

Comparison on Smart Cities Features from Different Countries

Nazatul Shima Abdul Rani, Ibteessam Boubekur,

Universiti Kuala Lumpur, Universiti Kuala Lumpur Business School, Kuala Lumpur, Malaysia,
Universiti Kuala Lumpur, Universiti Kuala Lumpur Business School, Kuala Lumpur, Malaysia
shima.rani@unikl.edu.my, boubekur.ibteessam29@s.unikl.edu.my

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Abstract

The world is facing a global phenomenon of rapid urbanization all over the cities, thus developing smart cities worldwide is considered as a must for countries to ensure a good quality of life for its citizen. Smart cities model is elaborated on a main six pillars of smart people, smart economy, smart mobility, smart environment, smart living and smart government; as a result, adopting smart city concept become a trend among modern cities. However, a huge number of cities are still behind for the smart cities race. Hence, the comparison between smart cities is quite hard since each city has its own characteristics but in order to find similarities or differences, comparing the six pillars outputs as well as evaluating the business impact of these smart cities could help in understanding the issue of having cities being late to drive their own smart cities to a highly top indexed smart cities in a global scale.

Keywords: smart cities, comparison, six pillars, rating, outlook, market size.

I. INTRODUCTION

The world is facing a global phenomenon of rapid urbanization all over the cities worldwide. Numbers and statistics had showed that by 2030 more than 60% of the global population will live in megacities, large, medium, smaller and peri-urban communities mainly focused in Asia, Africa and Latin America, this fraction is expected to increase by two third by 2050 [1]. A City is called smart when there is a participatory government managing the allocation of natural resources, infrastructure, economic activity and growth [2].

In addition, Smart cities model is elaborated based on the main six pillars of *Smart People*, *Smart Economy*, *Smart Mobility*, *Smart Environment*, *Smart Living*, and *Smart Government* [3]. Cities worldwide are trying to embrace effectively these pillars in order to become smarter, therefore it has led to a race on smart cities development and growth. Based on previous researches on smart cities ranking, it had been announced [4] through the latest report that the top 20 smart cities are classified based on mobility, public safety, health and productivity [14]. The results provided by market research organization had declared Singapore to be the world's smartest metropolitan for the year 2017.

Another study published from A.T. Kearney 2018 Global Cities Report had discussed different ranking for smart cities worldwide, their approach is mainly based on examining the global cities competitiveness and identifying factors steering towards success taken

from different perspective. The A.T. Kearney 2018 Global Cities report examines which global cities are improving in their competitiveness and what factors are driving that success. As an example, cities like New York, London, Paris and Singapore hold combination of factors of human capital, political engagement, business activity, information exchange, and cultural experiences in helping people and organization to be successful [5].

A global cities index and ranking and scoring was attributed to different cities based on the above factors of human capital, political engagement, business activity, information exchange and cultural experiences. In other hand, a Global cities outlook, rank and score provided based on the following factors which are *personal well-being*, *economics*, *innovation*, and *government* [5]. Another study of ranking smart cities was performed on top fifty (50) cities based on factors such as vision, leadership, budget, financial incentives, support programs, talent readiness, people centricity, innovation ecosystems, smart policies, and tracked records [6].

This paper examined the main top three (3) cities from each ranking and examine the different factors for each city to determine similarities and differences between those cities and identify in details the main success factors for smart cities.

II. REVIEW OF THE LITERATURE

This section discusses on the definitions, smart cities pillars, smart cities market size, drivers for smart cities market growth, and rating evaluation.

A. Smart Cities Definitions

In the last decades, definitions describing characteristics of future cities has been enhanced to better fit the concept promoted mainly by stakeholders. Time has played an important role for terms and definition to change based on the ideas fostered by political entities, universities, civil communities, and business environment. Smart cities defined as a smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of the present and future generations with respect to economic, social and environmental aspects [7] [21]. This definition shows that a smart city not only focus on new technologies however it is a complicated ecosystem (Fig. 1) made up of many stakeholders of city authorities, citizens, local companies and industry and community groups.

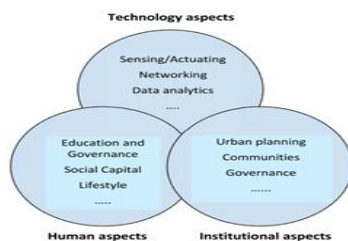


Figure 1: Smart Cities Ecosystem

Overall, it has been noticed from different authors that it is very hard to find one comprehensive definition accepted by academics, businesses, and institutions. The difficulty to define smart city is mainly regarding two main aspects which are the *adjective smart* and the *label smart city*. The adjective “*smart*”, as mainly it depends on the meaning given to this word. In literature, several typologies of city refer to Smart City concept, for example: Intelligent City, Digital City, Wired City, Knowledge City, etc. The label “*smart city*” is considered as fuzzy concept and it is used in ways that are not always in accordance each other. There are many cities that define themselves as Smart City when they identify some own characteristics as “*smart*”, but without referring to a standard meaning [8].

B. Smart Cities Pillars

Smart cities model is elaborated on a main six pillars of *smart people* which is identified as number one of

the fundamental building blocks of a Smart City System, require many crucial attributes as given such as highly qualified, knowledgeable, expert, creative, and innovative people. They are also characterized to be open minded, cosmopolitan, and actively participating in the city sustainable development. Smart city integrates universities and colleges in all aspect of life [3], whereas smart economy is the second block of smart cities.

Smart cities had opened the opportunity for entrepreneurial leadership as it provides it citizen diverse economic opportunities. Smart cities should be ready and prepared to all type of challenges posed by the opportunities derived from economic globalization. Smart cities experiments, supports and promotes sharing economy. It thinks locally, acts regionally and competes globally. By making strategic investments on smart cities assets. It mainly develops and supports compelling national brands and mainly insists on a sustainable economic development [3][15].

Smart mobility is the third building block of a Smart City System, and it focuses on people mobility and promote walkability and cycling and manages vehicle, pedestrian traffic, and traffic congestion. In addition to that, it integrates a high mobility system linking working places, residential areas and transports such as bus, train, and airport [3].

Smart environment is one of the fourth building blocks as the smart city conserves and preserves the ecological system in the city region. It also adopts and sustains biodiversity in the city region. It efficiently and effectively manages its natural resource base thus its identified to be a green city as well as a clean city [3].

Smart living is the fifth blocks of smart cities and characterized by providing the necessary safety and security to women, children, and senior citizens. It also provides high quality services and facilities. Additionally, it improves the urban way of life and celebrate and promote art, cultural and natural heritage in the city [3] and smart government it is the six-last block of smart cities.

C. Smart Cities Market Size

The objective of a smart city is to be recognized as a well-connected city which uses different information and communication technologies in which will be used by the public to improve the quality of government services and citizen welfare. Over the past years, this technology was used mainly towards improving public safety where areas of high crime were monitored using sensors and other high technology devices in order to enhance the current emergency plans [9].

The global smart cities market was valued by Allied Market Research in 2018 to about USD 517,629 million in 2017 and forecasted to achieve USD 2,402,123 million in 2025 with a registered Compound Annual Growth Rate CAGR of 21.28% from 2018 till 2025 [9]. In the other hand, on the annual smart city revenue by region showing a snapshot of the revenue growth from 2016 till 2025 at global scale (Fig. 2) with a global market revenue for smart cities solution and services growing from USD36.8b in 2016 towards a forecasted number USD 88.7b in 2025. [13]

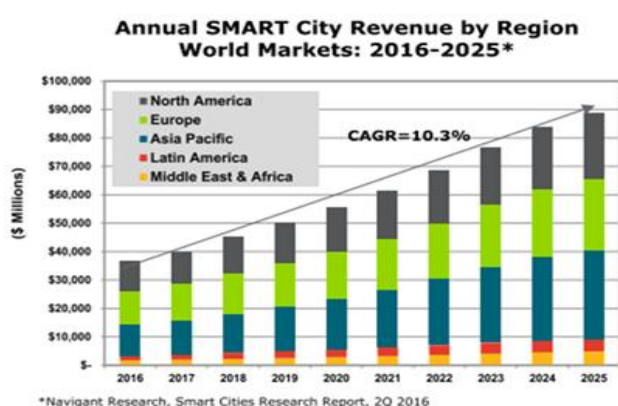


Figure 2: Annual Smart City Revenue by Region World Markets 2016-2025

The above figure shows a constant growing revenue trend for the regions of North America, Europe, Asia Pacific, Latin America & Middle East & Africa, where Asia Pacific is keeping a third position from 2016 till 2025. Deloitte had specified that the major trends that drives smart cities to grow are unprecedented urbanization, exponential innovation, safety and security, and trending green [13].

Moreover, another study was performed by Allied Market Research (2018) [9] had segmented the Global smart cities market based on functional area such as Smart Infrastructure, Smart Governance and Education, Smart Energy, Smart Mobility, Smart Health Care, and Smart Building. The results were showing the above functional area performance in 2017 and their projection for 2025. Overall, smart energy, smart governance and education, smart infrastructure and smart building are expected to grow effectively in 2025.

In 2017, smart infrastructure segment was leading the market and dominated the overall smart cities market share because of the high adoption of security and transportation solution among end users[9][16]. In addition to that, the study done by Allied Market Research in 2018 [9] covers the market segmentation by region where the results are shown in Fig. 4, it important to mention that in 2017, North America

dominated the overall smart cities market in terms of revenue because of the high adoption of smart cities solutions that mainly reinforced by an ICT spending within the government organization along with an increasing demand for a connected solution through the region [9].

In the other hand, the forecast results show that Asia Pacific is expected to have high growing rate due to the high numbers of smart cities pilot projects leading to the increase in IT spending strongly supported by government initiatives in emerging economies for instance China, Singapore, South Korea and India. The study also mentioned that companies such as Cisco Systems Inc., Ericsson, General Electric, Hitachi Ltd., Huawei Technologies Co. Ltd., AT&T Inc, IBM Corporation, Intel Corporation, Microsoft Corporation, and Schneider Electric SE are key players operating in a global smart cities market [9].



Figure 3 : Global Smart Cities Market by Regions (Allied Market Research,2018) [9]

D. Drivers for Smart Cities Market Growth:

Statistics derived from the United Nation Population Funds performed in 2014 had shown that 54% of the of the world's population lived in urban area, this number will increase to approximately 67% by 2030 (Fig. 4) . In addition to that cities are generating 70% of an average country GDP, with around 70% of energy consumption and more than 50% of global greenhouse gas emissions. As a result, urbanization strongly demand smart technology initiatives that will engage more in market growth, especially in developed country where city growth and economic development are tightly connected. Moreover, megacities form emerging economies are predicted to be the largest markets existing premium products and technologies [10].

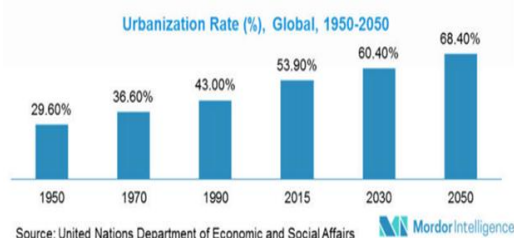


Figure 4: Global Urbanization Rate (%) from 1950-2050 [10]

E. Rating Evaluation

Smart cities rating was performed by several consulting groups, each one has its own criteria to characterize, analyses and rate smart cities. Based on their research, the results are different and quite interesting, as an example Juniper Research (2017) had rated smart cities based on the following parameter of cost of living cost, carrier opportunity, liveability as well as the level of pollution and crime in more details, the researchers have been looking towards the urban ecosystem in which it uses digital technology, shared knowledge and connected process for citizens wellbeing and benefits measured by productivity, mobility, public safety and health. Thus, market research organization has announced that Singapore to be number one smartest city followed by London, New York, San Francisco (Table 1) [4].

Table 3.1: Factors to improve school counselling

Smart City Index 2017		
Conducted by Juniper Research		
Rank	City	Country
1	Singapore	Singapore
2	London	UK
3	New York	US
4	San Francisco	US
5	Chicago	US
6	Seoul	South Korea
7	Berlin	Germany
8	Tokyo	Japan
9	Barcelona	Spain
10	Melbourne	Australia
11	Dubai	UAE
12	Portland	US
13	Nice	France
14	San Diego	US
15	Rio de Janeiro	Brazil
16	Mexico City	Mexico
17	Wuxi	China
18	Yinchuan	China
19	Bhubaneswar	India
20	Hangzhou	China

In the other hand, the rating performed by The group A.T Kearney 2018 global cities report mainly focused to examine the global cities index mainly focusing on the actual city performance based on 27 metrics spanning over five dimension such as human capital, information exchange, business activity, cultural experience and political engagement. Importantly, this

index provides a good understanding of cities performance as well as their level of development to help comparing different cities and to recognizing the core strengths and differences. The results of 2017 & 2018 ranking shows that New York is rated number 1 followed by London and Paris, however Singapore is ranked number 7 in 2018 and 6 in 2017 [5].

In another hand, Eden Strategy Institute performed a study in which they have ranked the top fifty (50) cities only based on Governance to enhance smart cities development from a city government perspective [6]. Overall city managers and planners should have practical and technical skills to better understand budgets, policies, services, infrastructure, innovative governance and resourcing models of different cities. This ranking basically focuses on main ten key factors that city mayors found effective for smart cities development, these factors are vision, leadership, financial incentives, support programs, talent readiness, people centricity, innovation ecosystems, smart policies, and track records [6] [17].

The results of the top fifty (50) cities government ranking show a mix of cities mainly from three continent of America, Europe, Asia. The top three cities are London, Singapore and Seoul [6].

Moreover, the group A.T Kearney 2018 in Global cities report has done the evaluation for smart cities outlook based on cities potential rate of change of thirteen (13) metrics through four main dimension of innovation, governance, personal wellbeing, and economics. The aim of these metrics is to help evaluating the long-term investment and success. This can be achieved only by estimating factors like infrastructure, performance and innovation capacity [5] [18].

Thus, the forecast will bring a progressive view regarding city practices and city-level policies mainly to better being competitive in future as well as recognize and identify cities with a high potential of being future smart cities leader at worldwide scale. The results of this outlook show that the main top three cities for 2018 are San Francisco, New York, London [5].

III. RESEARCH METHODOLOGY

This research was performed based on journal articles, consulting studies and online web sources. Mainly the researcher was looking at different ranking of smart cities performed by different consulting groups such as Juniper Research (2017), A.T Kearney 2018 global cities, and Eden Strategy Institute focusing on the top three cities and comparing the results on how Smart cities six pillars of Smart People, Smart

Economy, Smart Mobility, Smart Environment, Smart Living and Smart Government were adopted in these cities.

Table 2: Summary Table on Smart Cities Comparison from Different Perspectives

Cities	Ranking			Factors			Smart Cities Six Pillars Adoption		
	Juniper Research 2017	AT. Kearney 2018	Eden Strategy Institute 2018	Juniper Research 2017	AT. Kearney 2018	Eden Strategy Institute	Juniper Research	AT. Kearney	Eden Strategy Institute
Singapore	1	7	2	productivity mobility, public safety, health	human capital, information exchange, business activity, cultural experience and political engagement	Governance: Vision, Leadership, Financial Incentives, Support Programs, Talent Readiness, People Centricity, Innovation Ecosystems, Smart Policies, Track Records	Smart Mobility, Smart Living	Smart people, Smart living, Smart Economy, Smart Governance	Smart Governance, Smart People, Smart Economy
London	2	2	1						
San Francisco	4	/	11						
Seoul	7	/	3						
Paris	/	3	46						
New York	3	1	4						

Sources: [4], [5], [6].

IV. RESULTS AND DISCUSSION

Based on the above results of comparing a total of six (6) cities namely Singapore, London, San Francisco, Seoul, Paris and New York, it is clearly seen that each city has a different ranking from these three-assessment performed by Juniper Research 2017, AT. Kearney 2018 and Eden Strategy Institute 2018 [4],[5],[6]. However, overall some of these cities are still within the top ten (10) such as Singapore, London, and New York. Moreover, with regards to Juniper Research 2017, the study was focusing mainly on two main smart cities blocks of Smart Mobility and Smart Living thus the results are three main top cities of Singapore, London and New York [4].

In the other hand, AT. Kearney 2018 approaches was mainly to rate smart cities based on factors that overall corresponds to Smart People, Smart Living, Smart Economy and Smart Governance. Their analysis had shown that the top three cities are New York, London and Paris, but in fact from their rating Singapore is rated number seven (7) [5]. The last rating was performed on the top 50 cities government elaborated by Eden Strategy Institute in 2018, the study was focusing on the governance where they have been looking at ten factors such as vision, leadership, financial incentives, support programs, talent readiness, people centricity, innovation ecosystem, smart policies and track records [6]. These factors overall integrate the following smart cities blocks of Smart Governance, Smart People & Smart Economy. Thus, the results showed that the top 3 cities are London, Singapore and Seoul.

Overall, the rating results shows rating rotation between cities which means that these countries are putting huge efforts in building and developing their smart cities strategies. The top performing cities are adopting smart thinking strategies, according to a study performed by [11] stated that cities need to develop a comprehensive, end -to-end approach where they have recognized ten main key elements crucially to be followed by smart cities in order to achieve success, these keys are city and its administration reevaluation, citizen and stakeholders involvement, apply best practices and look beyond e-Government, involve and encourage the contribution from private sector business and self – sustaining business model, create and develop data strategy and platforms as well as setting up innovation labs, enhancing data security, get the infrastructure operators involved in stages of design, financing and initiative implementation, obtain political backing integrated with public feedback and finally importantly is to create a coordinating platform along with a dedicated planning system [11].

In addition to that, the global market of smart cities is growing from USD 517,629 million in 2017 and forecasted to achieve USD 2,402,123 million in 2025 [10]. Moreover, Singapore is focusing on the education side where they have developed strong partnership with the top universities such as Massachusetts Institute of Technology (MIT) and the Swiss Federal Institute of Technology in Zurich [11].

According to Eden strategy institute (2018) London Mayor, Sadiq Khan has announced in 2016 a renewed smart city vision. This new vision will be under the Smart London Plan2.0 with objective of protecting the interest of their population. This new plan and 2020 vision focus on digitalization as the core elements of its strategy. Moreover, The Smart London Board members are mainly and thought leaders and industry experts with their main objective to support mayor in visioning, strategizing and applying smart city goals [6].

V. CONCLUSION

Smart cities race is an ongoing objective for most of the countries in which their main goal is to thrive and evolve economically and provide a good quality life for its citizens. Based on the analysis performed on comparing smart cities from different perspectives, it has been observed that rating done by Juniper Research 2017, AT. Kearney 2018 and Eden Strategy Institute 2018 was quite different as each of the groups was looking towards different perspectives however, we can see that mainly the top three cities keep a rotational rating. Overall, these cities are Singapore, London, San Francisco, Seoul, New York and Paris.

These cities are working hard towards successes by focusing towards applying the smart cities six pillars which are Smart people, Smart Economy, Smart mobility, Smart Environment, smart living and Smart Government. In addition to that we can summarize that Singapore is the leading top smart city in Asia as such they have launched smart the initiative of Asian Smart cities network [12]. Moreover, even though that Malaysia is putting efforts on developing its smart cities such as Johor Bahru and Kuala Lumpur [19] but it is still behind [20], thus it is recommended for further studies to evaluate and comprehend the factors that can help Malaysia to develop and grow its smart cities.

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