

From Governance to Service- Smart City Evaluations in Taiwan

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Abstract-The main purpose of this paper is to introduce the developing of a Smart City Evaluation Index based on the concept of leveraging ICT to make a better city life, i.e. transforming governance to service that match the citizens' need. Not only in terms of the readiness of ICT infrastructure, this Index also focuses on the statues of ICT application and capability matching the needs of the residents. According to the evaluations of ten cities/counties in Taiwan, even with the less readiness, the efficiency for higher satisfactions of the residents can be reached.

Keywords- smart city; public services; ICT application; city governance; evaluation

I. INTRODUCTION

From the estimation by United Nations, the number of urban residents will rise to 5 billion by 2030 and, moreover, 80% of the world population will live in the urban areas by 2050 [9]. On the other hand, especially for the developed countries, "city" has been gradually replaced "country" as the main unit on the perspective of global competitiveness due to the growing contribution of national GDP [15].¹ In recent years, this urbanization trend also arises in developing countries. For instance, in China, urban population has grown to over 600 million, equaling to 50% of population living in urban areas. That is, urbanization has become an irresistible trend and thus city management and governance will be the main issue of public service.

The development of a city is a complicated process and the city government faces numerous intense challenges in various issues as the city grows. However under the rapid development of technologies, ICT applications and services, which are regarded as enhancers for convenience and efficiency in daily life and business operations as well as production processes, have been the essential elements for building a competitive city. Because the capabilities of the city governments and businesses to provide better services and living environment for city residents, the concepts of the development of "Smart City" (or "Intelligent City") which are based on ICT applications has been discussed

¹ The top five cities in the United States and Japan contribute totally around 70%-80% of the whole country GDP and the biggest city in the United Kingdom and France even occupies more than 20%.

increasingly. Many research institutes or organizations, such as Intelligent Community Forum (ICF), Vienna University of Technology (TU WIEN), International Data Corporation (IDC), International Business Machines (IBM), and International Federation for Library and Information Associations (IFLA), all over the world try to capture the essential characteristics and elements factors for a city to become "smarter." There are various concepts or definitions of Smart City based on different perspectives as shown in Table I.

TABLE I. THE DEFINITIONS OF SMART CITY

Organization	Definitions or Concepts
ICF	Intelligent Communities (Cities) are those which have realized the importance of the enormous challenges to achieve a Broadband Economy, and have taken conscious steps to create an economy capable of prospering in it.
TU WIEN [11]	Smart City is used to describe a city with "smart" industries in the field of ICT and regard the education of its inhabitants and the relation between the city government administration and its citizen. Smart City is furthermore used to discuss the use of modern technology in everyday urban life.
IDC	A Smart City provides ubiquitous connectivity, future-proof broadband capacity and total wireless fidelity, with IP-enabled devices communicating and being managed through a control center, allowing tenants, residents, and visitors' real-time access to key information about their environment from anywhere.
IBM [1][12]	Cities must use new technologies to transform their systems to optimize the use of finite resources. The topics of the optimization include Transportation, Public Safety, Energy/Utilities, Healthcare, Education, and Developments.
IFLA	A Smart City provides an advanced ICT infrastructure to enables residents and organizations to make good and independent use of these technologies. To be "smart" the use of technology must be interactive or must lead to a transaction, that is, on-line activity must be more than a passive act.

In the past decade, there are more than 1,000 cities around the world proceeding relative projects or policies of Smart City to reveal sustainable developments and the numbers of these projects/policies grow every year. For example, with the investments of around 115 million Euros,

Deutsche Telekom launched the T-City Program to build the most innovative city in Germany since 2006 [10]. In order to identify the construction of a future city, T-City Program delivers a range of cost-effective one-stop services for governmental affairs, entertainment, education, health, and tourism inquiries to make the city life more intelligent and convenient. In Korea, based on the abundant experience of informatization since the 1990s, the U-Korea Master Plan launched in 2007 aims for “u-Life services” that provide customized services to meet the citizens’ needs and thus strengthen the national competitiveness [14]. That is, not only to construct the advanced ICT infrastructure, applying ICT to enables its residents and businesses to make good use of these modern technologies and thus realize better lives is also the key topic of the issue of Smart City.

It is clear that the various definitions of Smart City described in Table I focus on the ICT readiness, such as infrastructure constructing and technology access, as well as the abilities of the residents and businesses in the city to adopt/use ICT. However the goal of ICT applications should be promoting better quality and satisfactions/happiness of city lives, which are not clearly explored in the former researches. The purpose of this research is to introduce the concept of developing a Smart City Evaluation Index based on the concept of the performance of leveraging ICT to make a better city life.

After this Introduction, Section II introduces the fundamental concepts and methodologies to construct an evaluation index for Smart City. In Section III, by applying this Evaluation Index, the performances and efficiencies of ten cities in Taiwan are discussed. Section IV then concludes the finding of this research.

II. SMART CITY EVALUATION

Nowadays ICT are applied to solve the main common issues that cities all over the world are dealing with, such as transportation, public safety, energy and utilities, healthcare, and education, etc., and thus Smart City seems to be the vision of the developments of cities.

Studies on the evaluation of the “smartness” of a city, basically in Euro or the United States, have raised and focused on the performances of ICT readiness in recent years. To design an evaluation methodology suitable for Asian cities (in developing and emerging countries), this research constructs an index structure to reveal the effectiveness of creating better city lives with the satisfactions/happiness by the city government. That is, this Evaluation Index focuses the abilities of the ICT infrastructures and applications to make corresponding feedbacks of residents’ satisfactions and businesses’ competitiveness in the city, but not only the inputs or investments deployed. The concept of Smart City Evaluation in this research is as the following Fig. 1.

There are four dimensions to evaluate the “smartness” of a city, including

A. Smart Environment

This dimension stands for the status of the innovative environment in a city, with the infrastructure of supporting

communication and service delivering among government, businesses, and citizens.

B. Smart Business

This dimension stands for the status of informatization and innovation momentum of the businesses, which are influential to the sustainable development of a city.

C. Smart Citizens

This dimension evaluates the abilities and experience in ICT applications and services of the city citizens.

D. Smart Government

This dimension focuses on the effectiveness of the government in terms of all the public/utilities service, including services to businesses (2B) and to citizens (2C).

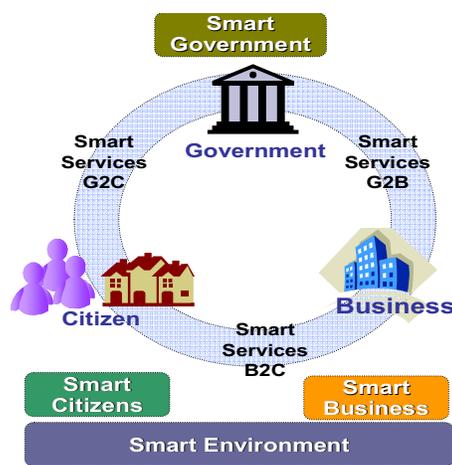


Figure 1. The Concept of the Smart City Evaluation

The four dimensions described above, with 13 pillars and 49 indicators, of the Smart City Evaluation Index introduced in this research are shown as Figure 2. After hard/soft data collecting, normalization is applied to calculate the relative performances of each city in selected indicators. The ranking of each city is thus determined after an equal-weighting aggregation for each pillar.

Smart City Evaluation Index	Dimension	Pillar		Indicator
	Smart Environment	Infrastructure	Sustainability	9
Smart Business	IT Industry	Innovativeness	10	
	Informatization			
Smart Citizen	ICT Adoption	Digital Learning	15	
	Comfortability	Health Care		
Smart Government	Public Security	Convenience	15	
	Governance			

Figure 2. The Structure of Smart City Evaluation Index

Not only data collecting and processing, the satisfactions, about all the public services offered by the city governments, of the citizens are gained by questionnaires. In this research, moreover, by applying Principal Component Analysis (PCA) and Data Envelopment Analysis (DEA), the correlations between the inputs, investments, and policies for “smartness” developing and satisfactions/happiness of citizens as well as competitiveness of businesses in the city can be analyzed to reveal the efficiency when the Smart City is growing.

III. EVALUATION OF THE CITIES IN TAIWAN

To understand the development status of Smart City in Taiwan, ten cities/counties are selected, including the New Five Metropolises (Taipei City, New Taipei City, Taichung City, Tainan City, and Kaohsiung City) and five counties (Taoyuan County, Nantou County, Changhua County, Ilan County, and Hualien County).²

Based on the Smart City Evaluation Index described above, the performances of these ten selected cities/counties in Taiwan are shown in Table II.

TABLE II. SMART CITY EVALUATIONS IN TAIWAN

Score/ (Rank)	Smart City Evaluation				
	Average	Smart Environment	Smart Business	Smart Citizen	Smart Government
Taipei City*	7.20 (1)	8.10 (1)	7.15 (3)	6.86 (1)	6.71 (1)
New Taipei City*	6.39 (2)	6.59 (2)	7.55 (1)	5.61 (5)	5.79 (3)
Taoyuan County	6.30 (3)	6.57 (3)	7.45 (2)	6.46 (2)	4.72 (9)
Tainan City*	5.90 (4)	6.50 (4)	6.48 (5)	5.45 (9)	5.18 (6)
Taichung City*	5.87 (5)	6.19 (5)	6.52 (4)	5.51 (7)	5.26 (5)
Nantou County	5.78 (6)	5.99 (7)	5.77 (6)	6.46 (2)	4.90 (8)
Kaohsiung City*	5.51 (7)	5.76 (9)	5.60 (7)	5.50 (8)	5.18 (6)
Ilan County	5.39 (8)	5.78 (8)	4.82 (8)	5.40 (10)	5.57 (4)
Hualien County	5.26 (9)	4.68 (10)	4.60 (10)	5.88 (4)	5.86 (2)
Changhua County	5.25 (10)	6.08 (6)	4.79 (9)	5.52 (6)	4.60 (10)

Intuitively, on the perspective of ICT readiness such as the dimensions of “Smart Environment” and “Smart Business”, the performances of the cities in northern Taiwan (including Taipei City, New Taipei City, and Taoyuan County) are better than other cities due to the abundant allocation of the central government resources, while the agriculture city (Changhua County) and eastern cities (Ilan County and Hualien County) locate in the last three ones. However, on the consideration of essences of the citizens and city governments in this Smart City Evaluation, different ranks among the cities arise, such as the ranks of Nantou

² In Taiwan, a city-merging and upgrading policy was executed to form five new metropolises in the end of 2010. The other five counties are selected due to the promotion of i236 Project by the Ministry of Economy Affairs, R.O.C.

County in “Smart Citizen” and Hualien County in “Smart Government.”

The essential concept of Smart City introduced in this research focus on the satisfaction or happiness of city life resulted from the leveraging of ICT applications. By combining the satisfactions of the citizen about the public services provided by the city government, the results from the questionnaires are shown in Table III. On the other side, from the efficiency calculation by PCA and DEA, the rank of each city varies surprisingly, comparing to the previous ranking based only upon the Evaluation Index shown in Table III.

TABLE III. EFFICIENCY ANALYSIS OF THE CITIES

City	Overall Satisfaction Performance/ Rank	Efficiency Score	Efficiency Rank
New Taipei City*	6.13 (10)	0.2823583	8
Taipei City*	6.60 (3)	0.3919198	7
Taoyuan County	6.49 (4)	0.1117501	9
Taichung City*	6.14 (9)	1.0000000	1
Nantou County	6.23 (8)	0.9714894	4
Changhua County	6.36 (6)	1.0000000	1
Tainan City*	6.40 (5)	0.0000000	10
Kaohsiung City*	6.36 (6)	0.8887287	6
Ilan County	7.12 (1)	0.9541714	5
Hualien County	6.81 (2)	1.0000000	1

As shown in Table III, Taichung City, Changhua County, and Hualien County take the first place due to the best performance (or the highest correlation) while developing a Smart City. That is, even with fewer resources, inputs, or investments, citizens in these three city/counties show higher satisfactions about the ICT applications on public service introduced by the city governments. However, on the other side, cities/counties with low efficiency performances should focus on the issues that actually match the citizens’ need in their city lives.

IV. CONCLUSIONS REMARK

The essential concept of the Smart City Evaluation Index presented in this research is the emphasis on matching the citizens’ need and thus raising the satisfactions of the city lives. However, most important of all, each city has its own characteristics and development path, and there are no common rules for a city to become “smart,” even the final ranking of the Evaluation Index introduced in this research does not determine the competitiveness of each city. From the results in Table II, it is clear that different cities/counties show different performance according its characteristics. Take Taipei City for instance, the government has to provide

complete infrastructure and ICT applications/services due to its business-oriented role. Some other cities, like Ilan County and Changhua County, focus on tourism development or agriculture sectors, therefore (relatively) lower penetrations of ICT applications is reasonable. The non-ICT-related factors may result in different kind of Smart City developing strategies for the governments.

However, based on the concept of Smart City, no matter what are the differences among the cities, the missions of the city governments are to provide the appropriate public services, depending on the corresponding ICT applications, that meet the citizens' needs.

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