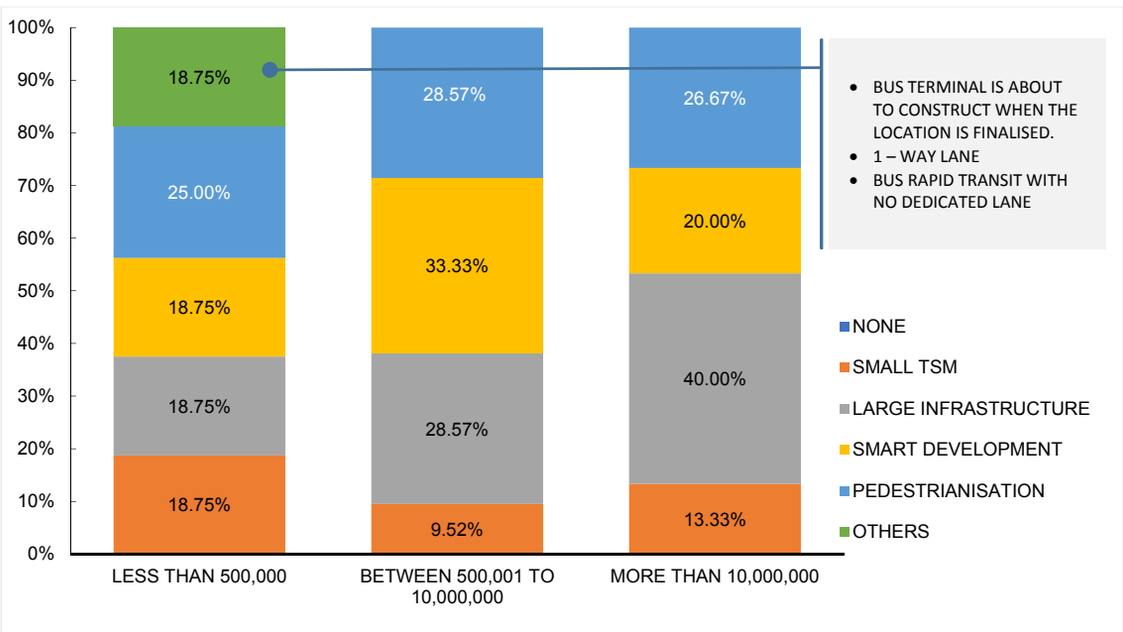
In all this the dialogue between cities is an important one. It should also lead to other cities outside the existing network coming to regard CityNet as a friendly source of information and advice and therefore worth joining.

Appendix Result

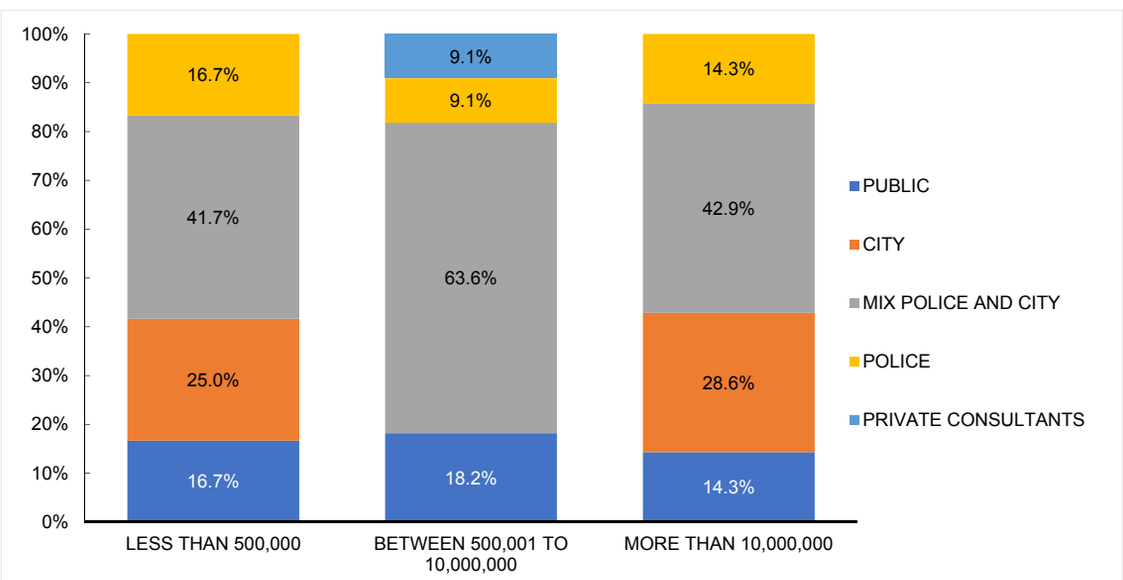
Appendix Result

The following selected statistics give a tabulation of the results of the survey. Questions before 2.20 are about specific information on each city and can be given on request to the person in charge of the project. The full excel sheet of answers city by city is also available for examination subject to privacy limitations. For more details contact CityNet Secretariat at info@citynet-ap.org.

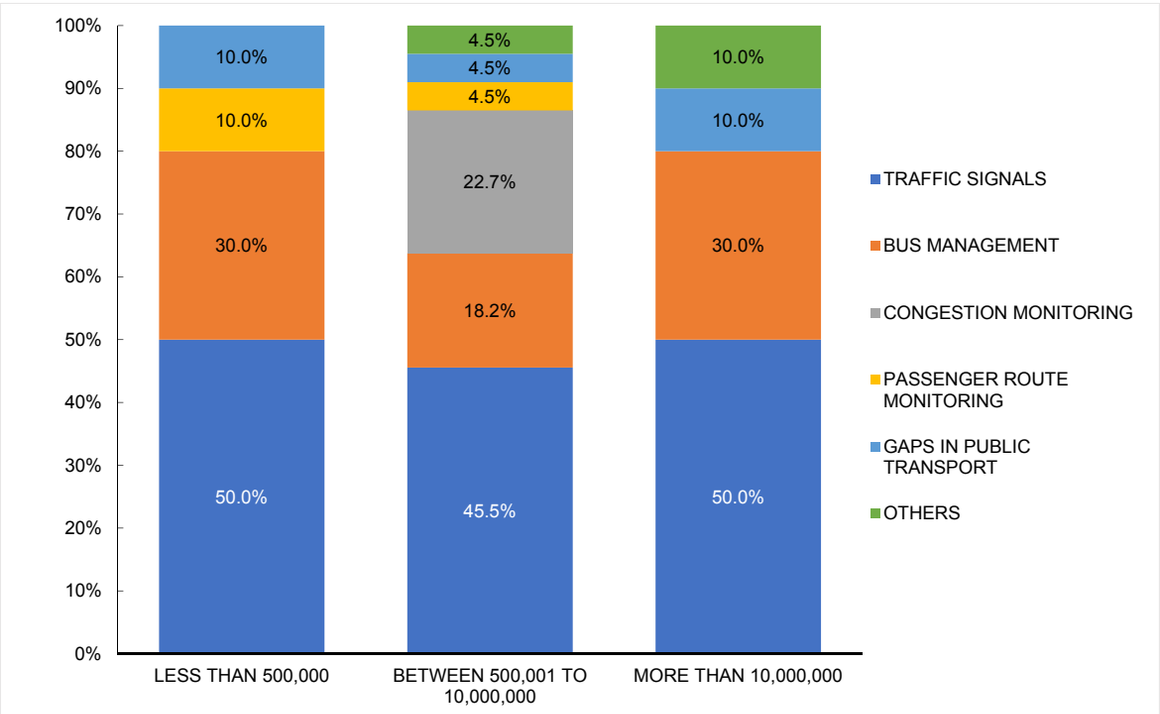
Q2.20. CURRENT STRATEGIES TO IMPROVE MOBILITY



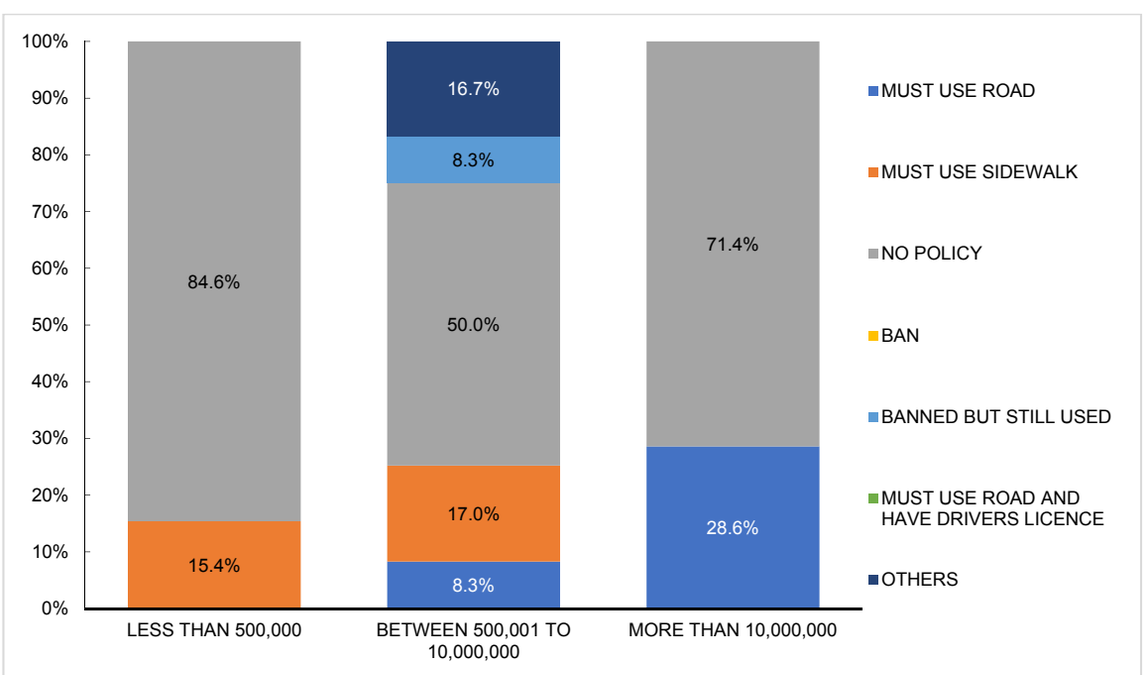
Q2.26. WHICH ORGANISATION IMPLEMENTS TRAFFIC IMPROVEMENTS?



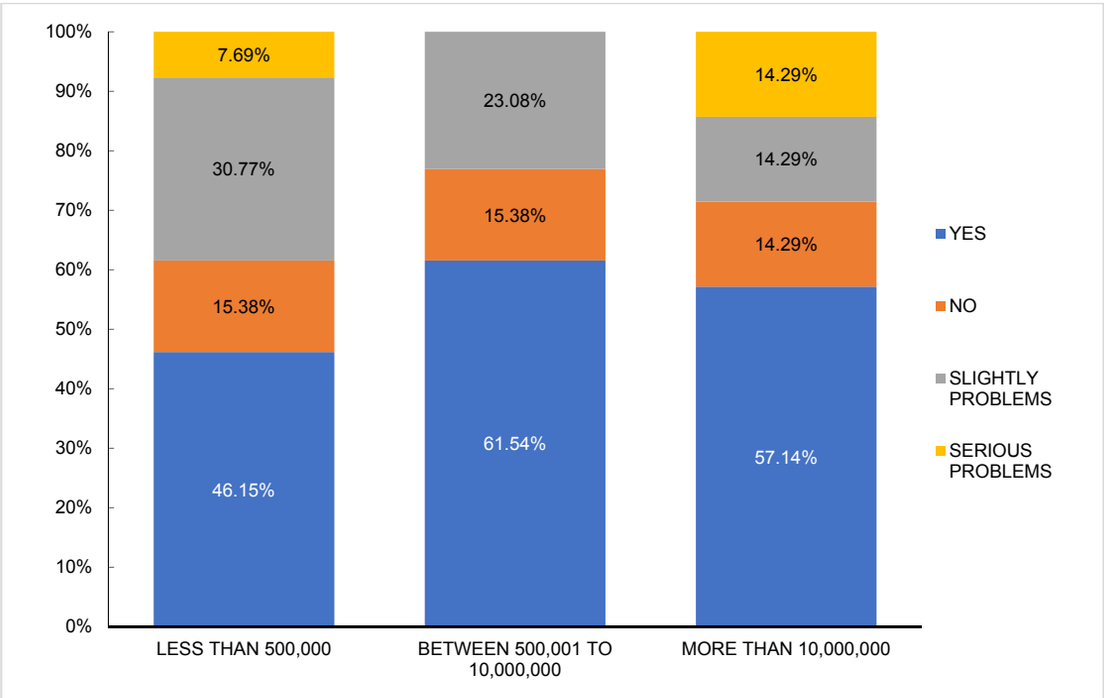
Q2.27. ARE SMART TRANSPORT SYSTEMS INTEGRATED REAL TIME?



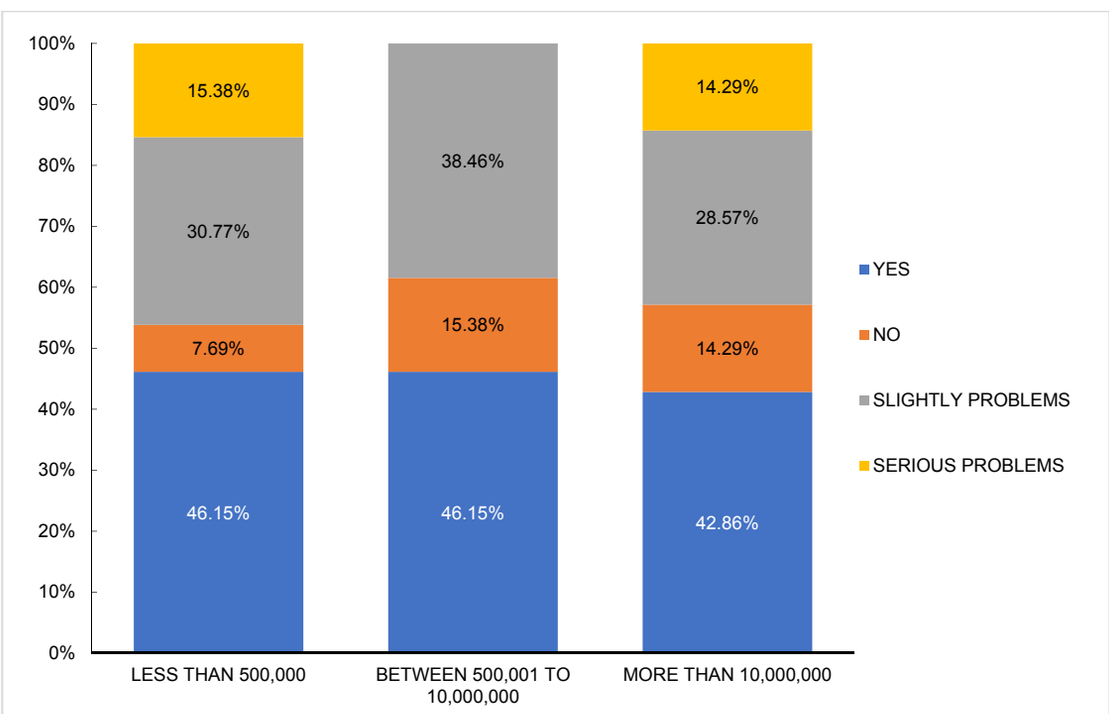
Q2.28. LAWS ON ELECTRIC MOBILITY DEVICES



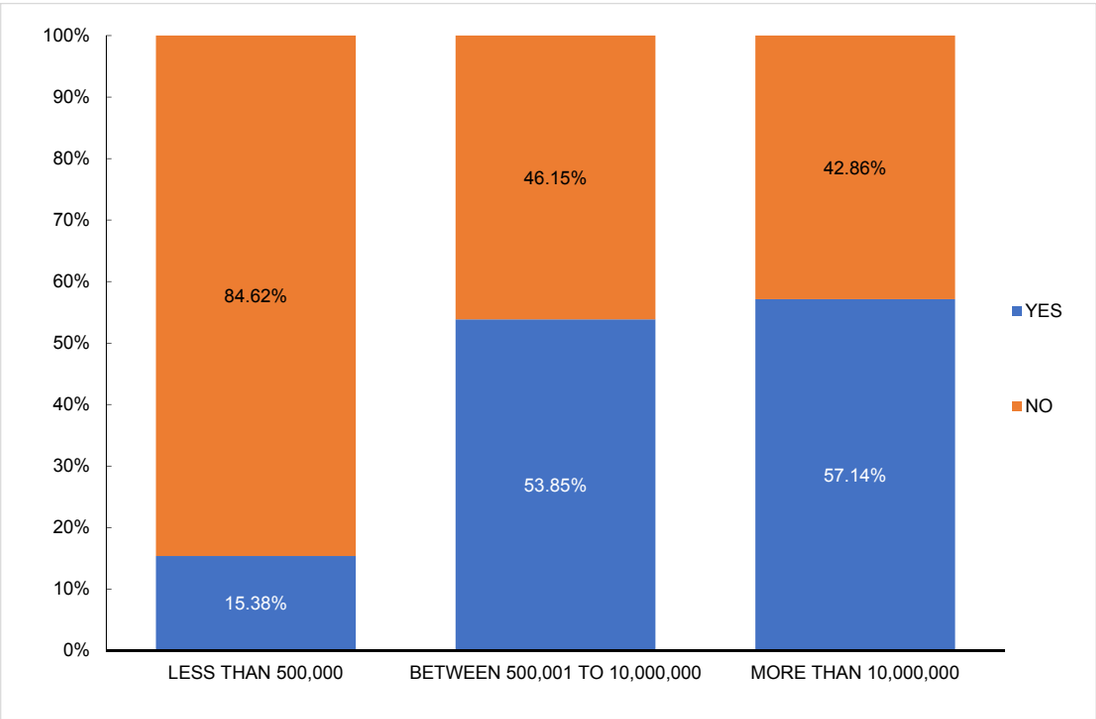
Q3.1. CAN CITIZENS EASILY WALK TO DESTINATIONS DIRECTLY?



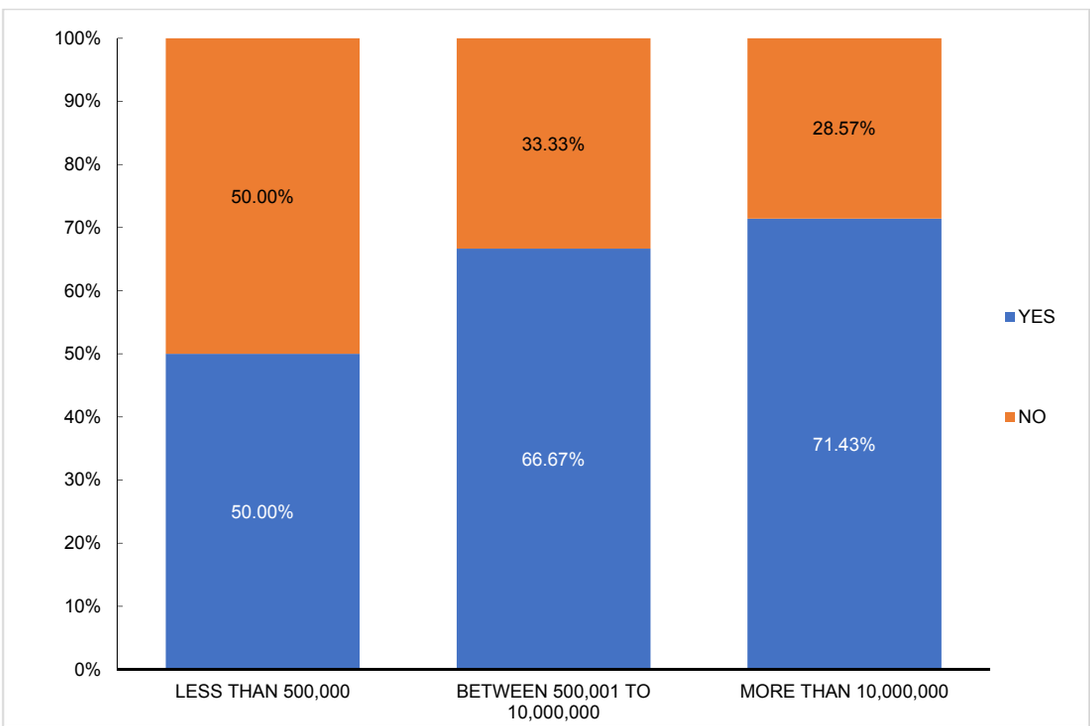
Q3.2. EASILY MAKE WALK AND PUBLIC TRANSPORT TRIP COMBINATION



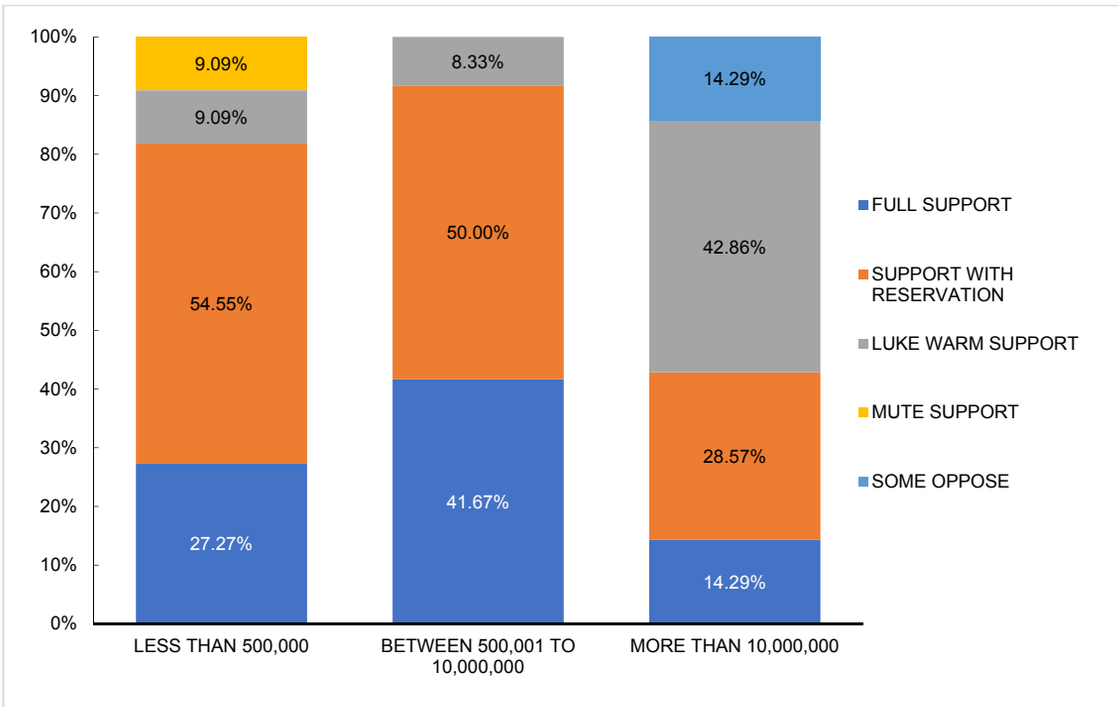
Q3.3. ARE WALKING TRIPS IN MOBILE DIGITAL PLANNERS?



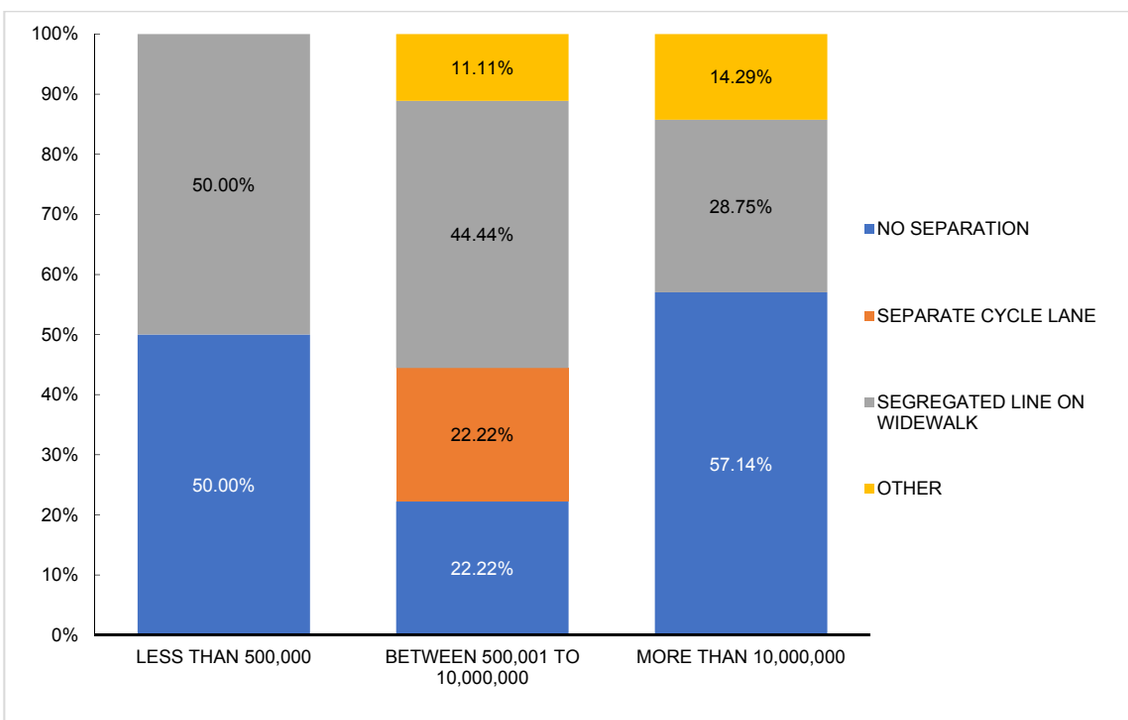
Q3.4. STEPS PER TRIP BASED ON DAILY RECORDED ON MOBILE TRAVEL PLANNERS (HEALTH)?



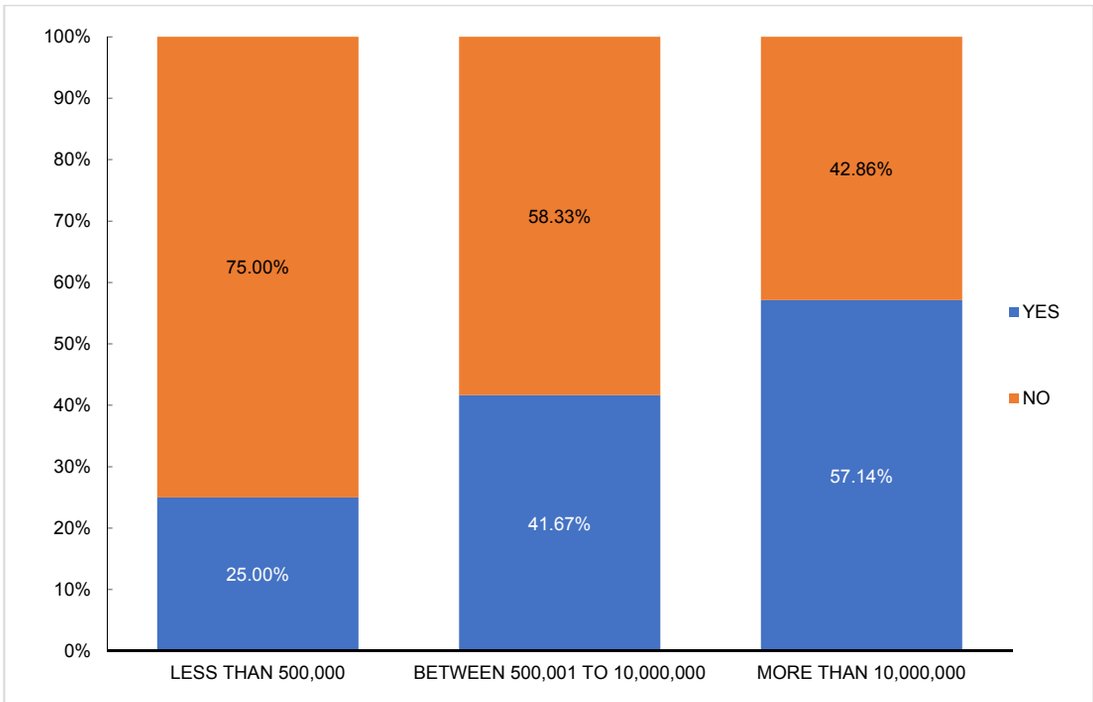
Q3.9. PUBLIC OPINION ON PEDESTRIANISATION



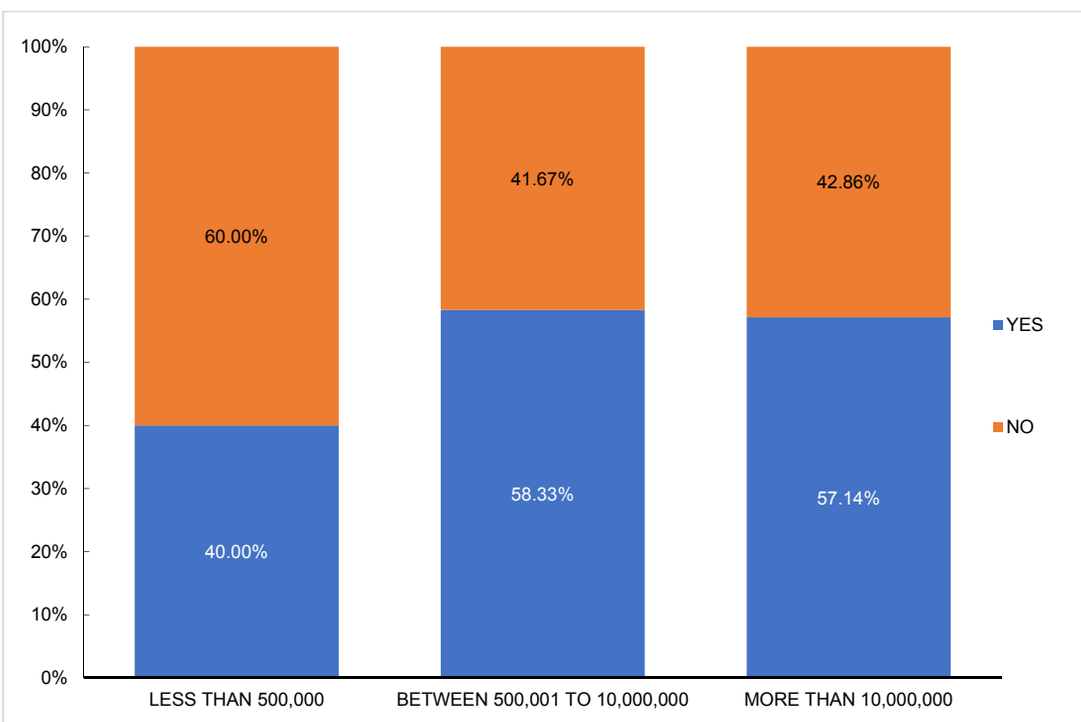
Q3.12. PROVISION FOR CYCLISTS



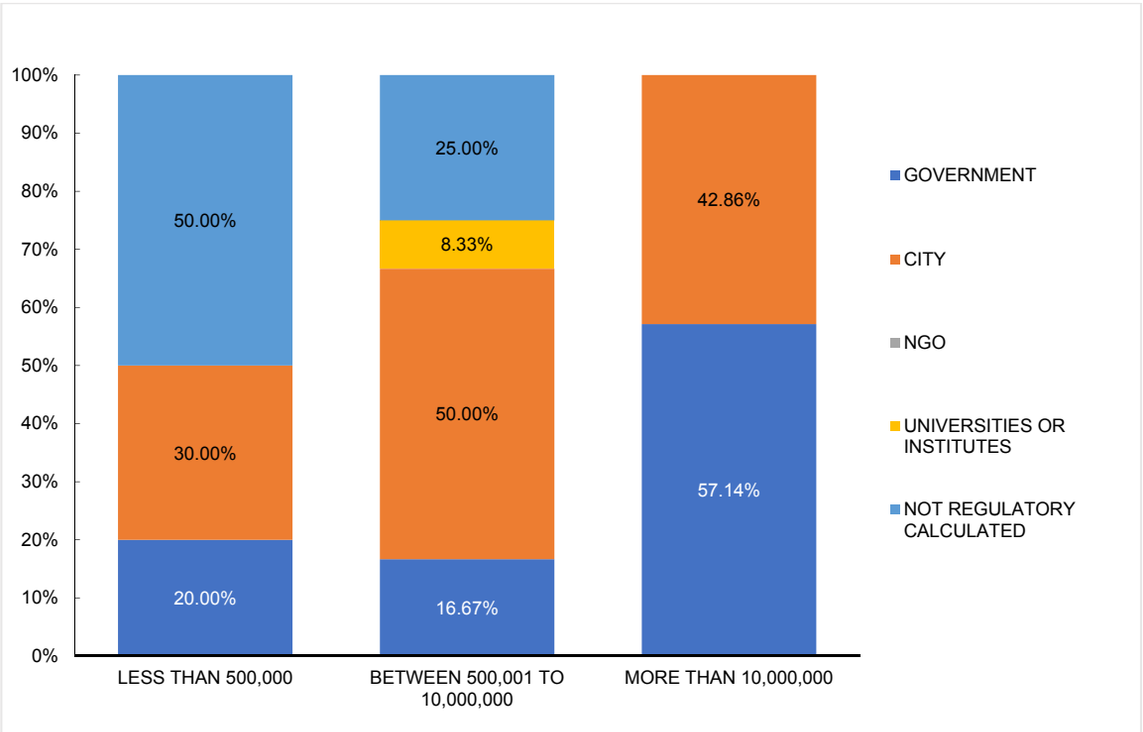
Q3.13. BIKE RENTAL SCHEME



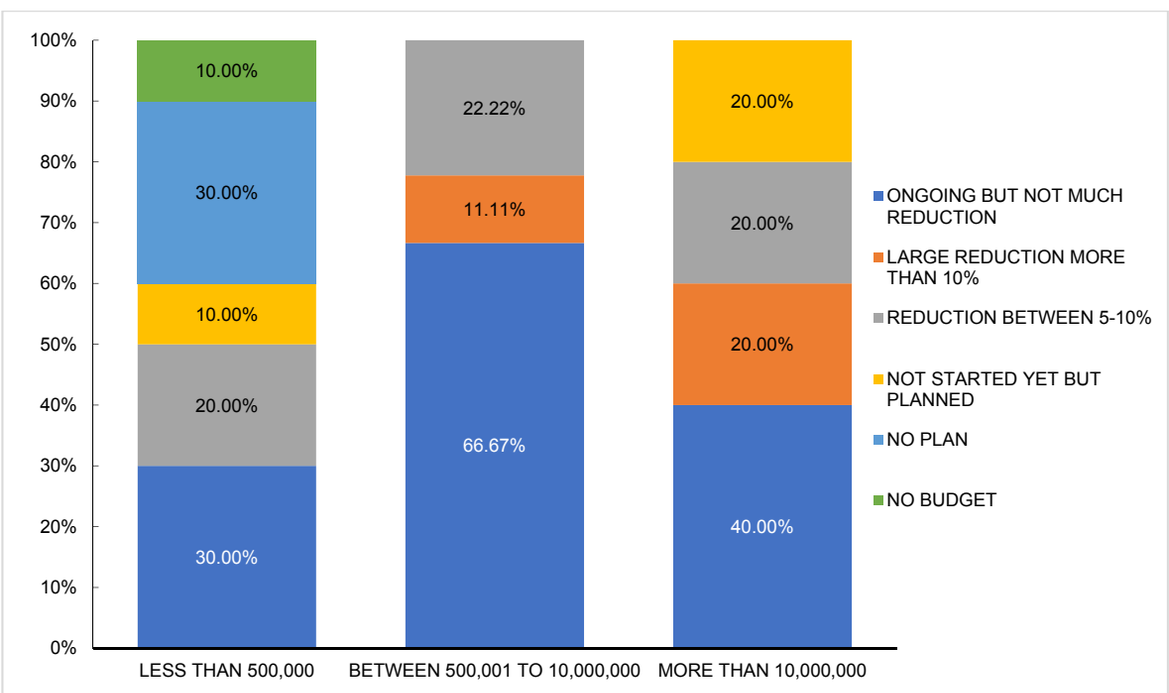
Q3.14. ANY POLICY TO PROMOTE CYCLING?



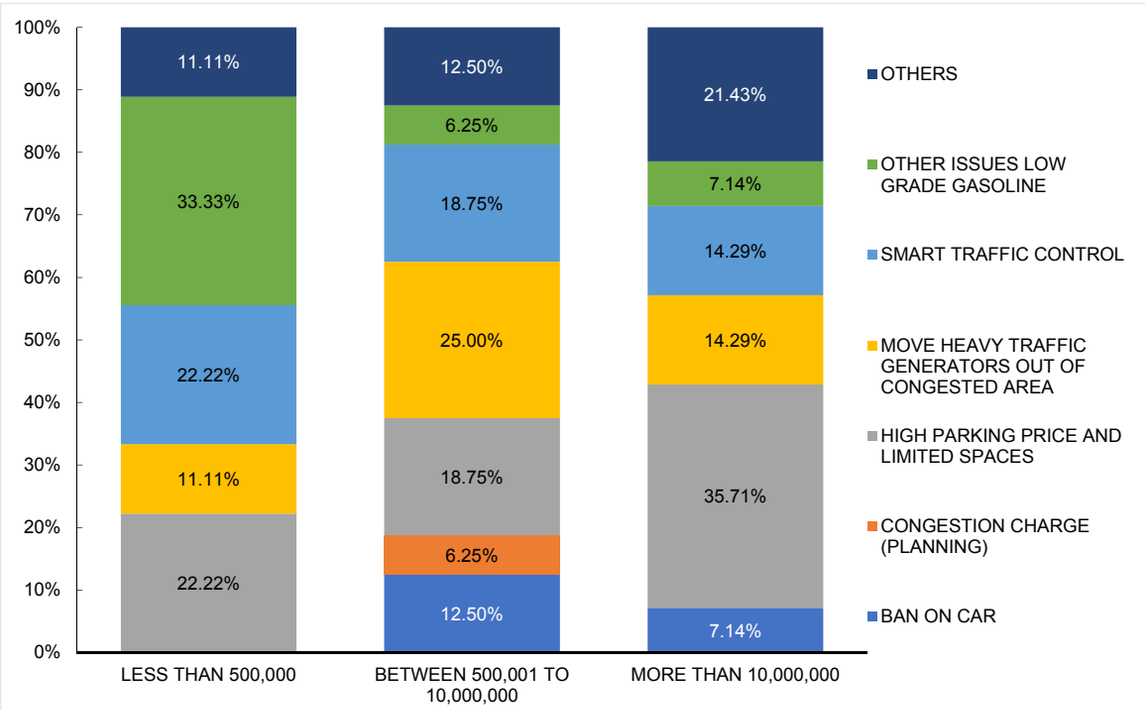
Q4.1. WHO CALCULATES THE CARBON FOOTPRINT OF YOUR CITY?



Q4.6. REDUCTION ACHIEVED TO DATE

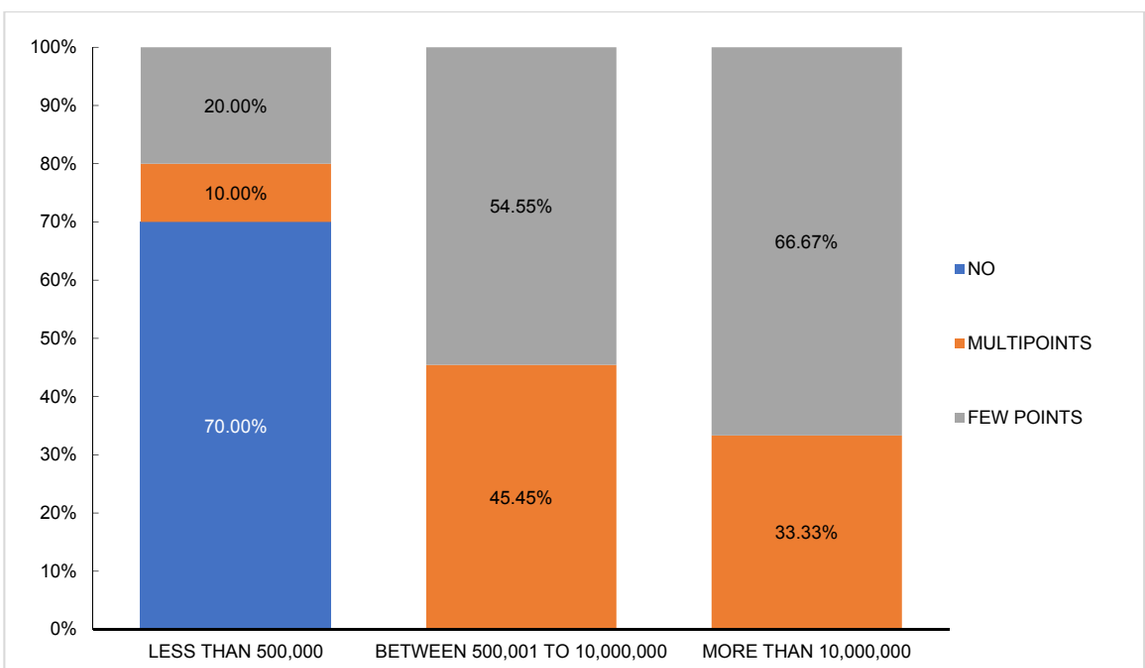


Q4.7. MAIN MEASURES TO COMBAT CONGESTION

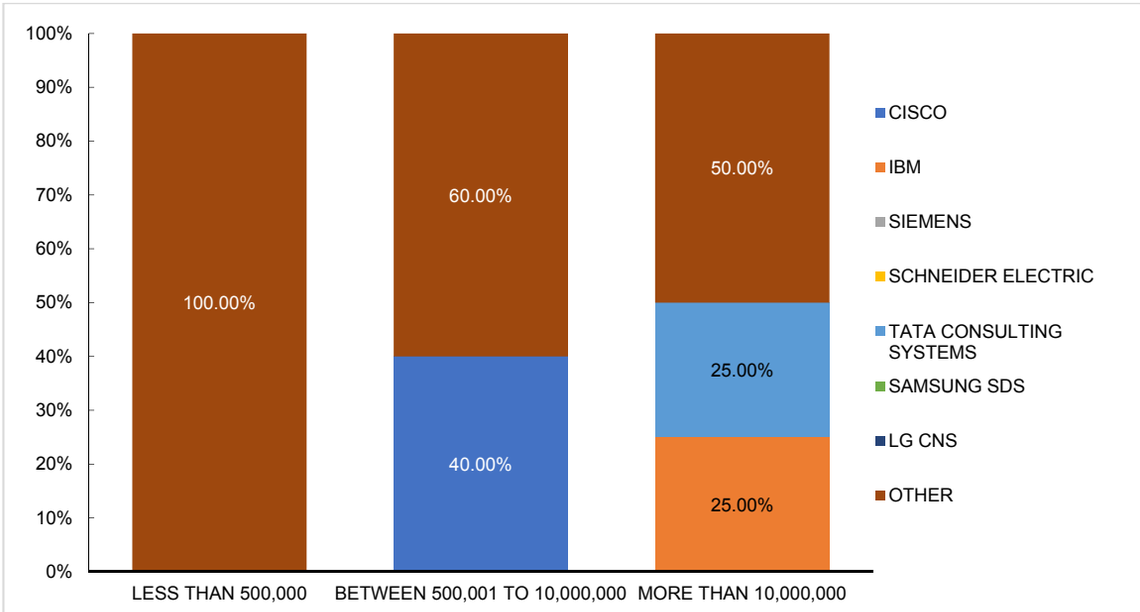


* Congestion charge was still under debate

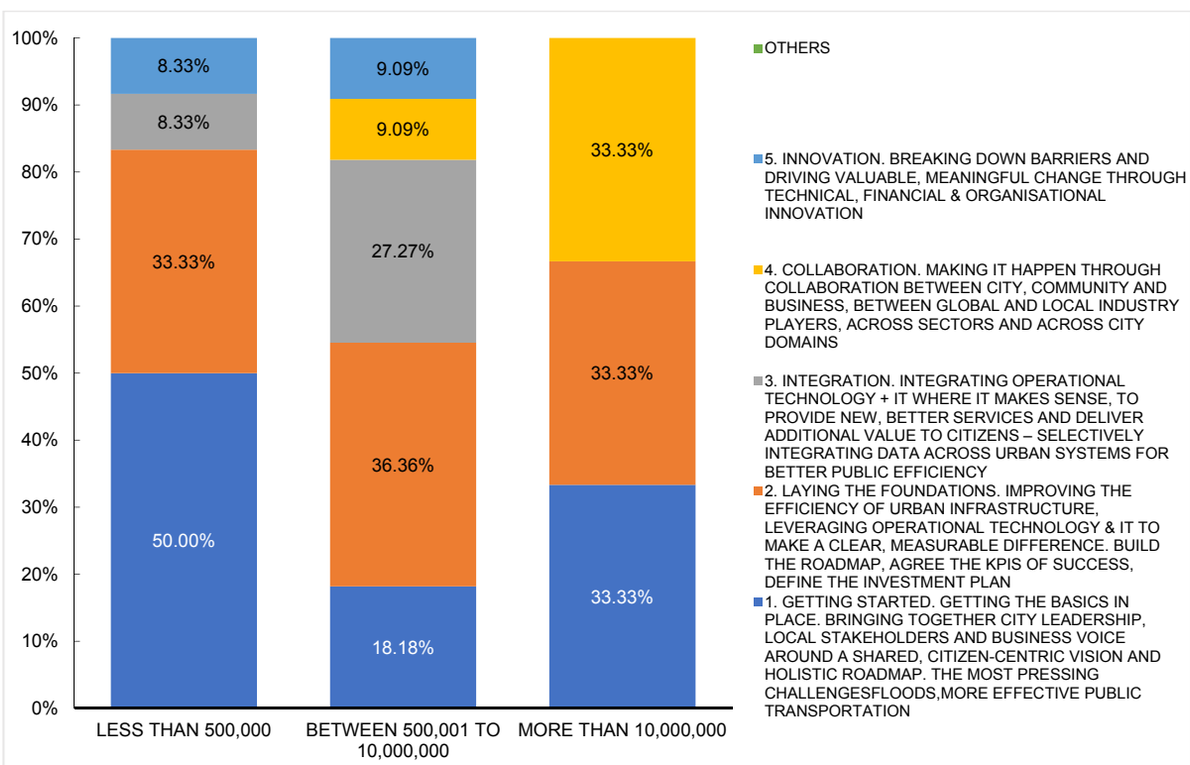
Q4.8. DO YOU MONITOR AIR QUALITY 24 HRS PER DAY?



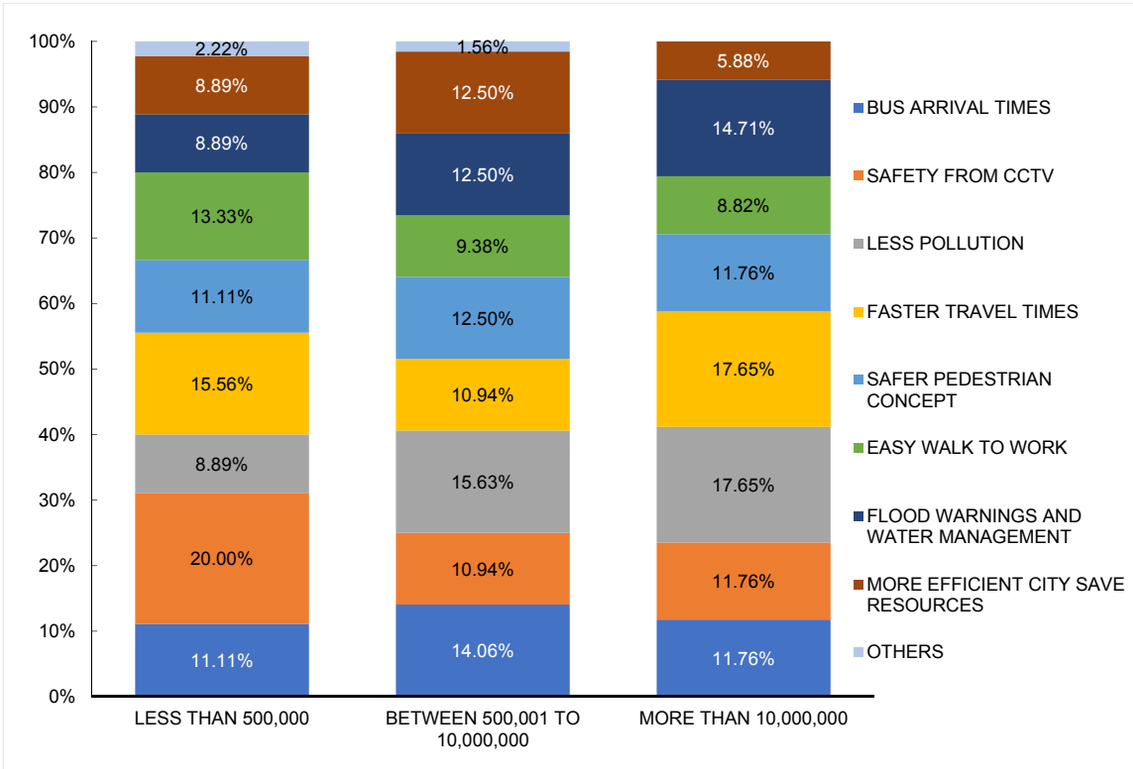
Q5.3. SYSTEM PROVIDER



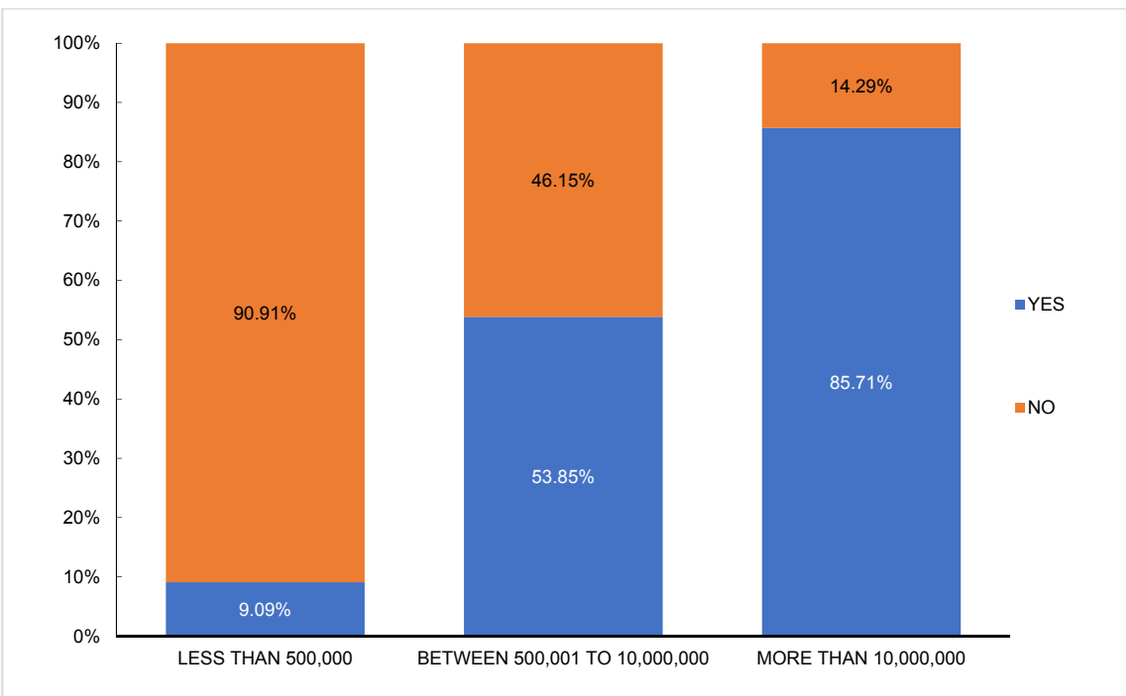
Q5.4. STAGES OF DEVELOPMENT CHOOSE ONE OF THE FOLLOWING TO DESCRIBE YOUR CITY



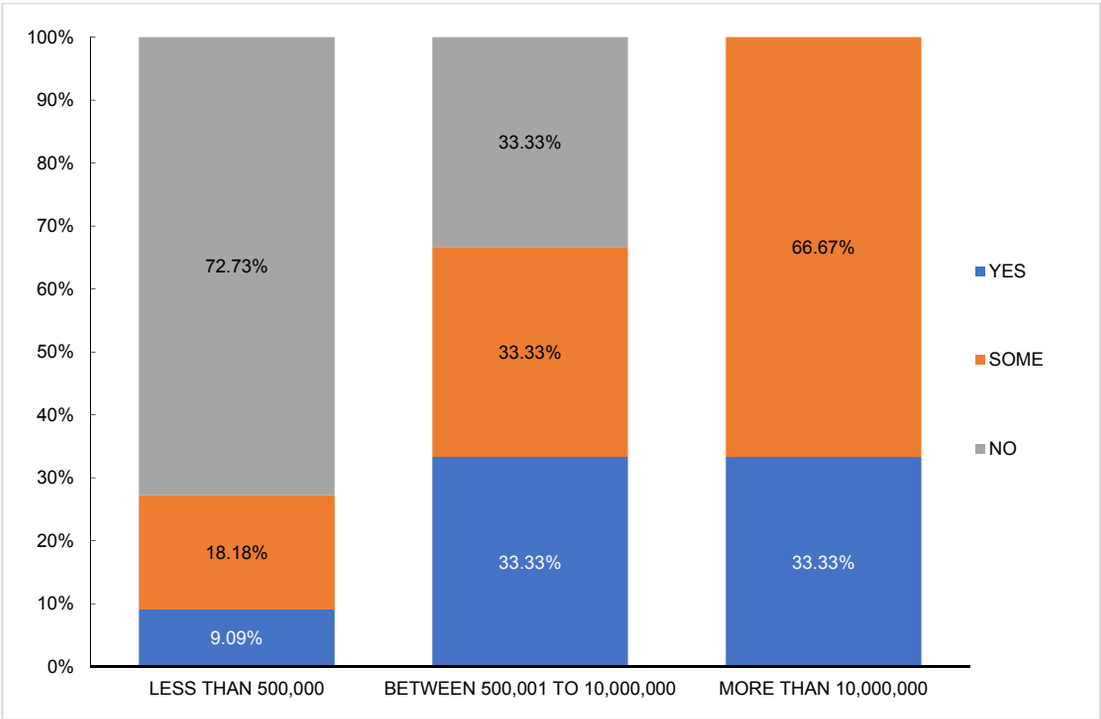
Q5.5. WHAT DO CITIZENS SEE AS THE MOST IMPORTANT BENEFIT OF SMARTNESS?



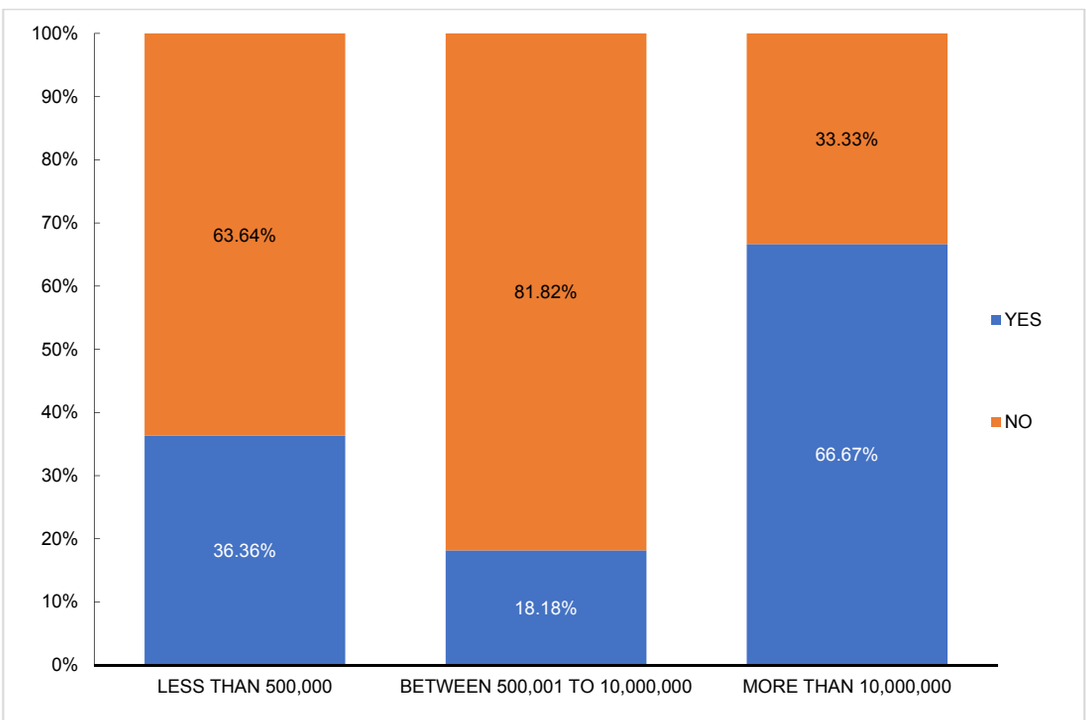
Q5.6. DO YOU HAVE A CENTRAL SMART SYSTEM?



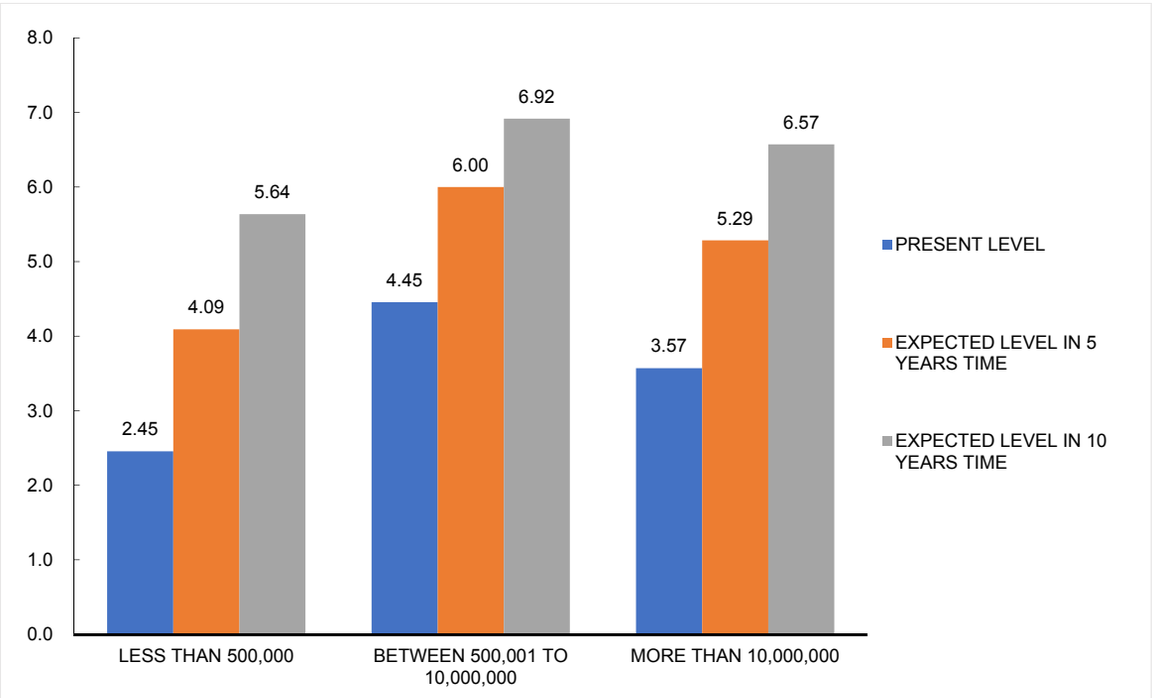
Q5.7. DECENTRALISED SMART SYSTEMS BY TYPE OF INFRASTRUCTURE



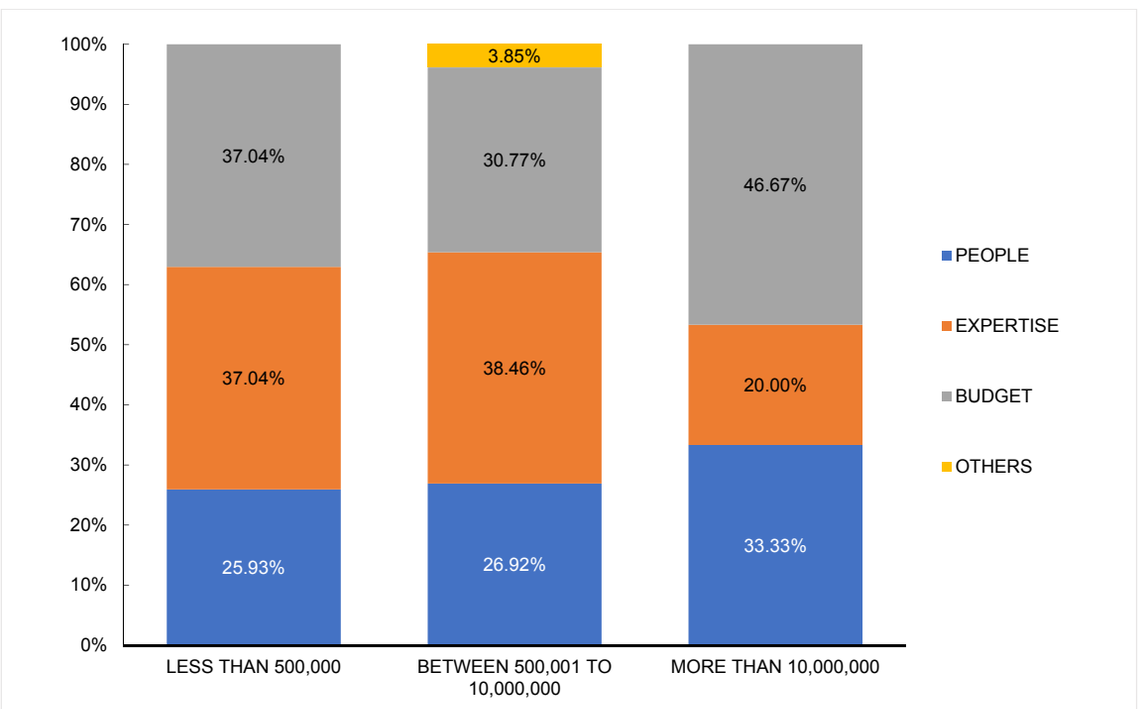
Q5.8. SCATTERED DISCONNECTED SMART SYSTEMS



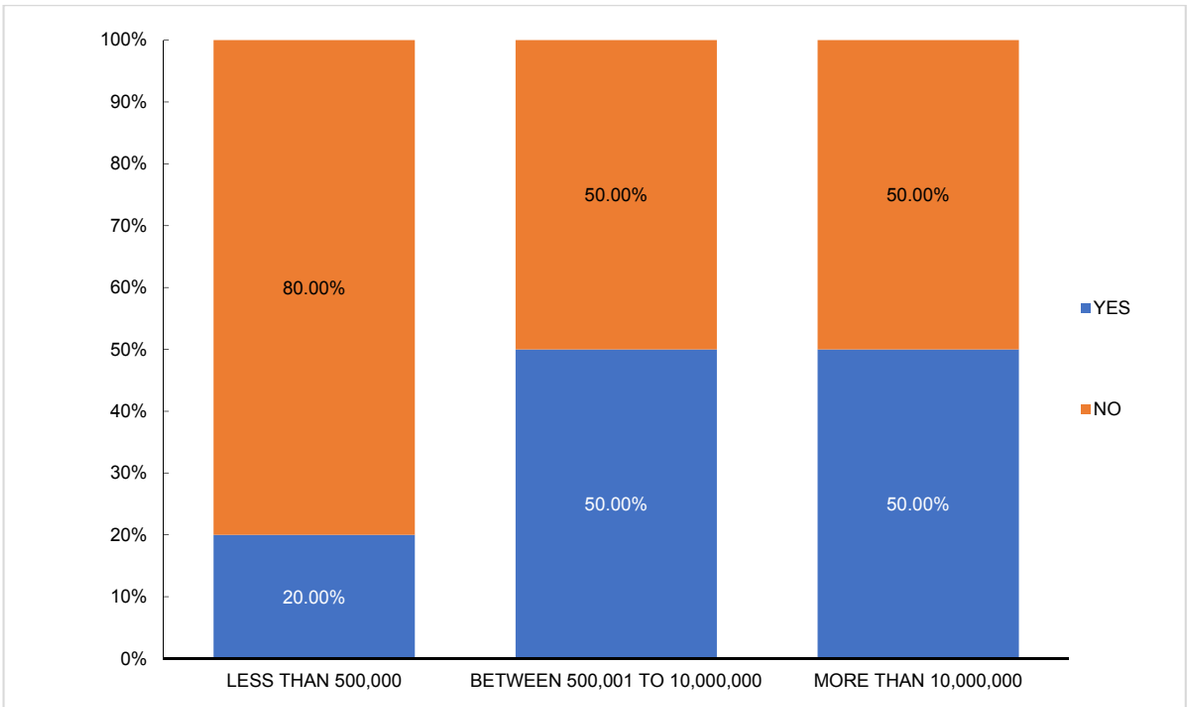
Q5.11-13. SMART LEVELS



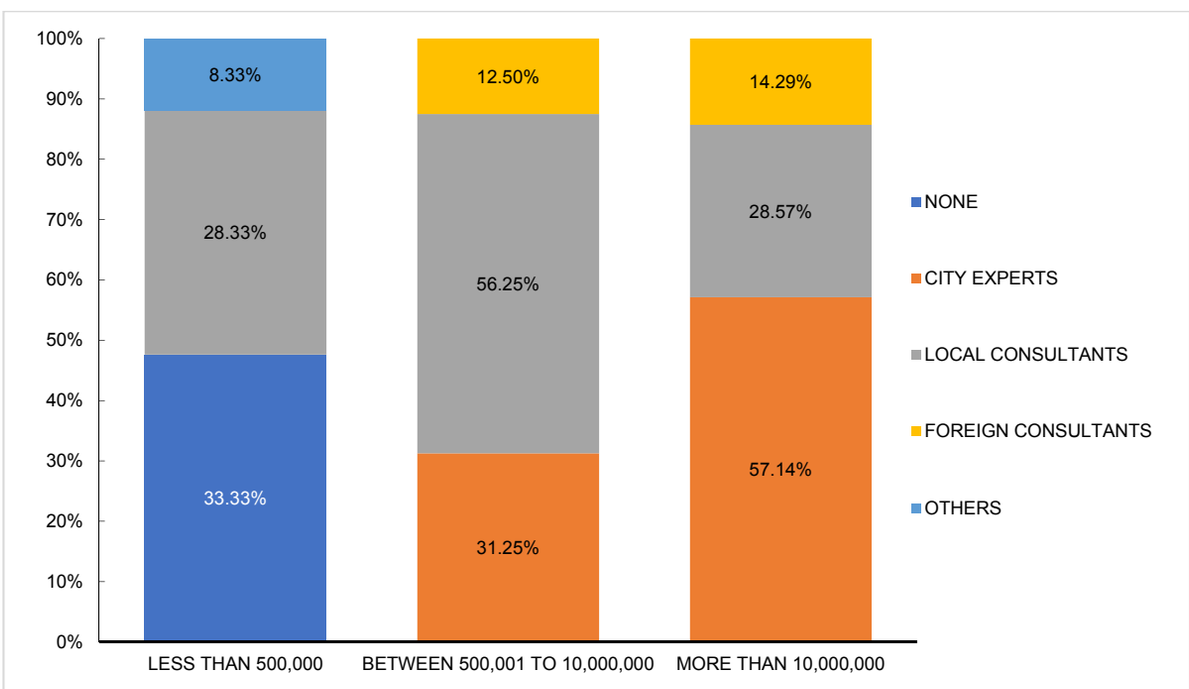
Q5.14. CONSTRAINTS



Q5.16. DO YOU USE INTEGRATIVE SOFTWARE?



Q5.20. CURRENT ADVISORS



Q5.21. WHAT DO YOU NEED MOST AT THIS STAGE?