What makes a city ‘Smart’?

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Abstract

Taking advantage of ICT tools and techniques for city administration, whether it is for urban planning activities, for transport solutions, or many other purposes is not a new concept. However in order for a city to be classified as ‘smart’, a synthesis of intelligence that transcends mere utilization is essential., This paper analyses the increasing use of ICT and sensing technologies in cities by examining this new way of city governing from a critical perspective.

Existing projects and initiatives were investigated to find out how, and to what extent, these tools are being employed by cities. The advantages and the current shortcomings of smart city are also discussed in order to understand the viability of using these tools.

1. Introduction

Mitchell’s ‘‘City of Bits’’ (1) introduced the Soft City concept, where software and IT augments the urban infrastructure and urban systems, and where a ‘’new’’ public / social space, the ‘internet’, becomes a very prominent part of everyday life. Over the last twenty years, this ubiquitous and increasingly real-time information technology has evolved into the ‘internet of things’ (IoT) which now promises to offer greater connectivity within the built and natural environment, whereby the entire physical world becomes a big connected database. Meanwhile the term ‘smart’ has become very popular over the last five years or so. Outside academia, the general ‘smart’ concept became a generic term fused with data collection, sensors and various monitoring technologies, big data and the IoT.

Data collection, using sensors and monitoring of every aspect of urban living is technologically possible and is being done across many communities under smart city schemes. Many cities across the world claim to be a ‘smart city’ or to belong to a smart region and many others are trying to become one. But what makes the city ‘Smart’? In this paper the author looks into the technological aspects of the smart city and tries to classify elements of the future city which are smart in every sense.

1.1. City and Technology

City authorities across the world collect many different types of data. Over the years cities tried to share this data with their citizens, for example, as an earlier study (2) points out, in the 1980s local governments in the US started applying IT, not only to speed up data processing but also to improve delivery of services, aid citizen interaction with local government and potentially increase political participation. Nowadays not only sharing the data with the citizens but also making sense of that data before sharing it becomes one of the most important new tools for city authorities.

Cities are complex, organic structures; they evolve and change constantly. Over the past 8000 years, cities have always been places where innovations in transport, communications media, printing, publishing, processing information and the creation of knowledge have been concentrated.(3) The creation of new technology and the utilization new tools and techniques of the day brought people from country side to cities to work, discover and live the *promised* prosperous life. However cities around the world are facing acute challenges. Although they are getting smarter in many ways, they are also getting bigger and denser. It is believed that by 2050 70% of the nine billion people in the world will be living in cities. (4) Population growth and resources depletion in cities makes urban matters a problem for everyone on earth, not just the residents of large metropolises.

The collection and analysis of data is a powerful tool for today's cities, and the data is often real-time. As smartphones and tablets become more affordable and popular and wireless networks more available, mobile phone and tablet applications offer the promise of making city life smarter and easier for citizens. It is believed that e a third of the world's population, more than 2.56 billion people, will own a smartphone by 2018. (5) These developments not only enable the accessing and sharing of data, but are also the means by which much 'big data' are generated- for example mobile devices such as smartphones allow their users to access information at the same time as they record the information accessed, and when and where it was and how it was used. (6)

1.1.1. Urban Informatics

Urban Informatics, in its narrower focus, pertains to the ways in which computers are being embedded into cities so that the routine functions can be made more efficient, not only through automated responses but through the data that such computation generates which is central to policy analysis. This narrow focus is on control. In its wider focus, it is concerned with the use of computers and communications to enable services to be delivered across many domains and to enable populations to engage and interact in policy issues that require citizen participation. (7) Urban informatics and urban analytics initially made the basis for the concept of a smart city. The idea was that by using the data and the analytics proactively, preventative and integrated responses can be produced almost in real-time.

1.1.2. Smart City

Although the smart city concept has been around since the 1990s, it is still a fairly new concept which, in tandem with technological developments, has evolved from the concepts and research areas of the 'virtual city', 'wired city', 'informational city', 'telecity', 'intelligent city', 'urban cybernetics', 'digital city' and others. From the technological perspective, in order for a city to be classified as ‘smart’, a synthesis of intelligence that transcends mere utilization, is essential; this is termed ‘fusion’. The result of this fusion, as Batty et al (8) describe, forms a city in which ICT is merged with traditional infrastructures, coordinated and integrated using new digital technologies. So far many academics have tried to define what a smart city is, and many local governments have claimed to be one.

There is no fixed definition for what a smart city is. This is because each city is different and each has different challenges and priorities. A recent classification (9) looks into 23 different definitions and the earliest of these goes back to 2000. However it is clear that the meaning of a smart city is multifaceted and continues to evolve. On top these academic definitions, governmental literature, ranging from the European commission level (such as 'The Smart Cities Stakeholder Platform') to the single local authority level, provide definitions. Equally these numerous descriptions have varying resonances to the different stake holders who play a part in making the city smart: technology suppliers, scholars, local authorities, and citizens. The Smart City phenomenon is attractive to business. Companies such as the ABB Group, Accenture, Alcatel, ARUP, Cisco, Dunlop, Enel, Ericsson, Fujitsu, General Electrics, Google, Hewlett Packard, Hitachi, Huawei, IBM, Intel, Itron, Mercedes-Benz, Microsoft, Oracle, Schneider Electric, Siemens AG, Telefónica, Toshiba are among those vying to provide smart city technology.

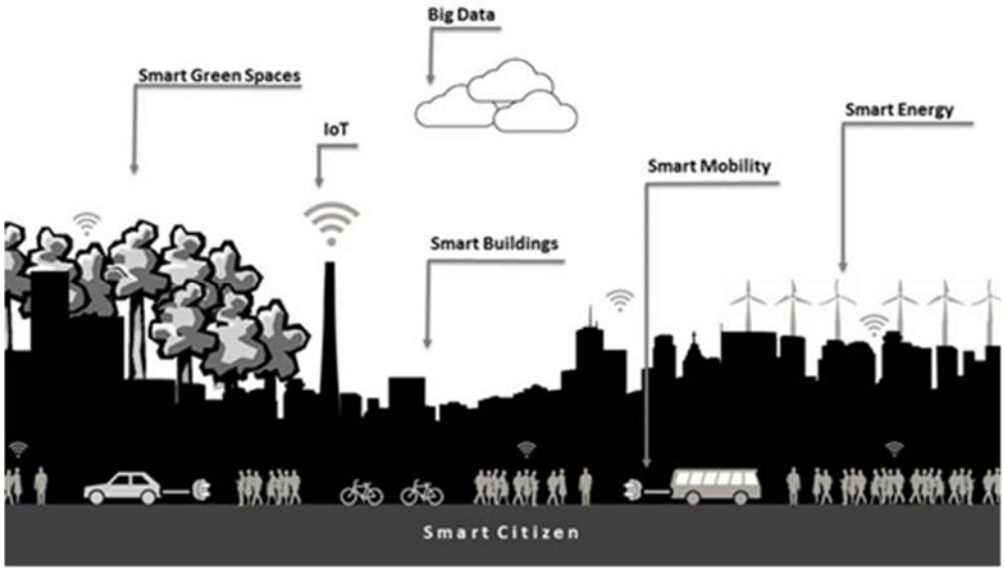

Figure 1 Smart City

The definition offered by the British Standards Institution (10), that a smart city is an effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens, is the preferred definition for this study. Here is why:

- It is an inclusive definition. It does not only favour technology as a way of becoming smart.
- Rejects siloed responses, instead favours integration of all systems.
- Recognises that the ‘citizens’ and providing a better life to citizens are the purpose of this movement.

Whatever the way the 'smart city' emerges, whether by design or by coincidence, by now many cities are 'smart'. In our recent survey, as of August 2016, we observed 1119 smart cities (proposed, just embarking on the project or classed as smart city already) with 1707 smart city applications. It should be pointed out here that many cities analysed have more than one smart city application. However, although some cities are classed as ‘smart’ in the literature, we could not yet access the types of applications that are supposedly in operation for those cities. If we look at the distribution of the smart cities across the world we see that 493 of these are in Europe, 494 in Asia, 87 in North America, 18 in South America, 10 in Africa and 16 in Australia.

Figure 2 Smart Cites across the world as of August 2016

There are three key players involved in the smart city concept: universities, industries, and local government. The scientific papers and practitioner reports reveal the presence of a triple helix concept of the knowledge-society, even if each key sector has different aims: research and knowledge spreading for universities, business and profit for private companies, local well-being and political consensus for public bodies. (11) It is also

believed that leading smart cities have adapted the triple helix model where universities, industry and government are working together to a common goal. (12) These cities have initiatives in digital infrastructure, data management, smart buildings and smart transport with dedicated teams with executive power. Inete Ielite a government official from Riga in Latvia emphasises that as well as having formal methods, establishing accessible e-services, engaging with researchers, involving inhabitants and working on strategic partnerships are important factors for becoming a smart city. (13) Matthias Krebbs, a city official from Mannheim City Council - Germany (2015), points out that in order to be successful as a smart city, local authorities should develop digital structures, have free Wi-Fi access, build open data platforms, have accessible public information, create learning opportunities and provide on-the- job training. (14)

The triple helix approach recently moved on to other more inclusive system approaches. One example is the Quadruple Helix model where partners from government, industry, academia and civil society get together to tackle city problems. One recent example of this is the Urban Living Partnership - Newcastle and Gateshead City Region project, which aims to identify complex and interdependent challenges within the urban region, working collaboratively to co-design and implement initiatives and solutions in order to contribute to the life and development of the area. (15) This project, funded by seven UK research councils and the UK government's innovation agency, Innovate UK, is one of the 5 pilot projects across the UK seeking to alter the blueprint of our city living. The results of these pilot studies will provide invaluable resources for us to make cities future-proof.

Smart City initiatives cover many aspects of city living. In our recent survey, where smart city projects across the world were investigated, 31% of the projects were urban living labs, and 22% of the projects were related to the smart government initiatives and 16% of the projects were related to smart environment activities. Following theses top three issues, the others we found were related to open data (13%), smart mobility (11%), smart economy (7%), smart living (5%), smart people (4%) and digital initiatives (1%) The remaining 2% of the projects consisted of ‘new’ smart cities, public safety, smart infrastructure, and health related projects. Most of these projects were led by the city or county authorities with the cooperation from various businesses for example ARUP, Cisco, IBM, and others.

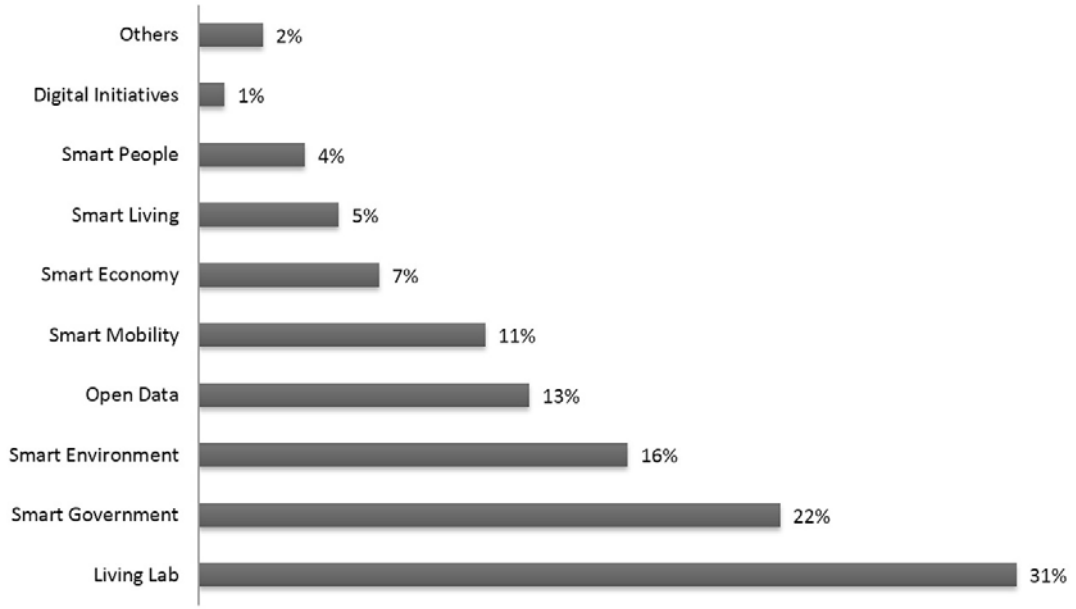

Figure 3 Smart City project types

1.1.2.1 Approaches to Smart City Developments

There are two approaches to the development of smart cities. A typical top-down approach can be observed with India's Smart City Mission prepared by the Government of India, Ministry of Urban Development in June 2015. Another example of this type is the Chinese Government's latest China's Five-Year Plan (13th Five year plan: 2016-2020) which encompasses the National New-type Urbanisation plan for the same period that emphasises smart city developments. Top-down approaches also include the 'new' smart city, as in smart cities from scratch, such as Songdo, South Korea; PlanIT Valley, Portugal; Masdar City, United Arab Emirates; Konza Technology City, Kenya.

However in Europe although there are some top-down approaches, at city level Europe has more of a bottom-up approach for the development of smart cities.

1.1.2.2 Participation in Smart Cities

It is clear that data and ICT play a big part in smart future urbanism. But equally there are other major concepts which contribute towards the creation of smart cities. It is highlighted that ICT is unable to transform cities without the human capital which brings the liveability of a city to attention. (16) Cities, whether smart or not, exist for their citizens, and therefore the involvement of the latter is a top priority.

Public involvement is an important urban planning tool whereby consulting and involving the public in decision-making processes enables wider and better acceptance of proposed plans by their future users. It has been pointed out that some of the activities such as parks and recreation, planning and community development typically involved in smart city projects can benefit greatly from citizen participation. (17)

Human Smart Cities is an emergent approach where ‘softer’ features of ‘smartness’ are emphasised, such as clarity of vision, citizen empowerment, participation etc., which can complement the technological drive of the underlying urban infrastructure. (18) The pillars of the smart city are categorized as connections (as networks and technological infrastructures), Open data and Sensors (including citizens being able to actively participate in a bottom-up way in city activities). (19) However we believe citizens will need to be considered as one of the fundamental support mechanism for a successful smart city development (20) aligned with the Human Smart City movement.

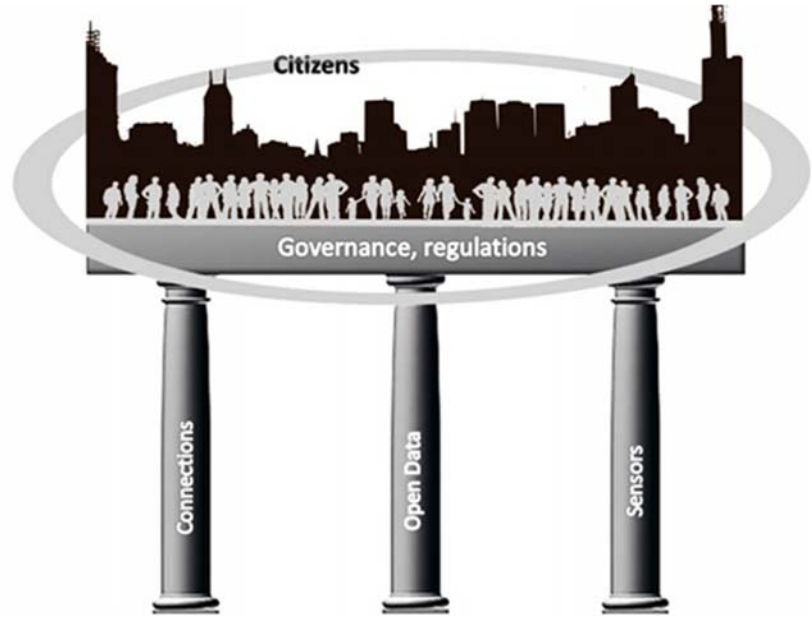

Figure 4 Pillars of Smart Future Cities (Adapted from (20))

A number of state of the art methodologies can be adopted in support of achieving Human Smart Cities, such as Participatory Design, Open Innovation, Living Labs and Design Thinking. These approaches all place the end user at the centre of the process, leading to a more effective solution that meets people’s needs. (18)’Tell me’, ‘Save Energy’, ‘MyNeighbourhood’, ‘PERIPHÈRIA’, ‘Smart Campus’ are some of the Human Smart City projects that can be further explored.

1.2. Big Data

By utilizing city-related apps and by just using the smartphone, we, as users of these devices, are contributing towards the 2.5 Quintilian bytes of data - so much that 90% of the data in the world today has been created in the last two years alone. This data comes from everywhere: sensors used to gather climate information, posts to social media sites, digital pictures and videos, purchase transaction records, and cell phone GPS signals to name but a few. (21)

Big data consists of massive, dynamic, varied, detailed, inter-related, low cost datasets that can be connected and utilized in diverse ways, thus offering the possibility of studies shifting from: data-scarce to data- rich; static snapshots to dynamic unfoldings; coarse aggregation to high resolution; relatively simple hypotheses and models to more complex, sophisticated simulations and theories. (22) However the big data concept comes with challenges too. These challenges can be summarised as; the volume challenge, the velocity challenge, the variety challenge, veracity and visualization. (23) Overcoming these challenges, or in other words efficiently utilizing big data, requires better understanding of the problems cities are facing.

The useful data sources for urban applications that contribute towards big data can be categorized into three different types:

- data coming from individuals carrying location- aware devices
- businesses moving some of their activity online
- governments releasing an increasing share of their data in open formats. (24)

2. Real-Time City

Initiatives using IT technology, in the form of e- government, to interact with citizens by local and national government agencies date back to the late 1990s. (25) Nowadays a wide range of activities, from interaction, to publishing, to transaction and to data gathering take place between citizens and government as a matter of fact. These interactions are the source of the real-time city. Real-time systems are defined by an ability to constantly monitor environmental conditions vital to the operation of the system. The system operates by using feedback from one part of the system to either induce or inhibit activity in another part of the system, pushing it towards an optimum stable state chosen by the designer. Yet the city, as a system, (up until recently) has never operated at anything remotely approaching real-time. Traditionally, in city planning, the individual is rarely the unit of analysis. Yet it is clear that the point of intervention of mobile communication technologies is the individual, not the institution, neighbourhood, city, or region. (26) Since this analysis (26) there has been a steady change in capturing citizen's data which contributes towards real-time data in cities. Many planning organizations and agencies are beginning to understand the ways in which different web and mobile technologies improve workplace efficiency, increase access to information, streamline repetitive processes, and improve communication processes both internally and with the general public. With the accumulation of large amounts of anonymous and aggregated data, it will be possible to model the complex system that is a ‘living city’. (27) The challenge is processing the real-time data and making it available rapidly, since the value of information decreases as it ages. (23)

2.1. Data Interaction in Real-time Cities

Data sources that correspond with the data typologies (24), for example social media, mobile applications, open data websites, and city dashboards or smart card data (for example the Oyster travel card in London) and mobile phone trace data etc. are becoming

extremely valuable resources. Urban living labs and city blogs also provide data interactions and communication. As the city is becoming a series of sensors, providing streams of information relating to its occupants' movements and use of space (28), these data interactions are making the city ‘real-time’.

2.1.1. Urban Living Labs

Living Labs represents a user-centric research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real life contexts. The implementation of Living Labs is based on the involvement of the users (firms, organisations and consumers) in the innovation process, thereby making the innovation system user-centric, as opposed to technology centric. (29) Urban Living Labs, meanwhile, are development environments that integrate residents and other stakeholders to develop and test new solutions in their daily life. The users of the new services or solutions are active partners in the whole development process, which happens in the real urban context. Key success factors for Urban Living Labs are the early and continuous involvement of the affected people, clear goals and expectations, and acting instead of discussing. The methods must be adapted to the goals and participants. (30)

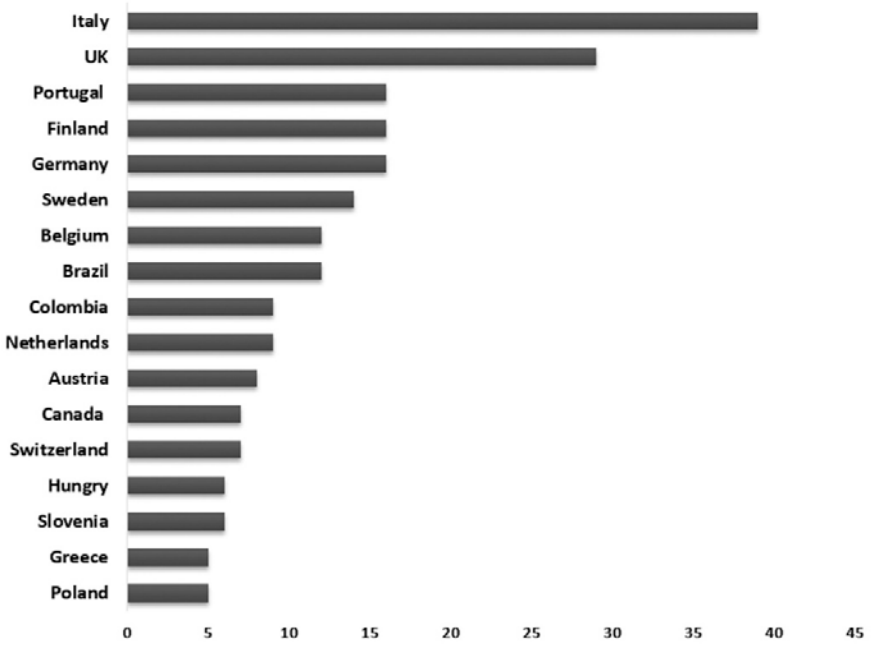

Figure 5 Urban Living Labs across the world – 5 or more per country (data gathered from http://www.openlivinglabs.eu/livinglabs)

In our survey of 1707 smart city applications over 1119 smart cities, 31% of these smart city applications were based on Urban Living Labs. 84% of these living labs are based in 19 countries, with the remaining 16% coming from 35 different countries. In many cases urban living lab data can be visable via Dashboards or can be obtainable from city data stores. For example, the Urban Observatory project in Newcastle upon Tyne, UK (https://research.ncl.ac.uk/urbanobservatory/) monitors the city at multiple scales and provides long term data storage and links into the City Dashboard.

2.1.2. Social Media

Utilizing data from social-media applications is an emerging trend. It is known that, regardless of the motivation, everyday social-media is heavily used across the world and in some cases becomes the only true communication tool between the citizens, as seen in many mass social events (in the examples of Egypt 2011 revolution, London riots of 2011 and Occupy Gezi Movement in Turkey in 2013 and others) This shows citizens' readiness to utilize these types of technologies (smart phones, tablet computers, social media, instant messaging, email, live face-to-face chat etc.) to interact, organise and communicate.

Social media is defined as a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content. (31) Many relatively inexpensive and widely accessible electronic tools make the basis of social media which in return enable anyone to publish and access information, collaborate on a common effort, or build relationships. (32) Exploring social-media data has vast potentials. It has been pointed out that (33) the collection, mining and analysis of social media are arguably one of the core examples of ‘big data’ sets. The dynamic nature of the media makes it a new and emerging base for the analysis of human behaviour and brings new opportunities to understand groups, movements and society. Many tools are established to give citizens to define the problems and negotiating solutions for example digital voting systems, the App Movement, digital story telling are some of the examples can be given here. (34)

Many different types of social media applications for example; Blogger, Facebook, Flicker, Instagram, LinkedIn, RSS, Share, Skype, Twitter, What's up, You Tube etc. are in use across the world. Twitter, in particular, a micro blogging site, originally developed for mobile phones, designed to let people post short, 140-character text updates or 'tweets' to a network of others (35), gives immense possibilities for data-mining.

2.1.3. Mobile Applications

Many city-related mobile apps have been the focus of academic and grey literature recently. For example in a recent study (36) looked into mobile-smart phone applications and explored how this technology is currently influencing planning practice; and he also created a taxonomy for current mobile applications. The New Cities Foundation (37), has held an annual competition since 2012, titled AppMyCity! (4) which rewards new mobile applications that improve urban living.

There are countless apps that relate to city living. Many of them are informative- giving live information on traffic, where to park, weather, where to eat etc. Some work as crowd-sourcing applications and collect data from app users; this is either volunteered

information such as reporting a pothole in a specific location or non-voluntary info which feedbacks to database, for example location information. In our recent survey where city related mobile apps were investigated, it was found that near half of the apps (45.6%) related to travelling (car, bus, cycle, parking etc.) in cities. Some of these apps are endorsed by the local authorities and/or can be accessed via their websites. 15.6 % off the apps were cultural ones where information on art galleries, libraries, shows etc. were given and in some cases transportation and parking links related to these activities were included. And following these, the third highest ranking app type looks into helping citizens to report faults, issues etc. to local authorities (also apps such as bigov app (5)-a dashboard provider, Public Transport Management App (6), and Situational Awareness Framework (SAF) (7) do offer their services to authorities) (Figure 6) Apart from these applications new ways of engaging citizens with each other and help each other during emergencies becoming a reality. One of the exiting new apps is the 'PulsePoint' which was launched on 1st June 2016 in Seattle. PulsePoint is a free life-saving mobile app that alerts people to a sudden cardiac arrest in their immediate vicinity so that they can start CPR in the critical life-saving minutes before paramedics arrive.

It should be stressed here that this was a snapshot of the available apps, and the research is on-going, and we did not consider many commercial apps such as travel company or travel guide book related apps, radio stations, sports clubs etc. We needed to focus on the apps that create engagement between local authorities and citizens in general.

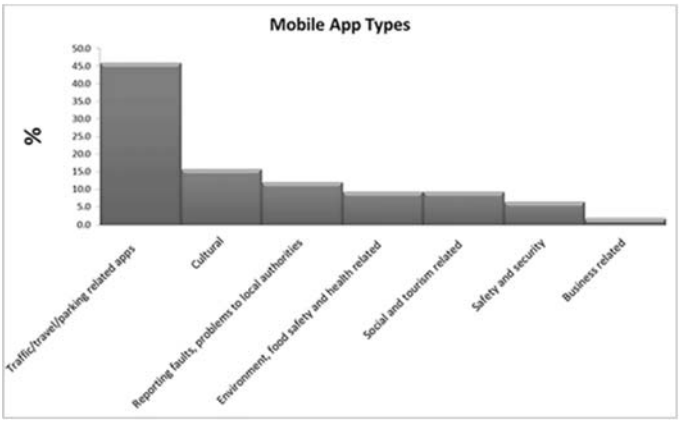

Figure 6: Mobile App types

2.1.4. Open Data.

Across the world many cities have now Open Data access sites where variety of city related data can be downloaded by anyone. Our survey has accessed 165 City Open Data sites. Western countries lead the way for making data available; 52% of these City Open Data sites are from Europe and 34% of them are from North America and following these, with smaller contributions to the total, Asia has 5%, Australia has 4%, South

America has 3% and Africa has 2% open data sites at city level (Figure 2)Apart from these city level open data cites there are also 32 country level open data sites available.

A recent study (38) gave examples on the selected European cities and their open data initiatives; for example Finland has 5 (Smart Kalasatama, Helsinki Region Infoshare, Apps4Findland, CitySDK, Helsinki Loves Developer), Manchester has 4 (CROSS, The Grater Manchester Data Synchronization Programme, Grater Manchester Datastore, Transport for Greater Manchester), Amsterdam has 4 (App for Amsterdam, Park Shark, FietsFinder, Code4Europe), Barcelona has 2 (OpenCities, iCity) and Chicago has 3 (Data Science Chicago, Chicago School of Data, Cook County Open Data) initiatives that are complementary to their city level open data work The examples from these cities focus on five different sector specific areas: transportation and mobility, health and wellbeing, environment, education, and finally tourism which matches with our observations as well.

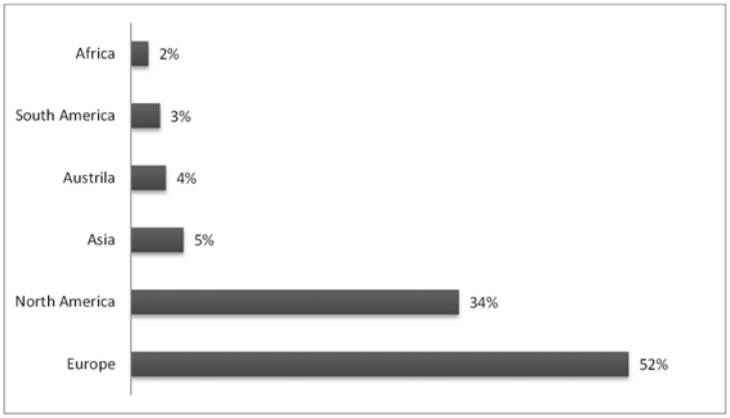

Figure 7: City Level Open Data Sites

These open data access sites provide various data sets. For example Leeds Data Mill (LDM) (8) is a place for businesses and organisations to share their open data with anyone interested in creating real change in the day to day lives of people working and living in the city. LDM project is part of a bigger vision titled Leeds 2030: Best City in UK and to achieve this they are working on two other main areas as well: Health and Well Being and Energy. The Mill was originally set up in December 2013 and secured backing from the UK Cabinet Office's Release of Data Fund and Leeds City Council in 2014. The project, which brings together open data information from multiple sectors across the city aims to kick start a new generation of data-driven cities and businesses (9) LDM provides 340 datasets in local services (60), transport (42), education (38), housing (31), health (30), art and culture (27), business and economy (26), licences (21), geospatial (20), tourism (18), sport (14), transparency (13) in twelve different file formats from thirty-eight different local and national agencies. Data portal is also supported with a dashboard (http://dashboard.leedsdatamill.org/canvas/leeds-city-council)

One of the most important developments from open data portal point of view is the Berlin 3D down- load portal. Since March 2015, free download access is given to building models in LOD2 and digital terrain of City of Berlin (40) Supported by the European

Fund for Regional Development, this portal provides 3D models in six different formats and also pre- assembled data sets of each districts of Berlin is readily available.

2.1.5. City Dashboards

The phenomenon of high volume and readily available data and current data analytics and data visualisation technologies lend itself to City Dashboards where real-time monitoring takes place. The dashboards have long been instruments that display the operation of a system in real-time. The most rudimentary of dashboards applicable to displaying the routine operation of the city do collect data in real time that are comparatively neutral in their factual complexion. That is, real-time data feeds that exist in many domains of the city predominantly from the operation of various infrastructures and the monitoring of natural events but increasingly supplemented by the use of hand-held devices. Viewers of the dashboard can thus visually compare and combine aspects of the city. (44) Many city governments now use real-time analytics to manage aspects of how a city functions. (6)

The data feeding urban control rooms and city dashboards, as well as wider administrative and statistical data, are becoming freely available for wider deployment. These are providing detailed information about city performance and trends, without citizens needing to learn how to handle data or use specialist visualization software. These open data and dashboard initiatives are changing not only the relationship between government and the public, but also the relationships between different business units within government responsible for delivering the services being measured. (41)

City Dashboards provide manifolds of data. We can talk about two types of data visualisation from the city dashboards perspective. The first one is the city portal where weather, transit, road traffic, pollution, Twitter trends, stock market prices, utilities and local news is provided on-line. According to our recent survey, some of the most accessible city dashboards are: Amsterdam, Birmingham, Boston, Brighton, Bristol, Cape Town, Cardiff, City Oberlin, City of Berkley, City of Doral, City of Portland, City of Williamsburg, City of Chicopee Denver, Detroit, Dublin, Edinburgh, Edmonton, Glasgow, Leeds, London, Los Angeles, Manchester, New York, Newcastle upon Tyne, Nice, Rio, Rome, Seattle, Venice, Waterloo.

The second type of data visualization is the administrative control centres where many types of data can be seen simultaneously such as in London and Rio (Figure 5) As well as the on-line London City Dashboard (40) CASA (Centre for Advanced Spatial Analysis, UCL) also established the Visualisation Wall for the Greater London Authority which can also be controlled remotely via any computable device allowing a central user to not only change data but also enable a mode where a video can be shown across all 12 iPads

simultaneously (8) Rio Operation Centre is designed by IBM and the centre gathers data from 30 agencies, helping the city coordinate their work.

The dashboards provide a visual means to organise and interact with data, enabling users to drill down into data sets, filter out uninteresting data, select an item or group of data and retrieve details, view relationships among items, extract sub-collections, and to overlay and interconnect disparate data, enabling summary- to-detail exploration within a single visualisation sys- tem. They can also facilitate the exporting of visualisations for use in documents or sharing via social media, or accessing the underlying data for importing into other analytical packages. (42)

Apart from the city level dashboard, many countries have country level dashboards. They include: Australia, Austria, Bahrain, Belgium, Brazil, Cameroon, Canada, Chile, China, China, Costa Rica, Denmark, Estonia, Ethiopia, Finland, France, Germany, Ghana, Greece, Hong Kong, India, Indonesia, Ireland, Israel, Italy, Japan, Kenya, Kingdom of Bahrain, Mexico, Moldova, Morocco, Mozambique, Netherlands, New Zealand, Norway, Oman, Peru, Philippines , Portugal, Republic of Korea, Russia, Rwanda, Saudi Arabia, Singapore, Slovak Re- public, Spain, Sweden, Taiwan, Thailand, Timor Leste, Tunisia, United Arab Emirates, United Kingdom, and Uruguay. These dashboards provide a selection of governmental data. UK Department for Communities and Local Government provides selection of statistics on a variety of themes including Local Government finance, housing and homelessness, wellbeing, and deprivation and supports geographical data One of the many applications UK service delivers is the ‘Local Authority Dashboard’ where a postcode search allows users to see visual representations of data for any area within the UK. (43)

In this relatively new domain, Batty (44) warns that the data being fed into dashboards in real time are not necessarily comparable and are factually correct. He continues to explain that measuring and interpreting city performance in any individual or synthetic way from these kinds of portal requires aggregation to some purpose and more powerful analytics with respect to how the user can interrogate and interpret the data are clearly required.

3. CONCLUSION

Increasingly, neither state intervention, nor neoliberal market solutions are seen as satisfactory approaches to urban planning challenges. The former is criticised for its managerial inefficiency while the latter is criticised for its neglect of external and community interests. (45) For this reason, we believe that smart urbanism that shapes and manages complex and multidimensional places by engaging multiple stakeholders would overcome the shortcomings of the above approaches.

It is known that local authorities traditionally have developed responses in a ‘siloed’ fashion (46) however the scale of the challenges that cities are facing nowadays are forcing them to evaluate these ‘siloed’ responses and move towards ‘smart solutions’. While data analytics, administrative control centres, social media, city apps, city dashboards and other tools offer insights to the city itself here and now, the solutions, visions, predictions about the city should not only relay on the technology and the data but also include all stake holders from the city in order to achieve smart but also human centred urbanism.

It is also clear that there is pressure on cities in the form of ageing infrastructure, change in population profiles and volume, depletion of resources etc. However in order to achieve better liveable cities for the future we should look into the new opportunities these pressures are leading us to. For example collaboration between cities to create integrated solutions, increasing connectivity, and being able oversee the city and its elements (buildings, infrastructure, land etc.) with the help of technological developments (BIM- Building Information Modelling and -CIM- City Information modelling, IoT, big data, etc.) These new opportunities will help us to re-define the future of cities. Yet the balance between the data requirements and data privacy needs to be fine-tuned.

Smart city concept is not only for creating new holistic systems without creating new silos but also about improving current systems with an appropriate level of technological interventions. Fundamentally, ‘smartness’ should not be determined by how up-to-date or expensive the technology is, but by how we will improve citizens’ lives and how we can create better living spaces for all by utilizing all available resources.

This fresh approach needs to be developed with the following points in mind:

- an overarching understanding of the increasing demand on the city resources,
- requirements of developing integrated solutions,
- necessity of securing citizen-wide access to basic technologies (internet, email etc.),
- impacts of the technological interventions (monitoring, sensing etc.) would have on the citizens and
- an in-depth understanding of the vulnerability of these technological processes to the many unintentional and/or malicious intrusions.

Vitally all systems should be able to securely exchange and utilize available data to produce integrated answers for a more sustainable and resilient city where citizens have a better quality of life in more liveable, efficient and productive places. Over all, smart city agenda should be based upon long term vision, people and processes as the main drivers.

Benefits from this new way of urbanism are diverse. Especially, governance cost will be reduced as the need to re-collect and verify data is removed; there will be a common understanding of communities and shared objectives; citizen will be able to engage more; decision-making process will be more transparent. (47) As the INSPIRE Directive's - the

spatial data infrastructure that enables sharing of environmental spatial information among public sector organisations and gives public access to spatial information across Europe- (48) full implementation deadline is fast approaching (2019) the importance of shareable data in this case spatial data is clear.

However the big question is still remains: what to do with all this data. At this stage, the process and procedures of local and national governments are not capable of utilizing the amount of data in real- time yet. Therefore future research will need to look into how aging governance systems across the world can be converted to real-time or near-real-time city governance with all the points discussed above.

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