EU S SMART CITIES POLICIES: FROM STRATEGY TO IMPLEMENTATION

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Abstract: In the current international situation, the European Union is facing the important issue of restructuring development. The proposal of smart city policies will be one of t measures to break through the bottleneck of economic, social and environmental development in the next decade or even longer. The concept of smart city in EU has long been proposed and gradually developed in recent years, and EU has preliminary built the complete smart cities development objectives and roadmaps. The paper shows that EU has formed the smart cities policies system from strategy to implementation. The system mainly consists of four-levels of top-down structure: respectively the strategy, research, platform and project level, to meet the requirements of different stages of smart city developments, involving a number of significant EU's development policies and research projects. The paper also found that EU needs to strengthen the cooperation between government, industries and the citizens, to develop information and communication technologies, and to accelerate smart cities and smart technologies marketization, therefore to finally meet the strategic objectives of the EU's future plan and to achieve the realization of smart cities.

Keywords: EU, smart cities, urban development strategy

1. Introduction

Since the issue of Smart City being raised, it has become a research development-related issues. According to statistics, more than half of the global population lives in cities, the Earth has entered the "urban era", while the European region as one of the earliest urban areas, more than 80 percent of citizens living in the city. Every year the cities product economic cost and energy consumption that accounted for the majority of social resources. Under the aftermath of the global economic crisis, the climate and environmental issues are still very severe, European cities get into the bottleneck of development and need urgent profound restructuring and innovation to achieve a new round of development growth (Barresi and Pultrone, 2013). As the planet becomes more urban, cities need to become smarter.

Smart City is just able to combine both the EU strategies and the measures together to promote the development of European cities. The concept Smart City includes innovative, low-carbon, sustainable development and other criteria, which are the EU s strategic focus over the nex (Tregoning et al., 2002; Moraci and Fazia, 2013). Plus the use of smart technologies such as information and communication technology (ICT) is also important to achieve increasing smart growth (Santinha and Anselmo de Castro, 2010). The EU as one of the world's most important economies, having both diverse and unified city model, is able to fully integrate their resources to promote the smart cities policies, thus studying about EU-led smart cities policies has important

meanings and values.

2. The history of Smart City and Smart Cities Policies

2.1 Definition of Smart City in EU context

Under the EU context, the most reliable source of a definition of smart city is usually considered the research paper by a group of researchers led by the Centre of Regional Science at Vienna University of Technology (Giffinger et al., 2007) entitled Smart cities: ranking of European This classification of the six characteristics of urban smartness is present in most literature about the smart city, which are Smart Economy, Smart People, Smart Governance, Smart Mobility, Smart Environment and Smart Living. There are 31 factors and 74 indicators under the six characteristics. The research about medium-sized smart cities later became the learning templates for many European smart cities studying and the six characteristics also became an important source of smart city standard definition.

In a report entitled "Mapping smart cities in the EU" made by the EU in 2014 (Manville et al., 2014), they made a deeper and more comprehensive definition about Smart City based o also compared and classified the European smart cities. The research report thi is a multi-stakeholder partnership, making use of advanced technology (especially ICT technology) to solve public issues, those solutions developing and perfection through smart city initiatives or projects, as well as various actions and networks. The report also retains and reinforces the six characteristics as the criteria of definition to form the structure of smart city (Figure 1).

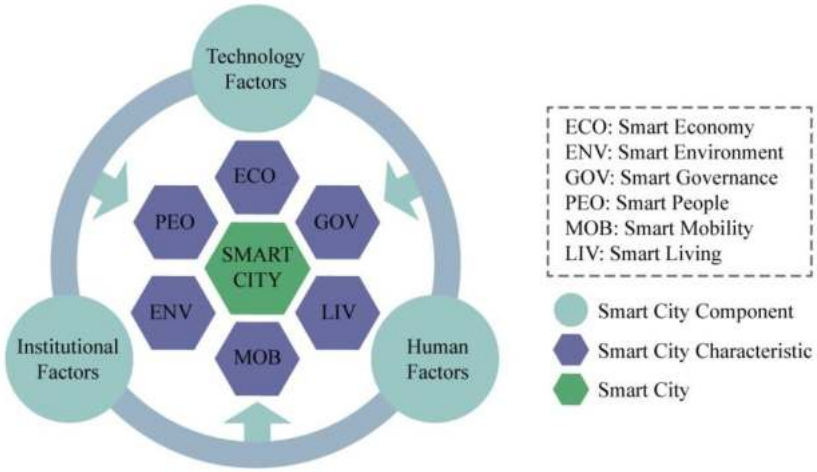

Figure 1. The components and characteristics of smart cities (Manville et al., 2014)

2.2 History of Smart Cities policies development

Since long ago the EU started thinking about using new ways to manage urban growth. From the 1990s, there is the emergence of sustainable development policy concept. In July 2005, the European

Union formally implemented "i2010" Action Plan, which stresses the importance of acceleration the introduction of eGovernment in Europe (Deakin, 2009) as well as the communication technology, new network, new service and media[1]. In 2006 the EU launched the European Network of Living[2], which uses new tools and methods, advanced information and communication technology to solve social problems. In 2011 the European Commission introduced the "Europe 2020", proposing three priorities of smart, sustainable and inclusive growth and determined the digital agenda as one of the seven flagship initiatives(EU, 2013). The following "Digital Agenda for Europe" explicitly listed smart city as one of the key projects. The latest progress is that in July 2012, the European Commission launched the "The European Innovation Partnership on Smart Cities and Communities (EIP-SCC)" to promote smart technologies development, and from 2013, the budget increased from 81 million to 365 million.

2.3 Motivation about EU s Smart Cities policies

1) EU s economic crisis and its accompanying hazards make EU need new stimulation of deve
The European debt crisis began in 2008 has several manifestations (McCann and Ortega-Argilés, 2013). Unemployment has constantly increased in several EU countries, with a particular burden on younger generations, and this dilemma has not yet been completely removed (Caragliu et al., 2011; Caragliu, 2013), EU countries hope through the economic stimulus package to save the domestic economy and enhance international competitiveness. For the regions whose majority of the population living in urban areas, they need a new way to manage the complexity of city life. Smart City concept combines many important issues of economic, social, environmental which are important for urban transformation.

2) EU s backward in the field of information technology urges its smart technology to d
Compared to other industrialized countries such as United States and Japan, EU is relatively backward in the field of information technology. According to statistics, Google, Amazon and other successful Internet providers that origins outside Europe; at the list of Fortune 500 companies, only one of nine ICT operation company is European company; among the highest 54 visited sites in the world, only four from Europe (EU, 2010). Today the information industry is flourishing, the importance of information security is growing, EU has fully conscious the importance of information technology industry.

3) Smart City concept will help cities save energy and create greater economic benefits
Smart City as Europe-wide demonstration projects, are able to improve energy efficiency by large-scale deployment of low-carbon technologies. Europe as a highly urbanized area, more than half of the pollution generated by the city, 70 percent of the energy consumed in the city, so the cities are the key to the EU low-carbon economy. The openness and connectivity of the European Single Market have allowed its cities to become hubs for the creative economy, technological and societal innovation,

[1] http://europa.eu/legislation_summaries/information_society/strategies/l24226j_en.htm
[2] http://www.openlivinglabs.eu/

welfare enhancement and sustainable development (Roche et al., 2012; Manville et al., 2014).

4) Smart City reflects the people s vision for clean, livable, sustainable urban
Smart City concept is prevalent in Europe also because it fulfills people s image of clean and livable urban environment, reliable advanced technology development, and stable and harmony social-economic environment (Vanolo, 2013).

3. Important structure and components about EU Smart Cities policies

Due to EU s special political joint system, making the European Union could integrate researc resources, provide fundings, and form a unified strategic and implementation system, therefore makes the EU Smart Cities different from other countries and regions. At the same time, it is possible to take into account the different characteristics of member states, to conduct different implementations with both integrity and flexibility.

Basically, the EU smart cities policy system can be divided into the following four levels: the **Strategy** level, EU s important strategies and major decisions for the future, Smart City aspects; the **Research** level, under the guidance of Strategy level, usually charged by the EU major research institutions and departments, can also provide adequate financial support for research; the **Platform** level, is a convergence between research results and practical application, it aims to provide cooperation opportunity for various stakeholders such as the city government ,the research department and the enterprises, to share information and experiences, and to find suitable solutions; the **Project** level is directly involved in the implementation of the smart cities, including the pilot smart city, smart technology solutions, regulations and activities etc.

3.1 The Strategy level

One of the most important strategies that has great impact on Smart City is the European Union s ten-year growth and jobs strategy that was launched in 2010. The Europe 2020 Strategy is intended to act as an umbrella organizing framework under which all EU policies will operate over the coming decade (Caragliu, 2013). Overall, the strategy wants the EU to become a smart, sustainable and inclusive economy. These three mutually reinforcing priorities should help the EU and the Member States deliver high levels of employment, productivity and social cohesion[3]. Concretely, the Union has set five ambitious objectives on employment, innovation, education, social inclusion and climate/energy to be reached by 2020[4]. Each Member State has adopted its own national targets in each of these areas. The strategy is also supported by seven flags which the EU and national authorities reinforce their efforts in areas supporting the Europe 2020 priorities such as innovation, the digital economy, employment, industrial policy and resource

[3] http://ec.europa.eu/europe2020/index_en.htm
[4] http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/priorities/index_en.htm

efficiency[5]. The relationship between three targets and seven flagship initiatives are as follows (Table 1), the contents of Smart City belongs to the Smart Growth, the initiatives and measures of Smart City considered to be a beneficial tool to achieve Europe 2020 objectives.

Table 1. Europe 2020 priorities and flagship initiatives

Smart Growth	Sustainable Growth	Inclusive Growth
Digital agenda for Europe Innovation Union Youth on the move	Resource efficient Europe An industrial policy for the globalisation era	An agenda for new skills and jobs European platform against poverty

Digital Agenda for Europe (DAE) is a branch strategy of Europe 2020, it aims economy and help Europe's citizens and businesses to get the most out of digital technologies. Launched in May 2010, the DAE contains 101 actions, grouped around seven priority areas, including create a new and stable broadband regulatory environment, launch grand coalition on digital skills and jobs, launch new electronics industrial strategy etc. Over the next decade, by increasing investment in ICT, improving eSkills levels in the labour force and reforming the framework conditions for the internet economy would increase the European GDP by 5%, or 1500 per person. In the end of 2020, up to 900.000 digital jobs will be provided, while 1.2 million jobs could be created through infrastructure construction, this would rise to 3.8 million new jobs throughout the economy in the long term[6].

In terms of Smart Cities, digital technologies translate into better public services for citizens, better use of resources and less impact on the environment. Smart City makes the traditional networks and services more efficient with the use of digital and telecommunication technologies, for the benefit of its inhabitants and businesses.

3.2 The Research level

The complete name of FP7 is 7th Framework Programme for Research and Technological Development, which is the European Union s main instrument for funding researcl 2007 until 2013, the programme has a total budget of over 50 billion. It re increase compared with the previous Framework Programme (FP6 only about 63% of FP7), reflects the high priority of research in Europe[7]. The Seventh Framework Programme (FP7) bundles all research-related EU initiatives together under a common roof playing a crucial role in reaching the goals of growth, competitiveness and employment[8], such as a new Competitiveness and Innovation

[5] http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/index_en.htm
[6] http://ec.europa.eu/digital-agenda/digital-agenda-europe
[7] http://ec.europa.eu/research/fp7/understanding/fp7inbrief/what-is_en.html
[8] http://cordis.europa.eu/fp7/understand_en.html

Framework Programme (CIP), Structural and Cohesion Funds, the European Research Area (ERA). The objectives of FP7 have been divided into four categories: Cooperation, Ideas, People and Capacities (Table 2). For each type of objective, there is a specific programme corresponding to the main areas of EU research policy.

Table 2. FP7 type of objectives and programmes

<table>
<tr><td rowspan="13">COOPERATION</td><td>Health</td><td>IDEAS</td><td>European Research Council</td></tr>
<tr><td rowspan="2">Food, Agriculture and Fisheries, and Biotechnology</td><td rowspan="5">PEOPLE</td><td>Initial training</td></tr>
<tr><td>Life-long training</td></tr>
<tr><td rowspan="2">Information and communication technologies</td><td>Industry-academia</td></tr>
<tr><td>International dimension</td></tr>
<tr><td rowspan="2">Nanosciences, nanotechnologies, materials and new production technologies</td><td>Specific actions</td></tr>
<tr><td rowspan="8">CAPACITIES</td><td>Research infrastructures</td></tr>
<tr><td rowspan="2">Energy</td><td>Research for the benefit of SMEs</td></tr>
<tr><td rowspan="2">Environment (including climate change)</td><td rowspan="2">Regions of Knowledge</td></tr>
<tr><td rowspan="2">Transport(including aeronautics)</td></tr>
<tr><td>Research potential</td></tr>
<tr><td rowspan="2">Socio-economic sciences and the humanities</td><td>Science in society</td></tr>
<tr><td>Coherent development of research policies</td></tr>
<tr><td>Security</td><td>International cooperation</td></tr>
<tr><td>Space</td><td colspan="2">Non-nuclear actions by the Joint Research Center</td></tr>
</table>

Horizon 2020 is the biggest EU Research and Innovation programme ever with nea funding during 2014 to 2020 (not included the private investment). It promises to bring more breakthroughs, discoveries and great ideas from the lab to the market[9]. Horizon 2020 emphasizes on excellent science, industrial leadership and tackling societal challenges, the goal is to ensure Europe produces world-class science, removes barriers to innovation and makes it easier for the public and private sectors to work together (Table 3).

Table 3. Horizon 2020 programme sections

Excellent Science	Societal Challenges
European Research Council	Health, Demographic Change and Wellbeing

[9] http://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020

<table>
<tr><td>Future and Emerging Technologies
Marie Sk odowska-Curie actions
European Research Infrastructures, including e-Infrastructures</td><td>Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy
Secure, Clean and Efficient Energy
Smart, Green and Integrated Transport
Climate Action, Environment, Resource Efficiency and Raw Materials
Europe in a changing world - Inclusive, innovative and reflective societies
Secure societies Protecting freedom and security of Europe and its citizens</td></tr>
<tr><td>Industrial Leadership</td><td>Spreading Excellence and Widening Participation</td></tr>
<tr><td rowspan="3">Leadership in Enabling and Industrial Technologies (including Information and Communication Technologies; Space; Nanotechnologies, Advanced Materials, Advanced Manufacturing and Processing, and Biotechnology)
Access to risk finance
Innovation in SMEs</td><td>Science with and for Society</td></tr>
<tr><td>European Institute of Innovation and Technology (EIT)</td></tr>
<tr><td>Euratom</td></tr>
</table>

In Horizon 2020, the ICT Research & Innovation is a spotlight. The ICT sector represents 4.8% of the European economy. It generates 25% of total business expenditure in Research and Development (R&D), and investments in ICT account for 50% of all European productivity growth. EU investments in ICTs are due to increase by about 25% under Horizon 2020 compared to FP7[10]. Horizon 2020 will support the whole chain from basic research to innovation that can deliver new business breakthroughs. It underpin innovation and competitiveness across private and public sectors and enable scientific progress in all disciplines, that is the reason that ICT-related topics can be found in all priorities, from Excellence Science to Industrial Leadership , to Societal Challenges , re secure, clean and efficient energy, smart, green and integrated transport and climate action etc.

3.3 The Platform level

The Smart Cities and Communities Initiative (SCC) was launched in 2011. It has close relationship with FP7 and Horizon 2020. In the coming year 2012, the European Innovation Partnership on Smart Cities and Communities (EIP-SCC), the Partnership is under the framework of Digital Agenda as well as directly funding by Horizon 2020. In the year 2012, only 81 million has be SCC initiative, covering only two sectors: transport and energy. Demonstration projects financed under the scheme can be in either one of the two sectors, rather than the two combined. Starting from

[10] http://ec.europa.eu/programmes/horizon2020/en/area/ict-research-innovation

2013, the budget has been increased from 81 Million to 365 Million, coveri
of two: energy, transport and ICT. In addition, each and every demonstration project financed under the scheme must combine all the three sectors[11].

With this Smart Cities Partnership, the EU will combine cities, industries and citizens, through a more sustainable way to improve city life, to establish a strategic partnership between European cities and industries and to contribute to the EU s 20/20/20 climate action goals. Current the potential of smart technology innovations, such as high-tech risks, the uncertainty of the return on investment and regulatory difficulties. The Partnership aims to overcome bottlenecks impeding the changeover to smart cities, to co-fund demonstration projects and to help coordinate existing city initiatives and projects, by pooling its resources together[12].

The European Innovation Partnership on Smart Cities and Communities (EIP-SCC) consists of High Level Group, Sherpa Group and Smart Cities Stakeholder Platform (Figure 2). The representatives of Higher Level Group are coming from industry, research and cities, together with Sherpa Group, they are responsible for the Strategic Implementation Plan (SIP), which helps promote Smart Cities into practice. It also helps how the European Commission can support these measures during the next Research Framework Programme (Horizon 2020).

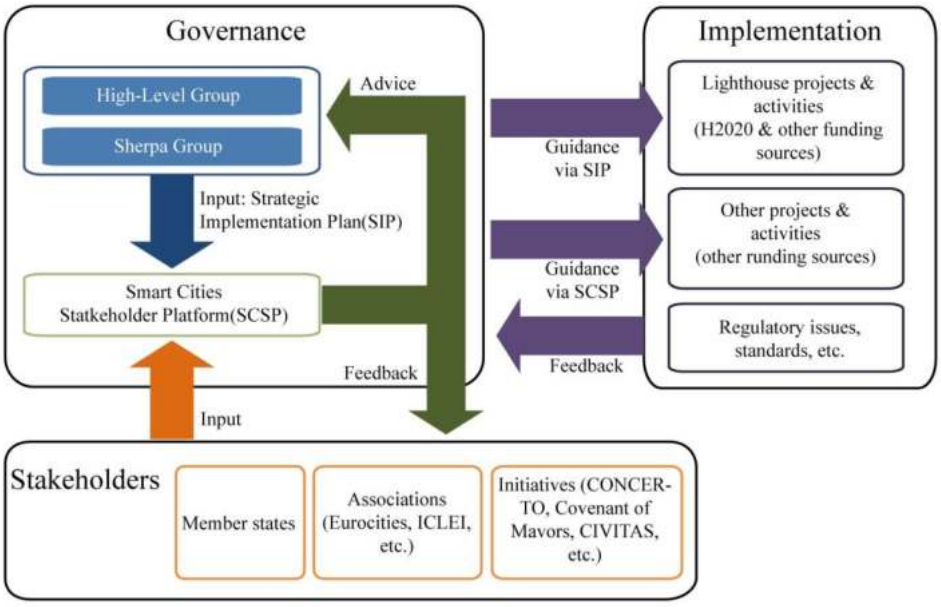

Figure 2. European Innovation Partnership on Smart Cities and Communities operation mode (Resource:http://ec.europa.eu/eip/smartcities/about-partnership/how-does-it-work/index_en.htm)

The Smart Cities Stakeholder Platform was initiated by the European Commission with the dual aim of identifying and spreading relevant information on technology solutions and providing information

[11] http://europa.eu/rapid/press-release_IP-12-760_en.htm
[12] http://ec.europa.eu/eip/smartcities/about-partnership/what-is-it/index_en.htm

for policy support to the High Level Group and the European Commission. The Working and Coordination Groups are at the heart of the Smart Cities Stakeholder Platform. There are three thematic expert (technical) Working Groups, each dedicated to one technology area, and three horizontal groups, for developing strategic visions for the future based on the work undertaken in the Platform[13]. The Smart City Stakeholder Platform provides a unique opportunity for individuals and organizations across Europe to take part in establishment Europe s Smart City Ro and analyzes all information stakeholders input, you can upload all the data and add any news about your city and the projects or you can look for specifically tailored projects for your city. The Platform also helps High Level Group feedback on Strategic Implementation Plan, the Group and the Stakeholder Platforms work together to encourage and support more extensive cooperation of smart cities.

3.4 The Project level

The Project level consists of all sizes and forms of projects and becomes a Smart City project library, which covers the urban pilot projects, smart city organizations, the use of smart technology and other aspects.

For instance, the Strategies Towards Energy Performance and Urban Planning(STEP-UP) aims to bring together excellence on energy planning from four European cities together with their industrial and research partners, running from 2012 to 2015. The Planning will assist cities enhance their sustainable energy action plans and integrate energy planning into their sustainable city planning. The programme is working together with twelve organizations, local government, research and commercial partners in the European cities of Ghent, Glasgow, Gothenburg and Riga. The programme is also part of the EU FP7. The main targets of STEP-UP include to create a coherent and easy-to-use model for energy planning that helps to achieve Europe's 2020 energy targets; to deliver wider policy objectives such as improving security of energy supplies, achieving urban regeneration and economic growth; and to make these cities better places to live, work and do business[14].

ICT for Energy Efficient Neighbourhoods (IREEN) is funded under the FP7 as a Coordination and Support Action. The project commenced from 2011 to 2013 with total budget of 1, aim is to extend the notion of energy positive buildings. Energy positive are build those that have the capacity to generate more energy than they use, this can be achieved in three ways: spending less energy than they have produced over a time; facilitating eco-responsible behaviours; consuming low energy over their life cycle[15]. The project engaged with a wide range of stakeholders including those from technology, energy, construction, local authorities, building managers and owners.

[13] http://eu-smartcities.eu/groups
[14] http://www.stepupsmartcities.eu/AboutUs/ProjectOverview/tabid/3166/Default.aspx
[15] http://www.ireenproject.eu/about

The whole structure system of EU s smart cities policies and their relationships are listed below (Figure 3):

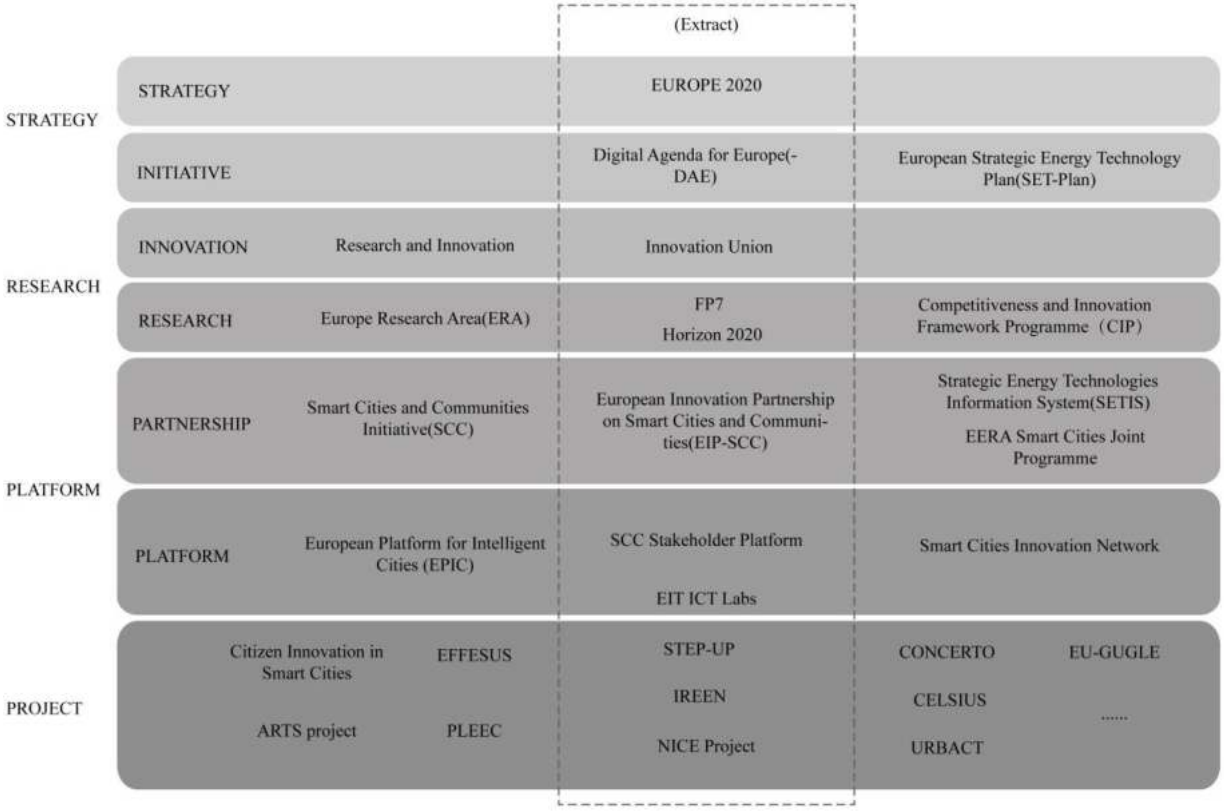

Figure 3. The structure of EU smart cities policies system

4. Evaluation of EU s implementation of Smart Cities

4.1 Achievement of EU Smart Cities

According to a latest EU research report (Manville, etc., 2014), seriously speaking nearly all the Smart Cities in Europe are in the primary stage of development and they still has a long way to go for the strategy of Europe 2020. In the key research cities, more than two-thirds of the smart city projects are still in the planning or pilot testing phase. The smart city projects mainly clustered into five characteristic types: neighbourhood units, testbed micro infrastructures, intelligent traffic systems, resource management systems and participation platforms.

The study also found that most of the smart city projects are towards the goals of Europe 2020, proving that the problem facing European cities are widely recognized. Smart City initiatives can be considered as a useful tool for cities to achieve their Europe 2020 targets. In most of smart cities initiatives, the environmental issues and green solutions appear to be the principal concern; nearly 50% of sampled initiatives address environmental problems through improved energy efficiency in buildings or smarter city transportation options. In addition, over one-third have initiatives that support

the attainment of poverty reduction targets while one-fifth of cities have initiatives that address employment. However, only few initiatives encourage private sector R&D investment. Some cities have project portfolios that aim to contribute to the attainment of multiple Europe 2020 targets.

The analysis found that by far the "smartest" five European cities are Helsinki, Hamburg, Amsterdam, Barcelona and Manchester. Although the implementation focus of the five smart cities are different, but the results of comprehensive evaluation shows the advantages.

4.2 Funding of EU Smart Cities

Since the great majority of Smart City initiatives in Europe had been financed by research funding, rather than on a commercial basis, thus it is necessary to understand the constitute system and operations of EU research funds. The European Union possesses five key funding opportunities to support research and innovation: the Research Framework Programme, the Competitiveness and Innovation Framework Programme, the Structural Funds and the Cohesion Fund within the Cohesion policy; the European Agricultural Fund for Rural Development and the European Fisheries Fund within the Rural development policy and the Common Fisheries Policy[16].

Usually smart city-related issues are funded by Research Framework Programme, Competitiveness and Innovation Framework Programme, the Structural Funds and the Cohesion Fund. Among them the Research Framework Programme is the most important source of funding and able to lead the smart cities research and become the core of innovation, system integration and standards establishment. The other two programmes are also important funding sources, they are not only involved in the Framework but also provide supports for other studies. In addition the Structural Funds and the Cohesion Fund support qualifying smart city projects, such as URBACT projects.

Furthermore, the EU act as an important guarantee for Smart Cities research and implementation, plus each projects could get funding from local government and private sectors, together they constitute the funding system of smart cities. Study also shows that projects using multi-channel sources of financial support are much easier to be successful.

4.3 Evaluation about EU Smart Cities

The EU has built a unique smart cities policies system, which already made some achievements, but also accompanied by a corresponding problem.

1) From the perspective of structure, the smart cities policies system constitu
from strategy to implement, however the complexity of the system may cause some difficulties while performing.

[16] http://cordis.europa.eu/eu-funding-guide/home_en.html

The EU smart cities policy system consists of four levels: the Strategy, the Research, the Platform and the Project, each level has own responsibilities and higher levels direct or cooperate with lower levels, the projects often reflect the strategy of Europe 2020 and the Innovation Partnership of Smart Cities, thus forming a complete industrial-chain system, which helps the final impleme Cities. But it is undeniable that the huge EU policy making system, as well as the research funding, are too complex and inextricable to manage, will cause some problems of coordination.

2) EU has a clear objective to develop and implement smart cities, which helps strengthen the confidence of the industries and governments to implement smart cities, but the "bottom-up" smart city participation is still weak.

From long ago EU considered that the smart city transformation can help them achieve their goals in environmental, social and economic aspects. The Europe 2020 strategy and other initiatives also stressed this point. For the government, these policies contribute to smart cities pilot development in order to achieve the future needs of the cities as soon as possible. For the enterprises, clear goals can directly enhance the confidence of research development, they are more willing to invest and promote the development of new technologies and intelligence technologies. At the same time, it cannot be ignored that the meaning of the smart cities includes Smart People and Smart Living, therefore the role of citizens should not be forgotten. We must focus on bottom-up participation in smart cities planning to build more livable and harmonious smart cities.

3) The system has built a multi-stakeholders platform for the governments, industries and the public, but most of smart city projects are still dominated by the city government, enterprises participate in the marketization of smart city technologies need to be strengthened.

The stakeholders of the EU smart cities policy system includes the European Commission, the European (and the world) industry enterprises, the Mayors and relevant EU organizations, and the citizens. Today the stakeholders platform is open, any stakeholders can participate and seek for better solutions. The technology platform is also established and the experts are integrated to guide the key technologies. The benefits of smart cities sometimes are not obvious and cannot entirely returns to investors, but it should be taken into account, which explains why most of the smart city projects are government-led. But it is undeniable that a market-driven business model is critical, the transformation of science and technology of smart city is important, and in this respect the EU still needs efforts.

5. Conclusions

Considering its international situation, the EU makes Smart City to be one of the most important issues to promote the EU's economic, social, environmental development for the next decade or even longer. The EU also develops a complete policies system from the strategy to the research and to the implement, in order to promote smart technology innovation leading by the information and communication technology industry; to define the goals of environment, energy, transport,

employment and other aspects; to build a platform for cooperation with governments, businesses and the citizens. Current European smart cities construction is in full swing and has achieved some success, especially in some big Smart Cities, the Smart concept has started to show some advantages. However in the future, the EU Smart Cities still need to strengthen bottom-up participatory mechanisms and marketization to be able to protect the long-term implementation of the EU smart city plans and to promote smart city vision finally realized.

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