

What business models for “smart city” assets?

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With special thanks to Louis-Philippe Carrier, JASPERS IQR, EIB
Luxembourg, May 28th 2018

SciencesPo



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Introduction

The state of “smart” cities in Europe

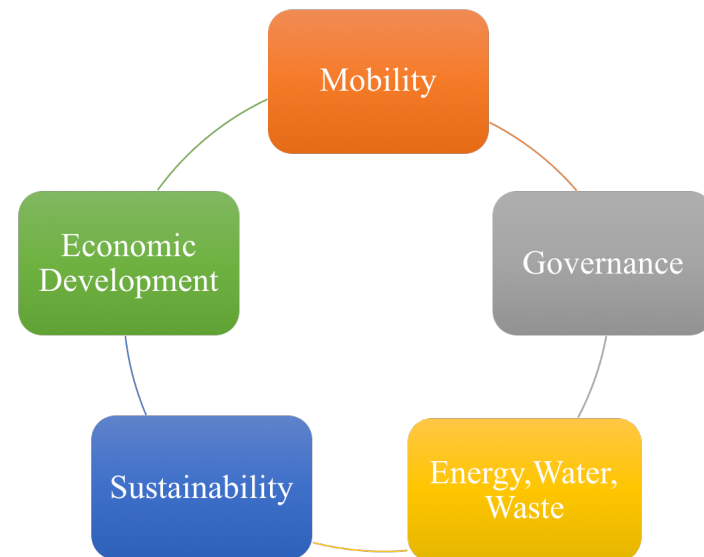
- Cities are increasingly looking for ways to use new ‘smart’ technologies to improve the lives of their inhabitants
 - ‘Smart cities’ are emerging as a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and business (*European Commission*)
- Urban investment is driven through various funding programmes on the European and state level based on the consensus that there are significant benefits to ‘smart’ investment
 - However, while in 2014, 90% of European cities with over 500,000 inhabitants could be classified as “smart cities,” only 43% of cities with 100 to 200,000 inhabitants could be categorized as such.
- Demonstrated need for more practical and empirical understanding of these topics in the European Union

Objectives of our study

- The main goal of our study is to understand the business models that are effectively used in the development of various smart city assets
- In order to accomplish this, we have tried to characterize the smart city assets currently in development around the world and to identify prevalent financing practices to serve as a standard for comparison in future
- We also aim to develop a better understanding of how assets are implemented and what contributes to the sustainability of these smart urban investments
- As a preliminary study on an emerging topic, our results are exploratory in nature and we hope that they will contribute to future studies

Defining the components of a smart city

- We defined and categorized the assets of a smart city according to the level of maturity and type of projects using a number of key references (Caragliu et al., 2009, Albino et al. 2015)
- Our research aims to collect empirical evidence for these concepts rather than to contribute to their theoretical development

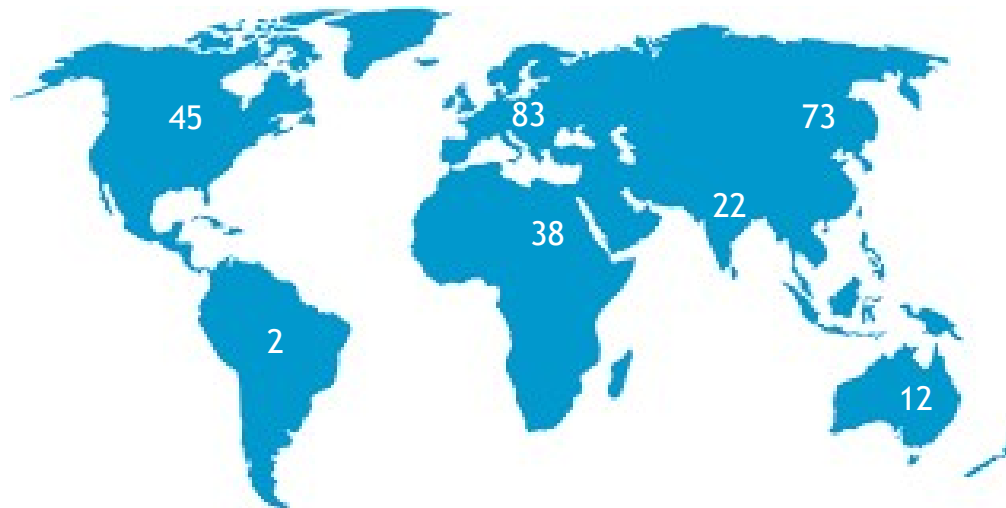


Adapted from Lombardi et al., 2012

Methodology

Sourcing of “smart city” database

- Using national and EU databases, news articles, reports by private consultancies, we identified various assets already deployed and foreseen to be deployed across a large number of cities around the world
 - For example, cities were identified through their participation in national initiatives such as *White House Smart Cities Initiative*, or in partnerships such as the *IEEE Smart Cities* network
- Focus on a wide representation across indicators of maturity, type of projects and location.



Preparation and distribution of questionnaire

- We developed a questionnaire to gather the following data from smart cities regarding their smart assets:
 - Asset and city characteristics, financing, operations and evaluation
- We developed and distributed our survey using the SurveyMonkey platform
- We finalized our questionnaire by incorporating several rounds of feedback on it from smart city field experts from the European Investment Bank
- For dissemination of the questionnaire, we identified individual contacts for smart city programs and assets, a process which reduced the initial size of our sample database
- We introduced our project and invited these contacts by email to participate in our survey
- With those that responded to our request, we fielded questions and clarified responses to enrich our data collection
- Amongst the respondents to our questionnaire, we selected the most robust results for further analysis in our results section

Survey Cover Page

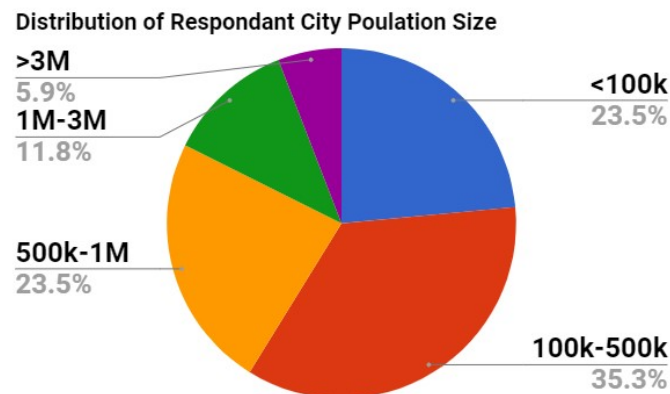


Results

Smart city characteristics

About our smart city respondents

- The majority of our respondents are European cities, though we also received responses from African, Asian, Australian, and North American cities
 - We had a 27% response rate, or around 20 responses with differing rates of completion.
- Our sample covers cities with great discrepancies in terms of population size and level of economic development.

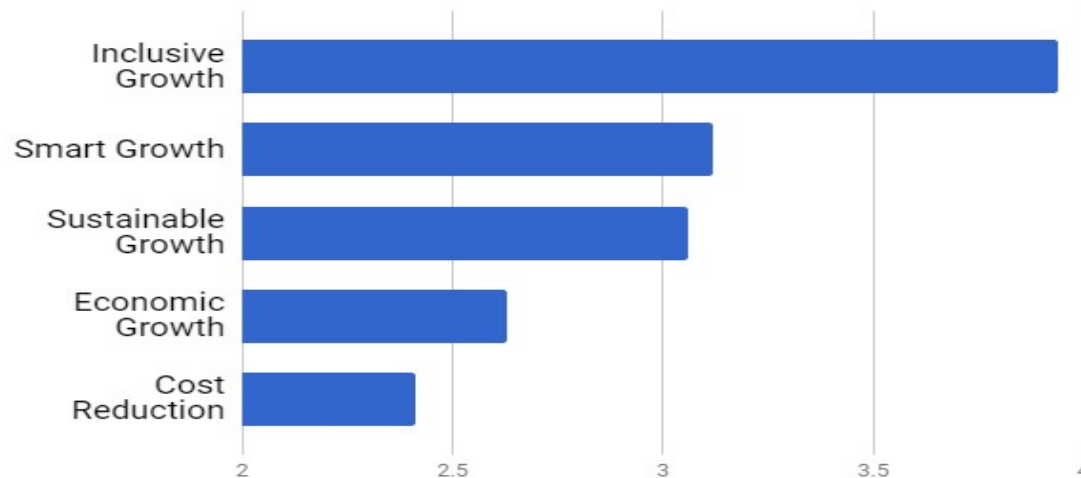


Smart city strategies

- 10 out of 12 respondents for this question well-defined smart city strategies
These included:
 - Improving the lives of its citizens by for example enabling citizens to access public services more conveniently
 - Facilitating innovation
 - Meeting environmental sustainability goals, eg. By using Big Data to minimize traffic congestion and resulting CO2 emissions
 - Taking advantage of existing regional strengths and comparative advantage such as a developed ICT industry, and a rich talent pool in the form of a specialized university
 - Encouraging collaboration between various city stakeholders- such as citizens, the public and private sectors, and knowledge institutions
 - Using ICT solutions to become economically competitive global cities
- The two respondent cities who did not have a strategy at present were in the process of putting together one

Priorities of smart cities

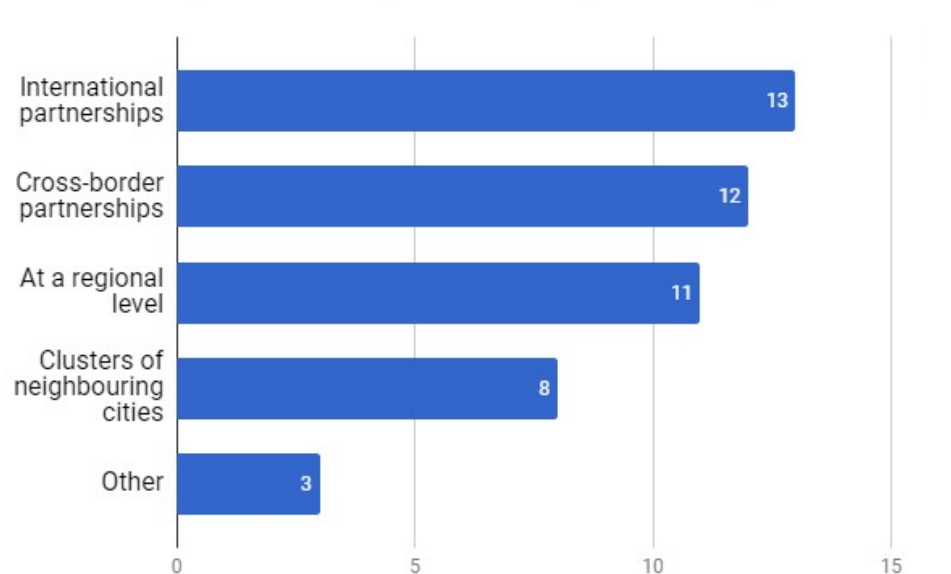
- “**Inclusive Growth**,” e.g. developing employment, social inclusion, education, public health and general security was the highest priority
- Secondary priorities were “**Smart Growth**” e.g. research & innovation, ICTs and SMEs and “**Sustainable Growth**” e.g. low-carbon, resource-efficiency, risk-prevention and transport
- “**Cost Reduction**” and “**Economic Growth**” are not top priorities



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Smart city partnerships

- Most of our respondents cooperate with other cities in Smart City partnerships
- International and cross border partnerships are the most prevalent
- However, most Smart City projects are developed specifically in line with a cities' needs, and not based off of other projects



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Asset Characteristics

Asset characteristics

- Only 1 out of 8 respondents classified themselves as ‘pilot’ projects
- Most of our respondents took around a year to implement their assets- which is in line with what is expected in the case of infrastructure-light assets
- The smart assets of our respondents were largely intended to serve the entire population of the city rather than being focused on particular areas, again likely because lighter assets allow more room more experimentation and implementation on a broader scale
- Smart assets were not typically targeted at particular age-groups within the population
- Many of the assets listed were in fact some form of platform to integrate various smart functions

Asset functions

- Taking into account that smart city assets are often diverse and multi-functional, we asked respondents to choose as many options as applied from among **Economic Development, Governance, Mobility, Energy, Water and Waste Management** and **Other**, to classify the function of their smart asset
- Smart assets in our sample were most commonly used to optimize the provision of services typically managed by municipal governments, such as **waste management, and energy and water**
- Assets to improve **Sustainability** were equally prevalent
- The **deployment of Mobility** functions such as parking and transportation through infrastructure-light smart assets were also popular
- The respondents who selected the ‘**Other**’ option listed **Pollution Control and Public Health Management, Communication, and Data Collection** as functions

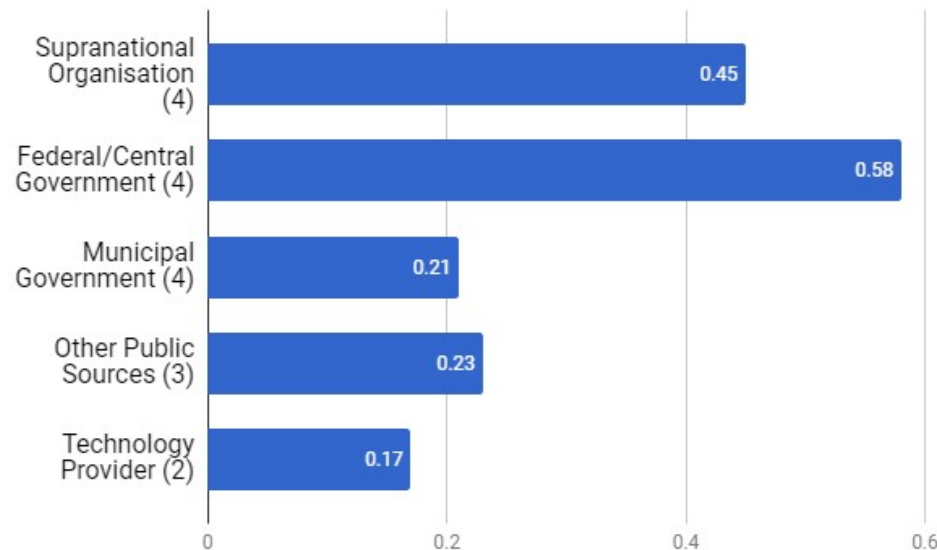
Financing

Initial Outlay

- 7 respondents answered our question on the amount of initial investment on the development of smart city assets
- EUR 120,000 is the least spent on the development of an asset; EUR 34 billion spent on the greenfield development of one of our respondents, is the maximum spent on development of a smart asset
- According to a recent report by the International Data Corporation, spending on smart cities is meant to reach \$80 billion (EUR 68 billion) by 2018, and \$135 billion (EUR 114.75 billion) by 2021 as investments in smart projects accelerate.

Funding: Sources

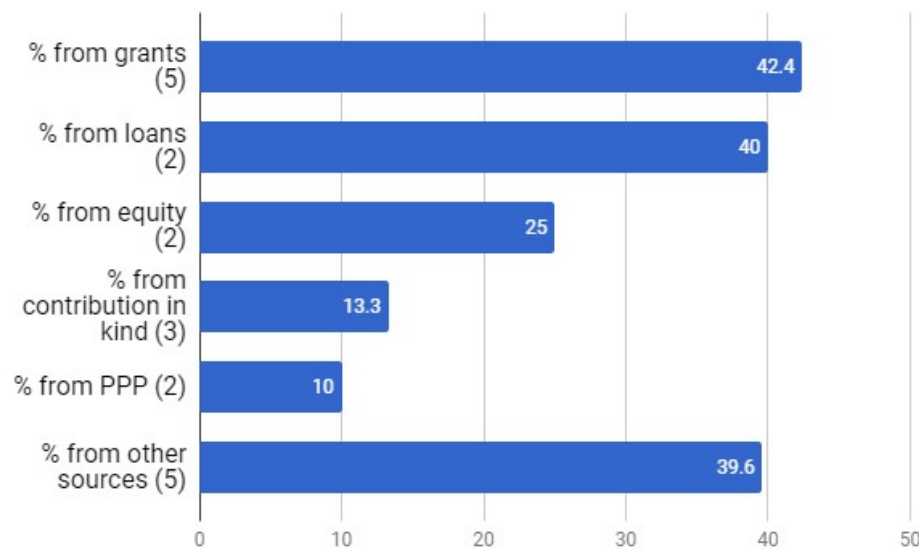
- Government budget represents an important source of financing for the majority of cities surveyed, with the federal/central government and municipality often co-funding assets
- Additional public sources include supranational organizations and funding programmes (Horizon 2020)
- None of the assets surveyed were fully funded by the private sector



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Financing: Instruments

- Grants are identified in projects involving less capital intensive projects, often supplemented to government budget funding;
- Debt financing and equity investment remain important funding instruments



Financing: Instruments by Type

Breakdown of Funding by Instrument Type					
% grants	% loans	% equity	%CIK	% PPP	% other
0	50	0	0	20	30
50	0	0	40	0	10
100	0	0	0	0	0
0	30	50	0	0	20
62	0	0	0	0	38

Financing: Instruments by Type

Breakdown of Funding by Funding Source				
% supranational organisation	% federal/centra l government	% municipal government	% other public sources	% tech.Prov
50	20	10	20	0
0	50	50	0	0
100	0	0	0	0
30	0	20	50	0
0	62	4	0	34

Operation and Maintenance

Operation Models

- We provided cities the choice between the following operational models based on Anthopoulos (2017):
 - Municipal-Owned-Deployment
 - Build-Own-Operate
 - Build-Operate-Transfer
 - Build-Operate-Comply
 - Build-Operate-Manage
- Municipal-Owned-Deployment is the preferred model among most respondents
 - None of our respondents followed a Build-Own-Operate model
- In the case of one of our respondents, certain assets were developed by private partners and **donated** to the city and a Build-Own-Operate model was followed for the remaining assets

Operating Costs

- Annual operating costs for the assets range from EUR 24,000 to EUR 4 million
- Most respondents anticipate an increase in operating costs over the coming years as new features are added to the asset, and more personnel are engaged in the operation of the asset
- Public subsidies are the most common method used to fund operating costs, followed by user fees
- Given that most assets were intended for use by the entire population of the city- operating costs per user ranged from EUR .018 to EUR 5

Procurement

Procurement process

- We asked respondents to choose among the following options to characterize their procurement process:
 - Open tender
 - Restricted tender, two-stage tender
 - Request for proposal
 - Request for quotations
 - Government discretion
 - Direct award
- Almost half of the respondents used open tender processes for procurement
- The other half used atypical procurement processes

Implementation

Challenges in Asset Implementation

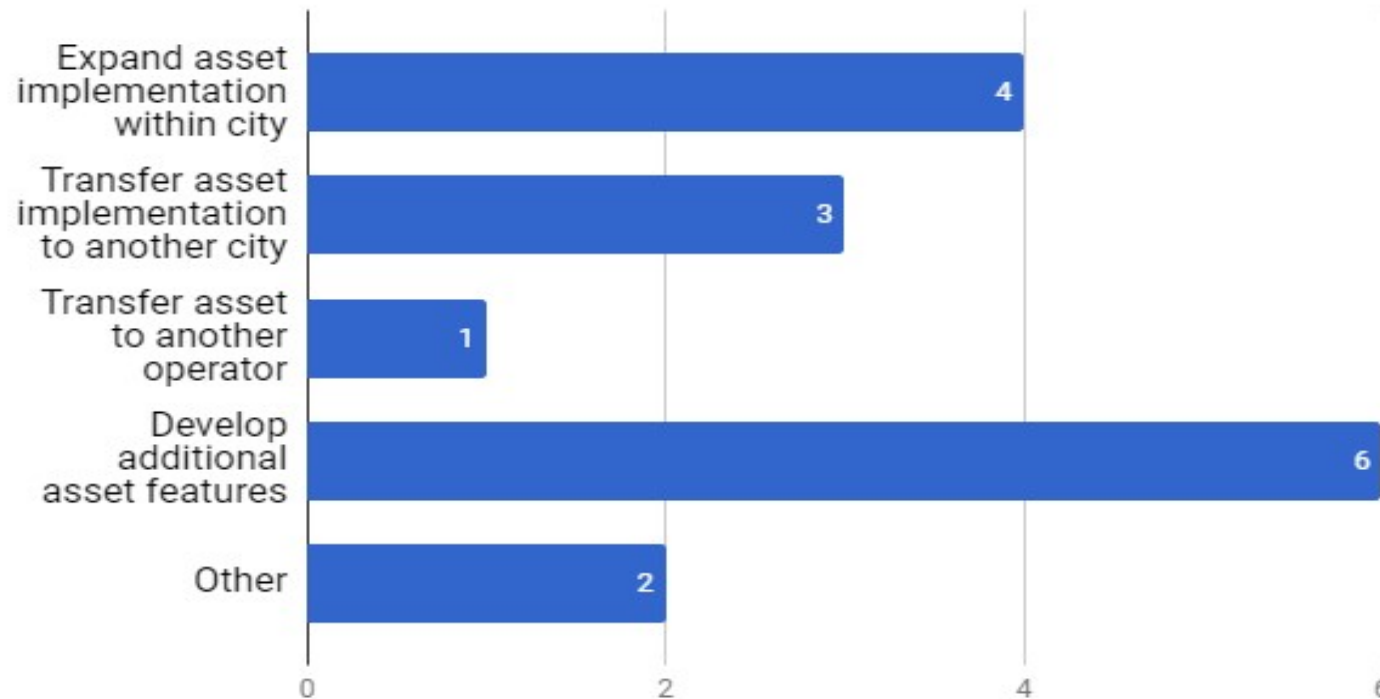
- Delays between planning and implementation of the asset due to:
 - Difficulties in securing financing
 - Administrative reasons
 - Lack of adequate capacity
- Engaging citizens, and spreading information about the usefulness of the asset
- Integrating the different hardware and software components of an asset
- Given the newness of the smart city concept, marketing the city to both foreign and domestic occupiers, and creating the correct institutional environment

Data Collection

- For two of our respondents, data collected constituted a Key Performance Indicator
- In most reported cases, data collected from the asset was not personal data belonging to the user, but rather data on environmental factors such as the temperature and weather
- In cases where personal data was collected, the ownership of this data was entrusted to the municipality rather than private actors
- Restrictions on the use of personal information was listed as a challenge for asset implementation by cities which aimed to provide a personalized experience based on previously-collected user data
- Concerns around the collection and use of personal data in the operation of smart city assets is particularly pertinent in Europe, given the recent General Data Protection Regulation

Expected growth of the asset

- Most cities are developing additional features of the asset and expanding the asset implementation.
- 8 Cities responded to this question.



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Conclusion

Relevance and limitations, recommendations

Key findings (1)

- A majority of our respondents were **European cities**, and the average population of our respondents was 1 million
- Smart assets aimed at serving the **entire population** of cities' metropolitan areas were most commonly used to optimize the provision of services typically managed by municipal governments, such as **waste management, and energy and water**
- All cities had well-defined 'smart city' strategies in place, or were in the process of putting together one
- Surprisingly, **inclusive growth** is the highest priority for cities when planning 'smart city' projects, while **cost reduction is the least important**- perhaps because the former is a more marketable objective when presenting the project to supranational financiers, or simply the result of a trade-off between multiple competing priorities

Key findings (2)

- International cooperation for smart city projects is much more prevalent than regional cooperation among clusters of neighbouring cities- which is perhaps indicative of the relative immaturity of the smart city concept
- Government budget represents an important source of funding for the majority of cities surveyed, federal/central government and municipality are often co-funding. None of the assets surveyed were fully funded by the private sector
- Grants were identified in projects involving less capital intensive projects, often supplemented to government budget funding

Key findings (3)

- Municipal-Owned-Deployment was the preferred operating model among most respondents. Build-Own-Operate models, which allow maximum autonomy to private sector actors were almost absent. On the whole, the involvement of the private sector is much less than expected, though that may be because of selection bias, and the small size of our sample.
- Public subsidies are the most common method used to fund operating costs, followed by user fees
- Difficulties in securing financing was a hurdle for asset implementation in many cases
- Data collection was a key function of many assets, though not necessarily personal data
- Most cities are developing additional asset features and expanding the asset implementation

Further questions

- Our study has demonstrated the importance of gathering empirical data on smart cities to determine the effectiveness of urban investment policies on the European level
- Further research would address our findings on the wider use of public funds for smart urban investments
- More information on the role of the private sector in promoting smart city projects would also be useful, though it may be difficult to elicit data from private sector actors, given confidentiality concerns
- Moreover, as the smart city concept spreads- it will be interesting to see if smart cities are able to truly bring the benefits they promise- especially in developing countries, where they are currently at a nascent stage