



Financing for Smart Cities

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ABSTRACT: This scientific approach mainly aims to develop a smart city/smart community concept to objectively evaluate the progress of these organizational forms in relation to other classical/traditional forms of city organizations. The elaborated model allowed the construction of the dashboard of access actions in the smart city/smart community category on two levels of financial effort correlated with the effect on the sustainable development of smart cities. The validity of the proposed model and our approach was supported by the complex statistical analysis performed in this study. The research concluded that low-cost solutions are the most effective in supporting smart urban development. They should be followed by the other category of solutions, which implies more significant financial and managerial efforts as well as a higher rate of welfare growth for urban citizens. The main outcomes of this research include modelling solutions related to smart city development at a low-cost level and identifying the sensitivity elements that maximize the growth function. The implications of this research are to provide viable alternatives based on smart city development opportunities with medium and long-term effects on urban communities, economic sustainability, and translation into urban development rates. This study's results are useful for all administrations ready for change that want the rapid implementation of the measures with beneficial effects on the community or which, through a strategic vision

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I. INTRODUCTION

Across the world, cities are acutely aware that they need to upgrade their infrastructure and systems to improve life for citizens and residents. This is becoming more urgent as rapid urbanization continues – by 2050, 66 percent of the world's population will live in cities, up from 54 percent in 2014, according to the United Nations. This could add 2.5 billion people to the world's city-dwelling population, placing additional strain on city services.

In a US survey from the International City/County Management Association (ICMA) almost 40 percent of respondents claimed they needed additional money “to sustain infrastructure at a baseline level” and indicated that the current state of their infrastructure is hurting quality of life.

As well as improving services for citizens, investing in smart city solutions also has the potential to save costs or even generate revenue for cities down the line.

A study from ABI Research found that smart city technology could save enterprises, governments and citizens globally over \$5 trillion annually by 2015. Cities could save as much as \$4.95 billion per year.

In terms of revenue, cities could raise additional taxes through increased economic development, as well as seeing a return through data monetization (a nascent but emerging area), leasing access to community-owned assets and advertising, to name a few examples.

However, despite broad acceptance of the benefits of smart city technology, internal funds for investment and smart city financing are not always easy to find. Research from Black & Veatch found that only 16 percent of municipalities surveyed said they could self-fund a smart city initiative.

To make progress, cities need to carefully consider the cost-benefit of any investment as well as exploring new finance and funding models. One thing is certain: it's unlikely cities can go it alone.

Public-Private Partnerships for Smart Cities

A clear trend is the need for greater collaboration and sharing of risks/rewards with the private sector.

Public-private partnerships (PPPs) are an increasingly popular mechanism for this. The PPP for Smart Cities institute defines PPPs as “relationships formed between the private sector and public bodies often with the aim of introducing private sector resources and/or expertise in order to help provide and deliver public-sector assets and services.” The partnership can take a range of forms, including PFIs (private finance initiatives).



In the Black & Veatch report three-quarters of survey respondents said they consider PPPs to be the most effective financing model for smart city initiatives, followed by government grants/subsidies (52%); tax incentives (41.7%); and property taxes (12.%). Only 8.1% and 5.5% respectively thought purely municipal or private funds were the way to go.

PPPs are being used to get all kinds of smart city projects off the ground, from telecommunications and transportation to energy and waste.

One of the most ambitious and headline-grabbing examples of this is Sidewalks Labs' recently announced collaboration with the City of Toronto to revamp the Waterfront area (read more: Toronto Smart City Portrait). Sidewalks Labs has committed \$50 million to an initial phase of joint planning and pilot project testing.

Another example is the Link NYC Free WiFi in New York City, a PPP between the city and a consortium of technology companies which generates revenue through advertising. There are many examples of PPPs throughout the world and IESE PPP for Smart Cities publishes regular case studies.

Another interesting example of private sector input was demonstrated when Cisco announced its \$1billion City Infrastructure Financing Acceleration Program to support the growth of smart city infrastructure and applications. Through Cisco Capital and its financing partners – Digital Alpha Advisors, APG Asset Management and Whitehelm Capital – the program provides debt and equity capital to facilitate smart city initiatives and offers flexible financing and payment solutions. For example, cities can choose traditional loans and leases, consumption-based financing, 'as a service' financing or concession financing.

Partnership with the private sector is not without challenges, though. Vendors need to ensure they will get a return on their investment and cities must balance this with their own goals. Big tech's growing stake in smart cities can also raise concerns about a 'Big Brother' society so a strong focus on transparency and privacy will be crucial to gain citizens' trust.



“Cities can form partnerships with large corporations, small and medium-sized businesses and startups to reach their smart city goals. However, they should focus on technology with open standards to stay flexible and to prevent dependency on one vendor”, comments Thomas Müller, Co-Founder at bee smart city, noting the importance of standards in making these partnerships a success.

II. DISCUSSION

Government subsidies for smart city funding

Central governments are also beginning to offer subsidies to stimulate smart city initiatives, mindful of the longer term social and economic benefits they can bring.

In action:

- India's Smart Cities Mission aims to create 100 smart cities in the country as model for development and to bring improvements to nearby cities and towns. A total of ₹98,000 crore (\$15 billion) has been approved by the Indian Cabinet for the development of 100 smart cities and rejuvenation of 500 others over five years. Each city is expected to receive approximately 100 crore (\$15 million) per city per year. Cities are selected through the Smart Cities Challenge, based on feasibility and potential impact. Each city will create a corporate company headed by a full-time CEO to implement the Smart Cities Mission. Central and state government will provide core funding to the company and it has to raise additional funds through debt or equity.



- The Government of Canada is challenging communities to come forward with their best ideas to improve the lives of their residents through innovation, data and connected technology. Each community must define a Challenge Statement and outline the outcome it aims to achieve by implementing its proposal. One prize of up to \$50 million is available to cities of any size, as well as smaller prizes based on population.
- Australia's \$50 million competitive Smart Cities and Suburbs Program supports projects that apply innovative technology-based solutions to urban challenges. Grants of \$100,000 to \$5 million have been made available to cover up to 50% of eligible projects' costs.
- Through the Smart City Challenge, the US Department of Transportation (DOT) committed up to \$40 million to the winning city – Columbus in Ohio – for its idea on how to create an integrated smart transportation system to help people and goods move more efficiently. This was alongside up to \$10 million from Vulcan Inc. to supplement the \$90 million that the city had already raised from other private partners. The DOT also announced an additional \$65 million in grants to support advanced technology transportation projects in cities across America.
- The European Commission's Horizon 2017 scheme offers projects €14.5 to €20 million each to develop and test new solutions for smart cities and communities.

Civic crowdfunding for smart city solutions

Crowdsourcing and crowdfunding are big buzzwords these days and they apply to smart cities too, as we highlighted in our recent article on crowdsourcing to accelerate smart city development. Crowdfunding is a “method of raising finance by asking a large number of people each for a small amount of money.” In a city context, this could include funds from citizens, and public and private sector. Options include donations, reward-based schemes, community shares and municipal bonds.

Research from Future Cities Catapult found that 90% of UK local authorities were largely unaware of the opportunities for civic crowdfunding but the organization says the approach could serve “as a tool to adopt and foster innovation and change,” and that it has potential to “revolutionize local democracy”.

Future Cities Catapult is working with the civic crowdfunder Spacehive and KPMG to support Manchester City Council and the city of Hull to develop an approach to harness and demonstrate the power of civic crowdfunding.

Although the model may not be suitable for all smart city initiatives, civic crowdfunding offers particular potential for small-scale, limited-time projects with a social purpose, Future Cities Catapult says. It also presents an opportunity to boost citizen engagement – see our recent article on the rise of the ‘smartivist’ and human-centered smart cities.



“The human element is something that has been largely neglected in the first generations of smart cities around the globe. Increasingly, cities recognize the importance of citizens and other actors inside the city or community for the creation of solutions tailored to the needs of their main “customers”, states Dr. Alexander Gelsin, Managing Partner at bee smart city.

Don't reinvent the wheel to finance smart city development

In some cases, it may be that local government and private funders are cautious because the case for investment is unproven. This is where small-scale pilot schemes, testbeds and collaboration with other cities can be useful.



For example, the City of Atlanta recently launched its North Avenue Smart Corridor. The corridor will serve as a “living lab” for Internet of Things (IoT) deployment, data collection and analytics, connected and autonomous vehicles, and partnerships to demonstrate how Atlanta plans to transform its transportation infrastructure. In a previous presentation, Samir Saini, Atlanta’s CIO, advised other cities: “Start with a street, not the whole city, test it out, prove the concept and then expand from there.” Further, although every place has its own unique challenges, they can learn from the work done by other cities to avoid wasted time, effort and money while following their smart city strategy. These case studies can be discovered through national and global forums and trade associations, events and the work done through programs such as the EU’s Horizon 2017 (see above) where European ‘lighthouse’ or demonstrator cities tackle sustainability issues around transport, energy and ICT. They trial different urban regeneration models which address their own individual challenges as well as generating broader practical takeaways for other cities.



“In reality, cities are likely to choose a suite of different options for funding their smart city efforts. Ultimately, a smart city is about an ecosystem of smart solutions and cities must research thoroughly to ensure that the outcome as well as the financial input meets their needs. The adaption or replication of existing best-practice solutions is a highly efficient approach that can help to reduce financing needs. There is no need to re-invent the wheel!”, Bart Gorynski, Managing Partner at bee smart city concludes.

III. RESULTS

The purpose of the Smart Cities Mission, initiated by the Government of India, is to promote economic growth and improve the quality of life of its citizens by harnessing technology and enabling local area development. The Smart Cities projects in India are expected to drive investments worth Rupees Two Lakh Crores (USD 28.09 Billion) over the course of the project. This essay is centered on the financial framework of the Smart Cities Mission. It outlines the smart city landscape along with other urban transformation missions in India. The key differentiating drivers, the various sources of financing, and the mechanism called Convergence are further discussed. The Smart City projects are characterized by attributes that allow cities to leverage integration of funds from different schemes. The Agra Smart City Limited example elaborated on in this essay illustrates the governance structure in place for implementing and monitoring the mission. A deep dive of the tendering process in the Agra Special-Purpose Vehicle (SPV) case explains the vendor management process. This includes vendor selection, vendor payment, and disbursement of payments.

The Europe 2017 strategy, as of June 2011, is supposed to be the European roadmap for our industry to remain or become a world leader, with innovation and research as the engines to capturing the growth potential of low carbon technologies, boosting its economy and creating jobs. By doing so, EU hopes to contribute to tackle the major societal challenges faced by Europe, such as sustainable mobility, climate change, energy security or our ageing population.



Cities have a role to play in such a new scenery, as well as companies. In the following paragraphs I introduce the EU legal framework backing public support for the Smart Cities, discuss obstacles for the implementation of the initiative and I bring into the light some suggestions on how to analyze “smart projects” and where to ask for funds. In preparing this article I have extensively consulted research reports from Accenture, HSBC Global Climate, Cities In Motion Think Tank, official documents from EU Commission, EIB and Think (linked to the 7th EU Platform). There is an abundant supply of blogs dealing with the Smart Cities issues and they have also helped me in organizing and structuring this article.

Energy: a problem and a solution

The well-being of people, industry and economy depends on safe, secure, and sustainable and affordable energy, while at the same time, energy related emissions account for almost 80% of the EU’s total greenhouse gas emissions. Thus, energy is one top priority: EU must meet the 20/20/20 climate and energy targets, reducing greenhouse gas emissions by 20%, rising to 30% if the conditions are right 1, to increase the share of renewable energy to 20% and to make a 20% improvement in energy efficiency (Oettinger, 2011).

It has been estimated that energy investments in the order of € 1 trillion are needed until 2017, both to diversify existing resources and replace equipment and to cater for challenging and changing energy requirements. EU’s energy and climate goals have been incorporated into the Europe 2017 Strategy for smart, sustainable and inclusive growth 2, adopted by the European Council in June 2010, and into its flagship initiative ‘Resource Efficient Europe’. One of its commitments is the launching of the Smart Cities and Communities Initiative.

Smart Cities

Cities are the key to addressing societal challenges since they have the critical mass of different communities, people and influences that come together to spark innovation and new ideas (Boulanger et al. 2012). At the same time, cities have to be seriously considered because they can be really dangerous for the environment, as Table 1 depicts. The smart city concept is a framework for a specific vision of modern urban development that recognizes the growing importance of information and communication technologies (ICTs) as drivers of economic competitiveness, environmental sustainability, and general livability.

Cities offer an ideal platform for ICTs and other industries to integrate and test new concepts to serve Europe’s sustainable future delivering energy saving (Kroes, 2011). To work together, all these technologies and services cities require common open platforms and an underlying ubiquitous ICTs infrastructure and wireless networks. They also need a ICTs application and service enablement suite, which includes smart media service enablers and citywide open access to sensors and actuators.

Obstacles that limit the potential of innovative smart technologies

Smart cities may offer a major market opportunity that can be easily exploited by ITCs providers and their telecom equipment partners (Giles, 2011). However, although the opportunity exists, capitalizing on it is not as straightforward as it seems: several obstacles limit the potential of innovative smart technologies, like high technological risk, difficulties over uncertain returns on investment or regulatory difficulties (Johnson and Suskewicz, 2009). This is why, on 10 July 2012, the European Commission launched the Smart Cities and Communities (SCC) European Innovation Partnership. It proposes to pool resources to support the demonstration of energy, transport and ICT in urban areas, concentrating them on a small number of demonstration projects. The funding will be awarded through yearly calls for proposals and the underlying idea is to ease that industry tests technology in a given city/community; it will show that the developed technology works on the ground, can be implemented for reasonable costs and has advantages for citizens and the whole community. The projects therefore bring competent industrial consortia together with one or two cities to demonstrate their advantages – so that other cities may follow to implement the same technologies.

The Smart Cities and Communities Initiative earmarked in 2012 € 81 Million, covering the transport and/or other energy sectors. From 2013, the budget has been increased to € 365 Million, covering three areas instead of two: energy, transport and ICTs; every demonstration project financed under this scheme must combine all these three sectors. (Goldmann, 2011). The main aims of the Smart Cities & Communities Initiative include:



Main aims of the smart cities & communities initiative (De Lounis and Bertrand, 2012)

- Engaging with the business sector and public authorities to realise ambitious technological demonstration programmes which will promote innovative integrated applications of low carbon technologies in cities;
- Achieving significant impact and high replication across the European Union for these programmes in the areas of energy efficiency; production of renewable energy, smart distribution grids, urban mobility and information and communication technologies;
- Proposing innovative organisational and economic solutions;
- Accelerating the large scale deployment of the abovementioned low carbon technologies and its measures at local level;
- Demonstrating concrete technological and economic solutions to practically support the measures as proposed in the area of energy efficiency.

In 2014, a High Level Group will formulate a technological agenda with the most important aspects/issues to be addressed. Based on it, the European Commission will make calls for proposals. Industry-consortia can apply, submitting their project ideas. The “High Level Group for Smart Cities & Communities” will advise on the strategic orientation of the initiative identifying bottlenecks that are blocking the transformation of our cities and necessary action. This will help to identify the main issues to be addressed by the lighthouse projects and it will be fully operational under “Horizon 2017”, the new research and innovation funding framework under the next Multiannual Financing Framework (MFF 2014-2017). Among the eligible projects to co-finance we may mention the following ones):

A short list of the eligible projects to co-finance

- Smart buildings and neighbourhood projects. They could expand the use of high efficiency heating and cooling (using biomass, solar thermal, ambient thermal and geothermal heat storage, co-generation and district heating). They could also support the construction of nearly zero-energy buildings and positive energy buildings and neighbourhoods.
- Smart supply and demand service projects. Funding could be available for schemes which provide data and information to citizens and end-users on energy consumption/production and multimodal transport and mobility services; to develop smart metering and related services for energy, water, waste; monitoring and balancing the grid; or energy storage (including virtual energy storage)
- Urban mobility projects. These could be electric public transport vehicles (for example trolley buses, trams, metro vehicles) that are able to exchange surplus energy (braking and accelerating energy) with the energy system. They could be using ICT to manage energy flows or using hydrogen as an energy carrier for storing energy and balancing demand at city level for energy and stationary power – controlled by ICT using forecasts for demand patterns based on weather forecasts, event planning, vehicle route patterns, etc.
- Smart and sustainable digital infrastructures. By reducing the carbon footprint of the Internet, in particular data centres and telecoms equipment, including broadband; intelligent heating, cooling and lighting solutions.

Managing an urban center’s energy use is critical to providing a sustainable high quality of life for its citizens and municipalities seek to improve across 5 main sectors: energy; mobility; water; public services; buildings and homes (Lompscher, 2010).

The actual elements used to create a smart city vary from one city to another: Greenfield cities require larger ICT projects, while Brownfield ones demand a transformation of existing ICT capabilities. And, of course, beyond product capabilities, smart cities need as well a variety of service firms providing design activities, planning, monitoring, maintenance, consulting and so on. In Giles (2011) report for Accenture, devoted to financing smart cities, it is said that smart cities would only survive if they diversify their capital base and generate cash-flow for reinvestment. These cities need public funding besides private and philanthropic capital. Whenever it happens that they are not chosen for a demonstration project under the SSC initiative and then, they need to find alternative and complementary ways of financing their smart initiatives.

How will technology project on an urban scale be funded?

From an investment perspective, what is the incentive to finance public infrastructure?. These projects require large funding volumes, as it has already been mentioned in previous paragraphs: the Strategic Energy Technology Plan (SET-Plan) foresees in 20-25 model cities investments of approx. €11 billion and these numbers do not refer to the roll-out of energy and other “low-carbon”-technologies, but to the implementation of the initial demonstration projects!!!!



Cities get their money from the taxes of citizens. We are in a time of austerity and money does not flow easily, so EU cities and companies have to manage their infrastructure in an economically efficient way (<http://reports.weforum.org/global-risks-2013/>). The challenge at the moment is to find a way that a city doesn't have to pay the money up front. From an investor stand point, there are long-term benefits from managing a city efficiently and it is crystal clear that eliminating waste in the existing infrastructure is extremely important. The possibility of recovering the amount of money invested within the lifetime of the technologies involved in the projects is one of the most relevant factors when deciding whether to invest or not. People in cities live longer, they look to save funds and you can observe a huge flow going into pensions and life insurance. That money needs to be invested somewhere and there can be a natural balance between the requirement for long-stated steady return products in which to invest your pension and public infrastructure projects. The long-term, stable returns that can be generated by the infrastructure projects will be necessary to build up new cities and retrofit existing ones. These are exactly the types of assets that are of interest to sovereign wealth funds, insurance companies, and pension funds. However, these are investments with high-risks involved, which are usually related with measures that involve extremely variable costs/prices, or with technologies that are not sufficiently tested to have predictable performances, and generally imply high upfront costs. Most actors are not willing to cover that risk, requiring that, in order to invest, some other entity covers the risk. In other cases, even if some measures are clearly cost-effective and there are no high upfront costs, investors still need incentives to be deployed at a wide-scale. The time of full recovery of the investment can strongly influence the decision whether or not to invest, especially in the presence of high uncertainties with respect to future energy and carbon price trajectories and/or regulation. Nowadays numerous firms and individuals have only a short to mid-term vision of their businesses or lives. Therefore, if they are not able to recover their investment within such or even shorter periods, they do not invest (Spedding, 2013).

In addition to the barriers presented above, we might find as well difficulties associated with an informational deficit that can include the lack of customized information and the lack of public awareness on climate change issues, but also the insufficient qualification of staff for complex integrated tasks at the public entities and service providers levels. When aiming for a wide-scale implementation of measures, barriers related to information problems might be crucial. If information is not available, is expensive to be collected, or is not provided in a clear way, decisions based on incomplete information cannot be avoided and, consequently, the selected measures, techniques, materials, technologies, etc. will hardly be the most suitable.

Funding Instruments for financing Smart Cities

Financing Smart Cities requires a mix of different funding instruments and models, including private players. Financing Smart Cities-measures mainly through classic municipal funding or through funds of the municipal households seem not feasible. The possibilities of utilizing European funding instruments in the new period of structural funds, like ELENA3 and/or JESSICA4 (2014-2017) have to be identified. (de Oliveira Fernandes et al., 2011).

Since there are various activities that require the coordination of different actors from different sectors or with different functions within the same sector, the divergence of interests is a frequent obstacle to the sustainability in a city. This coordination is complex, and usually requires some effort from all parties, which the regulatory mechanisms shall make sure to be sufficiently compensated by benefits to motivate all groups of stakeholders. There are three types of policy instruments that can directly mobilize public funds to support innovation: public loans/loan guarantees, public investment in the equity of innovating companies (Public-Private-Equity-Partnerships, or PPEPs), and subsidies.

IV. CONCLUSIONS

There are numerous types of innovation processes in the SET Plan; a rigorous cost-benefit analysis to determine the size of the existing financing gap and the choice of financing instruments should be guided by the stage of development of the technology and its characteristics. These include its cost (size of investments required for the development of this technology), the interdependence between this technology and other new technologies, the radical vs. incremental nature of knowledge involved in the development of this technology and the status of the innovating entity (regulated vs. non-regulated). Following the classification provided by the EC (EC, 2009c), it is possible to distinguish between a) close-to-be-mature technologies, which are, therefore, close to the market and whose deployment within the period 2011-2017 seems feasible; b) those technologies that could be deployed within the period 2017-2035; and c) those that are still farther from the market and are therefore highly immature. The type of finan-



cial support required will then depend on: (I) the size of the financing gap to be covered by public funds; (II) the project's ability to compete for public funds against other clean technologies; (III) the likelihood that support to this technology will need to be cut off because it fails to deliver according to authorities' expectations and (IV) the type of entity that is best suited to carry out this innovation (Newbery et al. 2011).

Funding low-risk projects requires providing strong efficiency incentives. One option is to make the release of funds and their amount conditional on the achievement of some minimum objectives. Given the high probability of success in these projects, linking support to project performance should encourage the innovator to carry out his function efficiently and reduce the public cost of support, while not prejudicing his willingness to undertake the project. A lack of innovators' liquidity or their concern about the credibility of the funding may indicate releasing some or all the funds up front or at stages during project execution on condition that they are returned if the project is not undertaken as agreed or the innovator, the most attractive contract is upfront funding unconditional on project performance. However, since this is the most expensive option from a public point of view, it should be reserved for high risk projects, and only use if other approaches will not deliver. Providing assured funding to centres of excellence (contingent on continued performance) attracts researchers and keeps research groups alive. Up-front unconditional funds may be provided as a fixed amount. However, providing instead funds covering a certain fraction of project costs might allow the public investor to benefit from below-budget delivery (successful projects that meet objectives at a cost lower than expected) (Newbery et al., 2011)

How to support a portfolio of smart cities

Supporting the portfolio of smart cities can be about supporting the city authorities as actors, and supporting city authorities as institutions. Still, it cannot be excluded that the implementation of certain smart city concepts will require private actor support that is not yet covered by the abovementioned sector initiatives and partnerships. Furthermore, these initiatives and partnerships focus on private actors so that support for a city authority as a public actor is not necessarily available, which could then also be provided in the context of the Smart Cities Initiative.

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