SMART CITIES IN CONTEXT TO URBAN DEVELOPMENT

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ABSTRACT

Urban performance currently depends not only on the city's endowment of hard infrastructure ('physical capital'), but also, and increasingly so, on the availability and quality of knowledge communication and social infrastructure ('intellectual capital and social capital'). The latter form of capital is decisive for urban competitiveness. It is against this background that the concept of the smart city has been introduced as a strategic device to encompass modern urban production factors in a common framework and to highlight the growing importance of Information and Communication Technologies (ICTs), social and environmental capital in profiling the competitiveness of cities. The significance of these two assets - social and environmental capital - itself goes a long way to distinguish smart cities from their more technology-laden counterparts, drawing a clear line between them and what goes under the name of either digital or intelligent cities. Smart(er) cities have also been used as a marketing concept by companies and by cities.

KEYWORDS: Smart Economy, Smart Mobility, A Smart Environment, Smart People, Smart Living, Smart Governance

INTRODUCTION

The challenges of climate change, population growth, demographic change, urbanization and resource depletion mean that the world’s great cities need to adapt to survive and thrive over the coming decades. Slashing greenhouse gas emissions to prevent catastrophic climate change while maintaining or increasing quality of life could be a costly and difficult process. There is an increasing interest, therefore, in the role that information and communications technologies could play in transforming existing power-hungry metropolises into low-carbon cities of the future. But, as yet, few cities have fully grasped the possibility of becoming a ‘smart city’

More than ever before, the traditional “bricks-and-mortar” drivers of economic growth are giving way to an economy based on “brains and creativity.” Competitive differentiation today is more likely to be based on the ability of the workforce to create and absorb skills and innovation than on traditional drivers such as available natural resources, physical labor or manufacturing prowess. As a result, the skills, aptitude, knowledge, creativity and innovation of a workforce – which collectively can be viewed as the talent pool in the economy – have become increasingly important drivers of economic growth and activity. Cities, as hubs of the global economy, are the focal points for this transformation. In the immediate future, three interconnected factors will place even more emphasis on the role of cities in talent-based economic development:

- The world is at an unprecedented level of urbanization.
- Cities contain an increasingly large share of the world’s highly skilled, educated, creative and entrepreneurial population, giving rise to highly concentrated and diverse pools of knowledge and knowledge-creation networks.
- Cities can support large-scale business and investment networks that create economies of scale in absorbing and
extending innovation.

**Smart Cities**

A city can be defined as ‘smart’ when investments in human and social capital and traditional (transport) and modern (ICT), communication infrastructure, fuel, sustainable economic development and a high quality of life, with a wise management of natural resources, through participatory action and engagement. (Caragliu et al. 2009). To Gildo Seisdedos, the smart city concept essentially means efficiency. But efficiency based on the intelligent management and integrated ICTs, and active citizen participation. Then implies a new kind of governance, genuine citizen involvement in public policy.

Smart cities can be identified (and ranked) along six main axes or dimensions:

- A smart **economy**, smart **mobility**, a smart **environment**, smart **people**, smart **living**, smart **governance**

These six axes connect with traditional regional and neoclassical theories of urban growth and development. In particular, the axes are based - respectively - on theories of regional competitiveness, transport and ICT economics, natural resources, human and social capital, quality of life, and participation of citizens in the governance of cities.

It insists that smart cities are defined by their innovation and their ability to solve problems and use of ICTs to improve this capacity. The intelligence lies in the ability to solve problems of these communities is linked to technology transfer for when a problem is solved. In this sense, intelligence is an inner quality of any territory, any place, city or region where innovation processes are facilitated by information and communication technologies. What varies is the degree of intelligence, depending on the person, the system of cooperation, and digital infrastructure and tools that a community offers its residents.

The concept of the smart city as the next stage in the process of urbanization has been quite fashionable in the policy arena in recent years, with the aim of drawing a distinction from the terms digital city or intelligent city. Its main focus is still on the role of ICT infrastructure, but much research has also been carried out on the role of human capital/education, social and relational capital and environmental interest as important drivers of urban growth.

The European Union (EU), in particular, has devoted constant efforts to devising a strategy for achieving urban growth in a smart sense for its metropolitan city-regions. Other international institutions and think tanks also believe in a wired, ICT-driven form of development. The Intelligent Community Forum produces, for instance, research on the local effects of the worldwide ICT revolution. The OECD and EUROSTAT Oslo Manual stresses instead the role of innovation in ICT sectors and provides a toolkit to identify consistent indicators, thus shaping a sound framework of analysis for researchers on urban innovation. At a mesoregional level, we observe renewed attention for the role of soft communication infrastructure in determining economic performance. The availability and quality of the ICT infrastructure is not the only definition of a smart or intelligent city. Other definitions stress the role of human capital and education and learning in urban development. It has been shown, for example, that the most rapid urban growth rates have been achieved in cities where a high share of educated labor force is available.

Innovation is driven by entrepreneurs who innovate in industries and products which require an increasingly more skilled labor force. Because not all cities are equally successful in investing in human capital, an educated labor force – the ‘creative class’ – is spatially clustering over time. This tendency for cities to diverge in terms of human capital has attracted the attention of researchers and policy makers. It turns out that some cities, which were in the past better endowed with a skilled labor force, have managed to attract more skilled labour, whereas competing cities failed to do so. Policy makers,
and in particular European ones, are most likely to attach a consistent weight to spatial homogeneity; in these circumstances the progressive clustering of urban human capital is then a major concern.

A smart city is one in which the seams and structures of the various urban systems are made clear, simple, responsive and even malleable via contemporary technology and design. Citizens are not only engaged and informed in the relationship between their activities, their neighborhoods, and the wider urban ecosystems, but are actively encouraged to see the city itself as something they can collectively tune, such that it is efficient, interactive, engaging, adaptive and flexible, as opposed to the inflexible, mono-functional and monolithic structures of many 20th century cities. This is not simply a philosophical aspiration but can directly address core strategic drivers, such as reducing costs or greenhouse gas (GHG) emissions, and increasing competitiveness.

Key to this is the idea of measurement; of infrastructure, buildings and activities reporting their state and behavior to systems that learn and adapt in response. These systems could be technological, legislative or social. The maxim “if you can’t measure it, you can’t manage it” applies here, and so the idea that urban fabric and activity can be ‘instrumented’ and measured in detail, and acted upon instantly, enables a new form of management, operation and engagement, perhaps equivalent to the difference between a traditional high street bookstore and Amazon.com. The latter is a constantly shifting, scalable system that is automatically generated ‘on the fly’ by constant learning from millions of interactions in near-real time, within a framework that enables both top-down intervention and bottom-up organization.

**Visions of a Smart City**

The smart city vision does involve hard infrastructure such as introducing smart grids alongside various forms of renewable energy generation and building new systems of mobility based on distributed networks but is perhaps primarily articulated through ‘soft infrastructure’ i.e. social networks and communities, legal and cultural systems, and various forms of ICT. This fast-moving layer is perhaps more approachable and appealing for cities, offering a way to quickly retrofit existing buildings and infrastructure with smart elements at relatively low-cost, whilst planning carefully for the longer-term shift to the ‘heavier’ forms of smart infrastructure.

Equally, the output of such thinking, through the emerging medium of urban informatics, can often be engaging, informative, even beautiful, realized in the form of increasingly refined audio-visual displays and interfaces, installations, websites and systems, all driven via these real-time learning layers overlaid onto the existing city. This has the effect of ‘making the invisible visible’ thus raising awareness about urban infrastructure, activity and ecosystem. The characteristics of a smart city can be quite liberal. The label **smart city** is still quite a fuzzy concept and is used in ways that are not always consistent. This section summarizes the characteristics of a smart city that most frequently recur in discussions of the topic.

**A Stage Reached in the Development of Infrastructure**

This usage is centered around the "utilization of networked infrastructure to improve economic and political efficiency and enable social, cultural and urban development", where the term infrastructure indicates business services, housing, leisure and lifestyle services, and ICTs (mobile and fixed phones, satellite TVs, computer networks, e-commerce, internet services), and brings to the forefront the idea of a wired city as the main development model and of connectivity as the source of growth. The critical role of high-tech and creative industries in long-run urban growth is stressed. This factor, along with soft infrastructure ("knowledge networks, voluntary organizations, crime-free environments, after dark entertainment economy"), is the core of Richard Florida’s research.
The basic idea is that "creative occupations are growing and firms now orient themselves to attract 'the creative'". While the presence of a creative and skilled workforce does not guarantee urban performance, in a knowledge-intensive and increasingly globalised economy, these factors will determine increasingly the success of cities.

**A Strategy for Creating a Competitive Environment**

Here, a ‘smart city’ is taken to be one that takes advantage of the opportunities ICTs offer to increase local prosperity and competitiveness - an approach which implies integrated urban development based on multi-actor, multi-sector, and multi-level perspectives.

This leads to an "underlying emphasis on business-led urban development", creating business-friendly cities with the aim of attracting new businesses. The data shows that business-oriented cities are indeed among those with a satisfactory socio-economic performance. To this end, cities may design business parks as ‘Smart Cities’: Kochi, Malta, Dubai are all examples.

Local intelligence capacity is intrinsically linked to that of the knowledge-based economy where innovation and technology are main drivers of growth and the collective community intelligence, which underlines capacity and networks as main drivers of a community’s success. This requires a planning paradigm pertinent for urban-regional development and innovation management, similar to the related concept of ‘intelligent cities’ (or communities, clusters, districts and multi-cluster territories). By developing sector-focused, cluster-based or more complex intelligent city strategies, territories can set in motion innovation mechanisms of global dimensions and enhance substantially their innovation systems.

**An Approach to Inclusive and Sustainable Cities**

An alternative approach gives profound attention to the role of social and relational capital in urban development. Here, a smart city will be a city whose community has learned to learn, adapt and innovate. This can include a strong focus on the aim to achieve the social inclusion of various urban residents in public services (e.g. Southampton’s smart card) and emphasis on citizen participation in co-design. Sustainability is seen here as a major strategic component of smart cities. The move towards social sustainability can be seen in the integration of e-participation techniques such as online consultation and deliberation over proposed service changes to support the participation of users as citizens in the democratization of decisions taken about future levels of provision.

**Environmental Sustainability** is important in a world where resources are scarce, and where cities are increasingly basing their development and wealth on tourism and natural resources: their exploitation must guarantee the safe and renewable use of natural heritage. This last point is linked to business led development, because the wise balance of growth-enhancing measures, on the one hand, and the protection of weak links, on the other, is a cornerstone for sustainable urban development.

**Smart City as a System**

Contemporary thinking about the integrated sustainable city of the city as a system can only be turned into reality with a smart, integrated approach to both delivery and strategy.

In an interconnected urban system, trees and green walls naturally cool streets and buildings; their green waste can be transformed into energy via anaerobic digestion or similar biological treatment; this energy can be used to power a fleet of street cleaning vehicles; the vehicles can make use of the recycled grey water from nearby apartments; the organic waste from the apartments can be used in greenhouses on the roof; and this can deliver food back to the apartments or the café at street level, and so on. Nutrient cycles are closed, water cycles are closed, energy is transferred from one system to
another, and communities are engaged. Benefits are environmental, social and economic. While smart city thinking can address virtually every walk of life, as indicated by the internet’s extraordinary reach, climate change has substantially focused the thinking around smart cities in terms of reducing GHG emissions.

**Framing of Smart Cities**

A Smart Cities offering is a service for policy makers, executives, city departments, developers, and industry.

![Figure 1](image)

**Strategy and Organization**

It is experienced in developing strategies that reflect priorities for our clients. We produce business cases to establish ongoing viability of projects. Our leadership development ensures that the client’s procurement strategy determines the options on ownership and the best supply chain mix. During implementation we provide technical assurance and programme management to ensure that projects are delivered on time and within budget. We help establish the best way to deliver smart cities.

**Urban Informatics**

Arup can design urban interfaces that help visualize real-time feedback loops of urban activity. These can be engaging design-led installations at a civic or neighborhood scale, behavioral-change strategies, or functional web services for citizens and city officials, making visible the invisible patterns of activity in the city. Informatics provides the public interface onto the smart city.

**Business Systems and Architecture**

Arup designs the broad range of technologies that deliver smart city projects. Our first step is to develop an enterprise architecture including key requirements, information systems and a supporting technical infrastructure. Specifications can then be developed to support costing and tendering. We define the information systems smart cities are built upon.

**Infrastructure**

The design of telecoms infrastructure is a key component of smart solutions. Arup is experienced in the design of infrastructure on major projects. Our capabilities include regulatory strategy, design of fixed ducts and mobile communications infrastructure, and site wide IT services (such as data centers, control room, TV and satellite antennae). Future proofing infrastructure is a defining aspect of smart cities.

**Steps to be Taken by City Leaders to Make their City Smart**

Growth for cities in the twenty-first century will increasingly be driven by people – the skills and knowledge of a highly educated, innovative workforce – and by the ability of citizens and city economies to absorb, commercialize and
extend innovation. Cities that want to thrive will need to plan, invest and work to improve their core systems with this in mind. But how do cities begin to make such improvements, especially in times of extreme financial constraints? There are a few basic steps and consistent guiding principles to help direct them.

**Decide what your City Should be – Determine its Brand**

- Identify the city’s differentiating strengths that will attract skills, knowledge and creativity.
- Create a strategy that emphasizes these strengths.
- Prioritize investments in core systems: transport; government services and education; public safety and health; as well as energy, environmental sustainability, urban planning and design in line with the strategy.

**Adopt Policies Conducive to Skills, Creativity and Knowledge Driven Growth**

- Attract internationally mobile talent by enhancing quality of life services and services responsiveness to changes in demand.
- Create a domestic talent base by offering education services and training, with significant emphasis on investing in education infrastructure.
- Enable better opportunities for deploying skills and abilities to help citizens realize their potential by using better deployment of data collection and analytics on changes in the labor force and skills supply and demand.
- Retain the existing base of talent to reduce potential “brain drain.”

**Optimize Around the Citizen**

- Begin to shift from standardized, uniform services to a model for the delivery of tailored services that meet individual needs.
- Create digital linkage across city core systems and the analysis and actions triggered by patterns in the data.
- Develop a clear and transparent system of user fees and charges that reflects the real costs of providing citizen centric services, thus encouraging both more direct demand for services management by the citizens and lower costs burden on public finances.

**Development and Application of Information Technologies to Improve Core City Systems**

The most important question facing cities, then, is, how do they improve these core systems in the most cost-effective and productive fashion? The answer: focus on leveraging the power of the vast amounts of real-world data they already collect about the behavior patterns of the city’s people and systems, taking care to equip their systems with three basic levels of ability:

- Collect and manage the right kind of data.
- Integrate and analyze the data.
- Based on advanced analysis, optimize the system to achieve desired system behaviors.

**Recognizing Talent:** skills, knowledge, creativity and innovation ability – as an ever more important driver of sustainable growth implies significant changes in how we think about managing and improving cities. It shifts our thinking from appealing to mass audiences to appealing to individual citizens en masse. Modern information technology makes this
seemingly daunting challenge not only practicable, but also, over the long term, cost effective and prudent.

Cities that adopt this thinking and make such wise investments now to build a smarter city can position themselves to thrive. Those that continue to invest in traditional infrastructure improvements designed for a mass population are very likely to struggle.

CONCLUSIONS

In this report we set out the enormous challenges facing cities, the size of the opportunity afforded by the focus being given, worldwide, to addressing those challenges by transforming city infrastructures and city systems, and the key actions needed to seize those opportunities. Growth opportunities lie, no less, at home through smarter approaches to transport management, healthcare and energy. On the back of better connectivity and better access to public information, we can manage cities more effectively, anticipate and solve problems more cost effectively, and raise the economic prospects and the quality of life in every British town and city. In so doing, the UK can strengthen its position as a global hub of expertise at a time when cities throughout the world are seeking innovative solutions to the challenges of urbanization.

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