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Abstract .....	3
Smart Cities in Europe .....	4
Smart Districts as Key to Smart Cities.....	9
Challenges to Develop and Deliver Smart Districts .....	12
Challenges through market barriers: .....	13
Leadership challenges .....	15
Streamlining the Smart City into Urban Development and Management .....	17
References .....	22

## **Abstract**

Since 2010 “Smart Cities” have been increasingly subject to scientific and political debate, leading to an uptake of the smart city concept into wider funding of innovation-oriented urban development programmes at national or EU level. Whilst the larger EU and other nationally led Smart Cities programmes are putting a strong emphasis on technology-based and data-driven development of smart district demonstrators, little emphasis is put on governance structures, processes, business model innovation and integrated action planning to support the actual delivery of results. This article gives an overview over the development of the smart city concept in Europe, discusses different drivers and potentially conflicting interests and points towards the concept of living labs and innovation districts as fruitful test beds for smart cities. The article argues that although implementing early pilot projects and demonstrators, crucial knowledge is lacking at EU level on how to streamline smart solutions into the core-business of urban governance and development. It is further argued that harnessing the full potential of the smart city as a model for sustainable urban growth will require a paradigm shift within public-private collaborations. Our current models of designing, building, financing and operating the city need to be rethought and updated. The article suggests focussing on three core areas of learning that help bring about the transition to a smart city mainstream model: the municipal role in smart city business models and replication, the integrator within the municipality and the systems integrator of smart districts and its role.

## Smart Cities in Europe

Since the 1980's regional and local policymakers throughout Europe have been propagating different approaches to develop cities that are liveable, economically successful and increasingly sustainable. Throughout this quest for "the city of the future" various paradigms hit the urban developers and policy makers like high-frequency Konratieff waves. In the 1990s it was the bottom-up movements of the Local Agenda 21 who tried to push for a more inclusive and sustainable development of cities. Many city authorities incorporated their ideas and shifted the focus to climate change mitigation and sustainable development goals over the years 2000-10. Integrated urban development plans based on the Leipzig Charter and a large set of city-oriented action-networks addressing all sorts of urban challenges were the results of this development. [Polis](#), [Eurocities](#), [Energy cities](#) or the [URBACT](#) city networks are strong and successful examples of this city-induced push for a more sustainable way of developing cities though integrated policies and sustainable action plans.

Around the year 2010 an important paradigm-shift has taken place in the mind-set of city managers, policy makers and industry leaders. Cities realized that building sustainable systems needs to include industry and technology providers to a far greater extent than originally thought. At the same time, the digital revolution made it actually possible to maximize efficiency of urban systems by linking clean technologies, infrastructures, city operators and citizens through smart devices and intelligent services. Businesses identified cities and urban environments as massive new markets and started to introduce apparently tailor-made solutions for the connected and digital city. Data-driven processes are now improving our urban mobility systems and increasingly decentralized energy flows. They help city authorities to take better decisions, save money and have the potential to connect to their communities on a real-time basis. Taken together, this shift of paradigm is the smart city!

Smart cities represent the culmination of a development that is now bringing together local green grass-root movements and Silicon Valley mind-sets. Smart cities promise us: we can build clean, efficient, sustainable and highly attractive cities by at the same time increase economic development. Policy makers across Europe hope that smart cities are the key to bridging the gap between social and ecological sustainability and economic growth. This is the reason why European policy makers today are putting a strong emphasis on the development of smart cities and communities: European Institutions like the European Commission (EC) or the European Investment Bank (EIB) but also national governments increasingly recognize smart cities as key element to achieving the highly ambitious development goals of the EU. With the "European Strategy for Smart, Sustainable and Inclusive Growth" the EU confirmed the 20 x 20 x 20 goals in 2010 and put emphasis on innovation, R&D and the digital economy (European Commission 2010). In its 2050 roadmap, the EC is looking beyond the 2020 objectives and sets out a plan to meet the long-term target of reducing domestic emissions by 80 to 95% by mid-century. Large potentials for reaching this target are seen within urban transport, buildings and energy systems and their respective technology transition (European Commission 8.3.2011). In its White Paper on Transport the EC sets out the goal to have no more conventionally-fuelled cars in cities by 2050 (European Commission 2011) and in October

2014 the European Council concluded on the 2030 Climate and Energy Policy Framework, which sets a binding target of 40% domestic reduction in GHG emissions and at share of renewable energies of at least 27% by 2030 (European Council 2014). At the same time, the EC has identified the completion of the Digital Single Market (DSM) as one of its 10 political priorities and is prospecting to invest 21.4 billion EUR into the digital economy – with cities and urban infrastructures being the key addressees for these investments (European Commission 2015). Taken together, the ICT and sustainability policies of the EC are set to reinforce each other and to culminate in Smart Cities as key areas of growth, markets and investments. Leading heads of the European Investment Bank and attached research institutions are starting to look towards smart cities as instruments for place based investments that would serve to master the transition towards regional specialization and economic prosperity of heterogeneous regions – especially in the less developed parts of Europe (Leanza and Carbonaro 2015).

There is, however, no consensus on what a smart city actually is. The terminology has become a handy vessel that can be filled with whatever the personal perception of a smart city is. For [Vienna](#) – one of the early birds to jump on the smart city train – the Smart City represents the overarching framework for an innovation-driven, resource efficient and liveable city that includes an innovation strategy as well as a sustainability strategy (City of Vienna 2014). For IBM or Cisco (to name just two examples from the corporate world) the Smart City is the perfect playground for the internet of everything: “*The smart city market is as an amalgam of several existing markets, as well as a driver for emerging technologies and solutions that span existing sectors especially smart energy, smart water, smart buildings, smart transportation, and smart government*” (Woods and Goldstein 2014). According to Navigant Research estimates, the global smart city technology market is expected to be worth more than \$27.5 billion annually by 2023, compared to \$8.8 billion in 2014 (Ibid.).

Although the concept of smart cities has emerged from tech-driven ideas about urban utopias and the perfect place of modernity, it now differs from these urban visions in some important ways. From the idea of creating the ideal place for innovating and developing new technologies (Silicon Valley), smart cities have become the target of the application of new technologies. *Although saturated as consumer markets, cities present opportunities for firms seeking markets for modern sensing, forecasting and management technologies.* Although 1990s city policymakers sought to replicate the job base and innovative milieu of high-tech centres, the contemporary purveyors of smart city technologies see city governments as markets for the products of the last 40 years of technology development. At the same time, ambitious politicians and civil servants are ever on the search for the next ‘big idea’ to move their city to the top of the rank of attractive places. The race to get on the bandwagon and become a smart city has encouraged city policymakers to embrace and embed the process of technology-led growth, directing municipal budgets toward investments that bestow smart city status (Glasmeier and Christopherson 2015).

These reinforcing factors result in a joint interest of industry and city authorities to deliver on smart cities, smart districts and smart services for their citizens and customers; yet – when taking a closer look – they reveal some aspects of the challenges that city managers and local governments face in the smart city debate: delivering

competitive local innovation ecosystems and providing healthy and sustainable communities for their citizens and future generations, by entering into new co-operations with industry and resisting the strong business push to sell poorly adapted urban technologies at the same time.

On European level the [Innovation Partnership on Smart Cities and Communities](#) (EIP) is the most important stakeholder platform for co-creating smart cities and corresponding solutions and processes. It is a large and loose network of over 4000 representatives of cities, industry, research, politics and multiplier institutions, which is trying to fill the Smart City Agenda with life. 370 commitments of mixed consortia and six action clusters are working towards a transition pathway that would help the European Smart City Community deliver on the promises of Smart Cities for Europe. Although run and supported by the EC, the EIP is a self-organizing network, which is hard to programme. Thus, it represents an excellent body for discussion and networking, but it is not expected to deliver a consistent and comprehensive Smart City Agenda for Europe. The most important achievement of the EIP so far, was to publish a Smart City Implementation Plan (European Innovation Partnership on Smart Cities and Communities 2013), which became the core strategic document underlying EU-driven Smart Cities initiatives. It defines 11 priority areas with three vertical areas (Sustainable Urban Mobility, Sustainable Districts and Integrated Infrastructures and processes across Energy, ICT and Transport) and eight key horizontal enablers on the themes of Decisions, Insight, and Financing.



Figure 1: Source: (European Innovation Partnership on Smart Cities and Communities)

Together with the Operational Implementation Plan (European Innovation Partnership on Smart Cities and Communities 2014), this document represented the background for a large EU funding programme on Smart Cities and Communities within the research and innovation framework Horizon 2020. In the work programme 2014 / 2015 over 210 Million € were dedicated as grants to large first-of-its-kind demonstration projects for smart districts in European lighthouse cities ([SCC1 projects](#)). Mixed consortia of cities,

research and industry were able to apply for funding in order to create smart lighthouse districts that would actually show urban Europe how to develop and deliver smart cities. While 19 consortia with ca. 120 cities applied in 2014, it was already 43 consortia with more than 250 cities that submitted an application to the EC in 2015. These figures alone show an impressive size of an accelerating movement amongst European cities and businesses towards creating smart districts and delivering on the promises of smart cities for citizens, communities and local economies.

Today, (November 2015) three large smart city lighthouse projects funded through the EC are up and running:

- [Triangulum](#) with Manchester, Eindhoven and Stavanger as Lighthouse cities and Prague, Sabadell and Leipzig as followers.
- [Grow Smarter](#) with Stockholm, Cologne and Barcelona as Lighthouse cities and Valetta, Suceava, Porto, Cork and Graz as followers.
- [Remourban](#) with Valladolid, Nottingham and Tepebasi as Lighthouse Cities and Seraing and Miskolc as followers.

An additional 4-5 lighthouse projects will be announced shortly and several dozens of new consortia are putting together their applications for the SCC1 call in 2016 and 2017. Therefore, this initiative by the EU is arguably the strongest driver of smart cities in Europe today.

Whilst the EU Smart Cities Initiative is putting strong emphasis on technology-based and data-driven development of smart district demonstrators, little emphasis is put on governance structures, processes, business model innovation and integrated action planning to support the actual delivery of results. The considerable amount of public funding for implementing tech-based urban innovations has led to a hectic development of smart city implementation plans across Europe's cities, but this really needs to be thought of as an initial impulse for developing integrated urban development strategies based on sustainable technologies and intelligent solutions, and not as a milestone within a paradigm-shift towards smart cities.

Many cities have responded to the EU call on smart cities and communities by quickly putting together smart city strategies in order to comply with the requirements for application. The strategy papers that have been developed and politically enacted in this process are – without naming any specific city – not living up at all to the full potential of smart cities for Europe. They often refer to a set of desired sustainability measures that are linked into an ICT backbone and supported by an existing (often inadequate and inefficient) governance structure. As beneficial as the EU funding is for the smart city, it has also misguided our focus to over-estimate the actual problem-solving capacity of smart cities and underestimate the complexity and required organizational shift that is needed to make smart cities happen. In addition we tend to neglect potential shortcomings of the merely tech-driven smart cities concept. As Glasmeier writes: many authors [...] *“agree that smart city technologies are ill-suited to solving the problems that lie at the heart of improving the quality of urban life. Poverty is not on the agenda of smart city planners. They may solve traffic problems, but it is not clear how they will regenerate failing schools or find ways to include neighbourhoods facing disinvestment. The contradiction between the promise of smart cities and its limited policy scope is aptly*

*demonstrated in one of the most celebrated smart cities, Rio de Janeiro. The city, with its control centre filled with wall size computer monitors, can perhaps use forecasts of threatening weather to send out warnings of storm intensity thus leading to speedier evacuation. What it does not address is the question of why people build housing in such high-risk environments and what it would take to change this behaviour. In this instance, at least, smart city technologies deal with symptoms rather than the disease” (Glasmeier and Christopherson 2015).*

Our task today, as city managers in Europe, is to fill the smart city vessel with life and to define the European pathway to Smart Cities. We therefore need to acquire sovereignty of definition about the goals and purposes that have us investing into smart cities, as well as about the potentials that the interconnection of new technologies, infrastructures, citizens and local governments actually bear for our communities. Therefore we need to augment the tech- and business driven smart city concept with governance models, investment frameworks and new forms of public-private collaboration. We need to look towards well-developed frameworks like the [triple \(or quadruple\) helix](#) (like for example [Eindhoven](#) is doing), the [sustainability cycle](#) or [sustainability management](#) tools (like [Stockholm](#) is applying) or [energy planning](#) approaches (like [Gothenburg](#) is using) and many other functioning instruments that will help us capitalize on the Smart City in a way that means real added value for our citizens, local economies and the environment.

It makes sense to take a look towards national initiatives on smart and sustainable cities for shaping the European Smart city in a good way. In Germany, a large stakeholder forum ([Nationale Plattform Zukunftsstadt](#)) has released a systems research agenda in February 2015 to transform cities towards becoming CO<sub>2</sub> neutral, energy and resource-efficient and climate-adapted (Nationale Plattform Zukunftsstadt 2015). Led by four ministries, this platform is being transformed into an “Implementation Platform” to initiate, oversee and monitor innovation-oriented projects on future cities that aim at delivering the tools, processes and best practices for cross-sector and cross-stakeholder collaboration on sustainable cities. In addition, the [Morgenstadt Initiative](#) is running a European network of leading cities, companies and research institutes that aims at developing and implementing socio-technical innovations for the city of the future and is using a [City lab approach](#) to develop individual action roadmaps for cities like Prague, Lisbon, Chemnitz or Berlin. To ensure that the UK can make the most of opportunities relating to smart cities, in 2013 the Government established the Smart Cities Forum to bring together cities, industry, sector experts and government departments to identify and address any barriers to development and deployment. With the [Future Cities Catapult](#), the UK has created a global centre of excellence on urban innovations and is investing heavily into applied research and innovation around future cities. The core focus is on promoting healthy cities, building resilience in urban infrastructure, and designing strategies to help cities adopt and finance smarter technologies. Since 2013 the French Government has been investing over 2 bn Euro into [Smart City activities](#) in France, led by the Ministry of sustainable development. In addition, the research and innovation network [advancity](#) is channelling urban innovation between the research and industry and has examined over 450 projects of which more than 158 have received financing, representing a total investment of €460 million in research and innovation for smart cities. Thus, there are numerous initiatives at national level that future smart cities can attach to. These initiatives, however, approach a sustainable urban development



from different backgrounds and thus shade different perspectives on smart cities. A first comparative analysis of Smart Cities in Europe comes to conclude that "...Virtually all cities with a population of over 100,000 in Nordic Member States can be characterised as Smart Cities, as can the majority of cities in Italy, Austria and the Netherlands and approximately half of British, Spanish and French cities. Germany and Poland have relatively few Smart Cities. Eastern European countries generally have a lower incidence of Smart Cities than the rest of EU-28"(DIRECTORATE GENERAL FOR INTERNAL POLICIES 2014).

## Smart Districts as Key to Smart Cities

In today's knowledge-based economy, marked by both unprecedented technological advancement and vigorous competition, the role of innovation is indispensable and cities as forerunners of innovation are of exceptional importance. Dense urban fabric with its high concentration of advanced infrastructure, qualified workforce and advanced commerce furthers interdisciplinary exchange, emergence of social networks, and establishment of new businesses, and thus provides the necessary foundation for unconventional thinking and disruptive innovation. The spatial geography of innovation is now undergoing a major change: as the world is growing increasingly more complex, technology is advancing at an immense pace. The great findings that once were made by single gifted researchers scattered around the globe, in their homes or garages, in the future will more likely be done by teams of experts working in collaboration. A trend of co-working spaces is becoming increasingly more popular: in collaborative spaces, scientists can exchange ideas with each other and have efficient access to everything from legal advice to state-of-the art lab equipment. In the 20th century the landscape of innovation was defined by several large-scale science parks in regions like Silicon Valley in the USA or Sophia Antipolis in France. However, the time of vast, spatially isolated corporate campuses, not accessible by any other means of transportation than a car has now passed. In the 21st century, a new and promising trend is emerging, namely an **innovation district**, which is a product of the current economic, cultural, and demographic forces that are reshaping the contemporary lifestyle.

In contrast to the aforementioned large science parks, smart districts are compact geographical areas within cities, which provide businesses, start-ups, research, educational and cultural institutions with space to form a tight-knit collaborative cluster built on the basis of cutting-edge technology. Physical proximity, ensured mobility and encouraged sense of community help entrepreneurs, scientists and students to work together, share ideas and technologies to promote „open innovation“. Networking is the key asset, replacing previous economic models of dispersed industries, sectors and specializations. Innovation districts pave the way for new transformative collaborations and creations by people and companies who might have never found common ground before, now see no obstacles for joint creative development via the convergence of disparate sectors and specializations. This dynamic physical realm, densely informed with innovative ideas inevitably causes knowledge spill over and acts as a catalyst for economic development in the region. Innovation districts make it easier to overcome

bureaucratic gaps which slow down new projects, and hinder new businesses such as finding financial and legal aid for start-ups.

This new model brings much-needed change to the way we have become accustomed to view urban social and economic development. The fundamental element of any city are the people that inhabit it – and people are looking for places where work, education, culture and social interaction are linked together by easily accessible means. The contemporary knowledge-based economy is hugely defined by the needs of Generation Y: for them work ceases to be in the first place a means of material support, rather they attach great value to deriving pleasure from their work, to realizing their personal ambitions and aspirations, to inspiring workplace environment, as well as to the exchange of ideas.

Innovation districts provide their citizens not only with open and creative working spaces, but also with suitable residential facilities if required. These modern enclaves follow the principles of sustainability when it comes to environment: intelligent energy management helps foster environmentally friendly and cost-effective energy use, while e-mobility and bicycle routes solve environmental problems caused by traffic and allow for a more effective time use. Living conditions offer a mix of options including affordable housing and efficient infrastructure, thus local residents are focused on achievements and progress, rather than on rent and living costs. New talents will inevitably be attracted by open, clean and functional working and living spaces, giving blood flow to the whole body of the city. The establishment of such innovation hubs is essential for successful economic development in the 21st century. Existing resources must be used in the smartest way possible, offering effective solutions to socio-economic problems caused by recent financial crises. One of the most prominent among these problems is unemployment: many people, including aspiring scientists and entrepreneurs, have lost jobs. The development of Smart Districts entails rapid job creation. Convergence economy with lowered external costs fosters dynamic business development and expansion, creating an extensive amount of high-quality jobs. Furthermore, smart districts offer numerous educational opportunities for all socio-economic backgrounds, making them skilled competitors on the job market. In strict fiscal terms, innovation districts are **beneficial for municipal governments** as they help increase the tax revenue by the commercialization of ideas that leads to the creation and expansion of firms and jobs via proximity and collaboration. Increased tax revenue may be used for better municipal development ensuring successful functioning of a lucrative self-sufficient economic model. This accounts not only for the innovative neighbourhood itself: the spill over effects are likely to improve the economic standing of the whole city and region.

The potential benefits of smart districts for local communities go hand-in-hand with a new approach to innovations of complex systems, which has started to increasingly gain traction among business innovators, open-innovation communities and even large-scale infrastructure developers: the idea of **Living Labs**. As we have seen, creating a smart city is a highly complex undertaking and needs to build on innovative technologies as well as on innovative planning processes and new stakeholder constellations. Political, spatial, economic, environmental, social etc. parameters need to be taken into account. Complexity science and transition management tell us that a successful form of creating complex systems is to start with small experiments and start scaling up from there.

*„The premise of the Living Lab is that the city can be used as a real-world testing ground for new ideas and technologies. A vast array of sensors in the urban realm can facilitate the testing of products and services on a real world platform, Schumacher and Feurstein define it as a research methodology for sensing, validating and refining complex solutions in multiple and evolving real life contexts.“ (Cosgrave 2013 et al. 2013, S 671)*

Smart districts that serve as living labs for socio-technical interactions bare the potential to show us the way to the city of the future. City districts provide the right scale for technologies and other system interventions that are neither too small to suffer from cost-effectiveness issues nor too large to suffer from planning and invasiveness issues. They provide well-bounded spaces to undertake radical change and evaluate the impacts of that change.

**Smart districts** combine the orientation towards a research-oriented knowledge-economy of innovation districts and the experimental character of living labs. Smart districts are thus in essence the places where the social, economic and technological model for the city of the future can be designed, tested and improved in new forms of collaboration between city administrations, businesses, citizens and research. Taken together, smart districts are the incubators of the smart city.

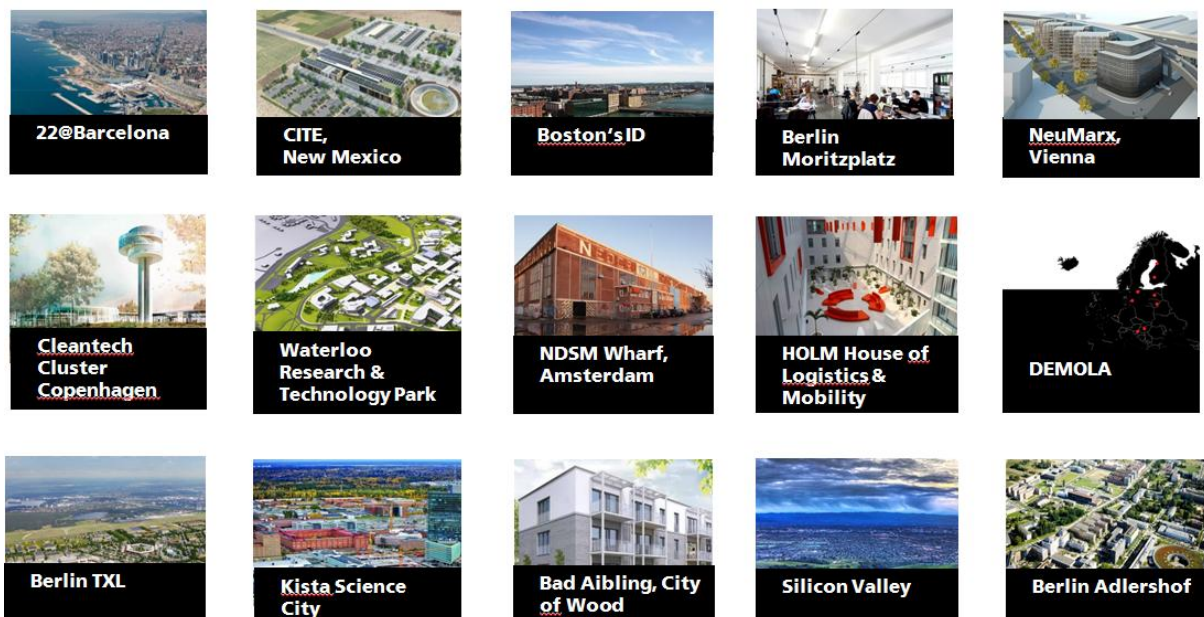


Figure 2 Smart city exemplars

Already today there are numerous good examples from districts across Europe and worldwide where an innovation-oriented economy meets conditions for experimenting with new urban technologies in a real-life environment. The proceeding graph gives an overview over existing best practices of smart districts across the world. Some of them have already been realized, others are still within a planning stage.

The key challenge in creating smart districts is to align four core levels of district development in innovative project consortia:

- The technology and infrastructure level,
- the socio-economic strategy level
- the governance and management level
- and the availability of finance

It has been noticed before that especially in smart districts a range of elements converge that make project development and implementation with conventional approaches difficult – and often impossible. These are not only conflicting goals between various stakeholders, more than this the challenge lies in providing new value added services to citizens in a stable and reliable manner, when the best environment for developing and testing new products and services is characterized through low degrees of formalization and less-binding mechanisms of accountability (Concilio and Molinari 2015). Chapter 3 deals in more detail with the different kinds of risks and barriers that hinder the development of smart districts today.

This general challenge of conflicting goals and badly matching requirements at the level of different stakeholders, results in a set of risks and barriers that make it difficult to plan, develop and deliver smart districts through a well-formed and commonly agreed upon approach. Up until now, there is no blueprint for developing smart districts. This is the reason, why creating smart districts has been recognized as one key area of public funding by the EU Commission, which is supporting the development of European Lighthouse districts in ca. 20 – 30 cities across Europe with ca. 400 Mio EUR through Horizon 2020 between 2014 and 2017. Cities like Manchester, Eindhoven, Stavanger, Stockholm, Barcelona, Cologne etc. have been selected throughout H2020 as SCC1 lighthouse cities and have received substantial funding to implement a set of highly innovative technologies and socio-technical systems for the development of smart districts. Yet, as indicated above, this funding is at risk not leverage the full potential of smart districts, because the paradigm shift in urban governance, urban financing, urban business innovation etc. has not been addressed adequately by accompanying measures at EU level. The H2020 Lighthouse cities are thus not only the testbeds for smart districts; they are also the guinea-pigs to discover, test and improve a new governance and business innovation approach to urban development.

## **Challenges to Develop and Deliver Smart Districts**

As we have seen, concepts and technologies for planning and realizing sustainable urban systems not only offer solutions to the many challenges of an urbanizing world, they also bear the potential to unlock significant future markets. Yet most cities are struggling with the process of transformation and businesses have so far not been able to harness the full potential of the sustainable city as a future market.

This is partly due to a range of new challenges that cities, citizens and companies face when trying to respond to the challenges of a smart city. Along with the design of urban systems solutions, cities, citizens and companies need to find new ways of collaboration and mutual engagement. Cities increasingly have to deal with complex systems that are cross-sectoral and dynamic. They aim at meeting goals that cannot be directly tied to specific technologies, but are highly ambitious and require collaboration across all

departments and sectors (e.g. achieving carbon neutrality, reduction of individual mobility, increasing resilience, etc.). Until now, no standard approach exists for companies to address cities as customers by tailoring their products to cities' needs in an efficient way without encountering major risks. The result is a range of corporate sales strategies for single products that are unable to cover the complex demand a city faces when attempting to implement more sustainable approaches to development. Business and research institutions need support from city officials and civil society to understand the real needs and demands of cities. Conversely, cities require support from researchers and business to identify the right set of technologies, business models and services that will help achieve these objectives.

Smart city solutions are characterized through a range of factors that make it impossible to use conventional business models and well-tested technology approaches. Developing smart cities in fact means that local governments and city administrations need to become innovators, just like companies need to discover their corporate share in urban governance. The following list of challenges for developing, implementing and operating smart districts and smart cities is based on a range of surveys, personal interviews, group discussions and personal experiences as co-ordinator of large multi-stakeholder smart city consortia. It is not deemed to be exhaustive but should give a good overview over the current state of smart city challenges in cities and corporations across Europe. The main challenges are structured into three larger categories:

- a) challenges through market barriers,
- b) organisational challenges,
- c) leadership challenges.

### **Challenges through market barriers:**

- Integration of innovative technologies has often **not been tested** and standards are missing. This lacking precedence means high risk for investment and unsecure ROI, leading to a situation, where conventional investment schemes fail and risks are neither taken by investors nor by the city.
- **Cash-flow models are not clear yet** – especially in complex stakeholder constellations, which are characteristic for smart and distributed solutions. In addition, different national landscapes for incentivising technologies like renewable energies (feed in tariffs) or electric vehicles prevent consortia from developing one-size-fits-all solutions.
- **Business models fail** in the face of complex urban systems solutions. This is due to two main reasons: a) sustainable technologies often have their largest gains within external costs (reduction of emissions, pollutions, noise, resource consumption etc.). If they are not factored in to the business model e.g. via government incentives, pigouvian taxes or cap-and-trade systems, they are unable to compete against conventional solutions, unless the service model is strikingly better and the achieved benefits are noticeably higher. However b) as complexity of solutions rises, more stakeholders are needed to develop,

implement, operate and maintain smart city solutions, which reduces the likelihood of an even distribution of benefits across all stakeholders, leading to unbalanced cost-benefit models and therefore to uneven investment incentives.

- **Standards** and **interoperability of systems** are lacking. There is little security of planning and transaction costs for smart city consortia are high, since they are not able to refer to existing architectures, communication protocols and standards.
- Many companies have not realized that own smart city products and business solutions need to be **embedded within larger systems**. New forms of collaboration, open innovation and co-creation need to be learned by these companies.

## Organisational challenges

- Most companies still think in products not in holistic solutions to larger needs and problems. They have a classic sales perspective that is output driven not demand oriented. However, in order to address cities as customers, companies must reinvent their sales strategies. No single products but systems-solutions to existing problems and needs are what cities want. The better a company can prove how their solutions contribute to the goals of the city; the higher it will be ranked as development partner. This, however, requires a deeper understanding of the city and its aims and problems (which are often individual). Instead of focusing on selling ones product portfolio, business-to-city (B2C) business means to constantly realign and reinvent ones solutions portfolio with cities' needs and demands. **Eco-systems of businesses, technologies and services** become more important, but companies are hesitant to truly open up to new partners.
- Virtually no company sees itself as **systems-integrator** of smart city technologies and services. Neither do city administrations, nor municipal service providers. Thus there is a vacuum when it comes to designing, coordinating and leading integrated smart city projects.
- Equally, most companies that aim to address the smart city market are not prepared to become **systems operators**. Since the actual benefits of smart city solutions for users, local economies and the environment consist in increasing the share of using connected systems and lowering the share of owning individual products, the operational model (and with this also organizational structures like sales, marketing and corporate responsibility) change drastically. The operators of smart city systems and the corresponding networks of companies and municipal representations have not yet been identified or developed.
- Far too often city administrations **still think and act in silos**. They are structured in silos and give actors a hard time who want to push for integrated projects and solutions since cross-coordination between departments often needs

to be built from scratch. The **smart city integrator** who is missing at corporate level is also missing within local governments.

What makes it even harder– there is no standard for organizing municipalities. This results in a broad variety of departments and offices across cities. Departments and offices are named differently and have different responsibilities in virtually every city. According to the administration's structure, the responsible managers for traffic, smart city, urban development, economic development, sustainability etc. are found in different departments. This causes barriers, e.g. when industrial partners need not only identify these managers across the city administration, but also get in touch with a number of them to reach one goal. The organizational pathway to deliver smart cities at local government level, thus needs to consist in local organizational innovation and change management processes rather than being able to adopt a blueprint for smart city organization.

Leading cities have developed a set of different strategies for dealing with complex cross-cutting issues and to escape the silo-dilemma. Some cities install cross-sectoral departments (New York City), some create special staff units (Ludwigsburg), others install rather informal inter-departmental work groups (Freiburg), and again others outsource the responsibility to semi-autonomous project companies (Vienna) etc. Depending on the city's approach to deal with cross-cutting issues, elements like smart districts, innovation leadership, sustainability, resilience etc. are emphasized and addressed differently. Creating a cross-sectoral structure that is able to bridge the silo-organization of city administrations is one of the most important success factor for pushing for the delivery of smart districts.

## Leadership challenges

- **Political leadership is missing.** Building smart districts means long-term investment and it requires the will to test something new. Many city leaders today are afraid of overstraining their citizens with new and innovative approaches that actually cost money and have not been thoroughly tested somewhere else before – especially if this means to push for an organizational shift within municipalities or to bet on an unclear return on investment. We are therefore seeing multiple challenges at the political leadership level of cities that make it difficult to have mayors buy in to smart city developments. Yet, if the top-level decision makers do not buy-in, there is little chance to push for a successful development of smart districts on the ground.
- Often no **real partnership** between cities and companies exist, since in some cases procurement regulations prevent close partnerships and in other cases the ways of thinking and acting are very different. When understanding a company and the city as part of a larger value model, city administrations and municipal stakeholders automatically start to become partners instead of customers. This shift in perception is of high importance since it means that urban solutions are co-created and fitted to the actual market, allowing for a rapid market uptake and providing support from the political and administrative realm. Full deployment of

the triple helix model means that there is a continuum between politics, administration and private sector, linking these players as partners with equal importance but different roles within the value model of a city.

- Cities need support in **creating sustainable value**. But opposed to business understanding, value for cities is not confined to business value – it also refers to a sustainable development, a healthy environment, socially viable solutions and long-term stability of infrastructure and economy. In economic terms large parts of the benefits of smart and sustainable urban technologies are achieved by reducing external effects and by creating socio-technical capital. This leads to difficult cash-flow models and unsecure investments. To actually identify the value of smart solutions and smart districts, companies and cities need to start thinking in **holistic value models** that reflect the complex benefits for environment, society, economy and a resilient city.

Companies and cities thus need to start thinking beyond business models and mere social welfare and understand themselves as part of a larger value model that delivers value added services to cities and citizens, creating value that reaches far beyond a monetary return on investment. In a second step smart city value models need to be transferred into business cases for corporate players. Today, however, many corporate players fail to address the real value of smart cities, since they start with their business model right away.

These different challenges to developing and operating smart districts in European cities can be found in any city in differing forms of representation. They can be described as serious risks to successfully delivering smart districts and to help the market for smart city solutions take off. Due to a lack of experience with the development of smart districts and a corresponding scientific monitoring of processes, there is no comprehensive overview over the barriers and risks that are related to the development and implementation of smart districts and there is no toolkit or basket of risk-reduction strategies and instruments that would help stakeholders identify the right strategies and measures to provide for good organisational, financial and technology-oriented measures to overcome the barriers and counter the risks.

The URBACT network SmartImpact will serve to develop a basket of measures for risk mitigation and overcoming the barriers for the development and implementation of smart districts along the concrete demands of partner cities in the network. To this end partner cities will work to identify current challenges and barriers in their own quest to develop smart districts, learn from each other and global best practices on smart districts and develop and test new approaches for a deployment of innovative processes, partnerships, business models and socio-technical solutions.



## Streamlining the Smart City into Urban Development and Management

As we have seen, many cities across Europe have started to successfully implement first pilot projects for smart cities and smart districts. Wherever these projects do not rely on a well-established efficiency model or are supported by a strong regulatory framework or government incentives, the implemented solutions still fail to build on viable business models that would allow for an easy replication under market conditions.

Through EU funding a range of barriers have been overcome within the Smart Cities and Communities Lighthouse projects (Triangulum, GrowSmarter, RemoUrban etc.) leading to a successful implementation of a broad range of smart city technologies in these cities. In absence of a viable business model EU funding closes the investment gap. However, the funding is directed towards a technology-based and data-driven development of smart district demonstrators. Little emphasis is put on governance structures, processes, business model innovation and integrated action planning to support the actual delivery of results. This shows that the EU Commission actually treats Smart City solutions in an equal manner like conventional innovations. It reveals the implicit EC hypothesis that a successful proof of concept is sufficient to spur private investments into smart city solutions. It however neglects, that Smart Urban solutions represent a fundamentally new approach of developing, implementing and operating cities and thus also need a fundamental paradigm shift with regards to business model innovation in complex public-private stakeholder environments. Up until today we are basing our investments into clean technologies on two models – the efficiency model and the policy model:

- The **efficiency model** is largely distributed and applied with clean technologies. Efficient devices like efficient motors, CHP power stations, LED lights, AAA+ electronic devices, water saving shower heads, isolated houses or the use of heat pumps are examples for efficiency technologies. The main innovation of the efficiency model lies within one single piece of technology or one clearly defined product. This makes market uptake rather easy.
- The **policy model** is strongly used in creating renewable energies and energy markets, or for overcoming lock-in structures of established socio-technical systems. We encounter it wherever governments seek to support politically desired technologies and there is a financial gap between the efficiency model and a profitable business model. The investor then invests into the clean technology and receives an additional bonus (in terms of granted return on invest or investment support) that allows for a profitable return on invest. Examples for this are feed in tariffs for solar and wind energy, subsidies for electric vehicles or market regulations like taxes, **fees** (e.g. for polluting cars), **caps** (e.g. emissions trading schemes) or **bans** (e.g. for FCKW).

Up until now, these models, the **efficiency model** and the **policy model** are the only economic models for incentivising investments into clean technologies and for developing the markets of clean tech. Smart city solutions draw on both these models. However,

smart city solutions are inherently different to the incumbent solutions, since they aim to link multiple technologies and multiple stakeholders from public and private by an ICT based connector. With digitalization and the Internet of Things (IoT) a new organizational and economic model for connected clean and efficient technologies needs to be developed and it will be substantially different from the two incumbent approaches towards financing clean technologies – the efficiency and the policy model.

Intelligent solutions that connect a range of technologies for a larger benefit not only have the potential to drastically increase efficiency, they also produce a range of additional benefits for many different actors. An **electric car-sharing** solution for example reduces noise in cities, frees up urban space, reduces emissions and increases personal mobility for everyone. A **hybrid district energy grid** reduces fossil fuel consumption, maximizes clean energy use, achieves cost effective production use and storage of energy through intelligent balancing schemes and increases the liveability for city dwellers that have electricity and heat at their demand at any time.

What is substantially different in this model is the interlinked and connected nature of the systems solutions that are able to achieve these effects. It is not one single technology, but rather a set of socio-technical systems that need to interact in an intelligent way, in order to deliver a broad set of benefits to an individual network of beneficiaries. The sustainability potential of these solutions cannot be harnessed through conventional business models and regulations or subsidies. New approaches are needed today to prove the potential of smart and connected solutions and to develop collective investment schemes that relate individual benefits with joint investments. The reason for this is the new interconnected nature of smart cities solutions. Multiple stakeholders from the public (municipalities, municipal enterprises, state-owned agencies etc.) and the private realm need to collaborate in a close way, sharing data, costs, benefits and responsibilities in a complex way. Neither of these organizations is set to do so in an easy manner. A public authority that is programmed to maximize efficiency of tax-money will not take on responsibility for private investment fall outs of single companies, neither will private companies easily disclose sensitive information about own business models, technologies and go-to-market strategies. **In essence, the role of the systems integrator is vacant.** We have not foreseen it in our conventional way of doing business. The systems integrator needs to bring public and private stakeholders as well as citizens and research into joint consortia with shared risks and benefits – and he needs to make sure the benefits outweigh the costs for each actor that is needed to deliver a successful smart city solution under market conditions.

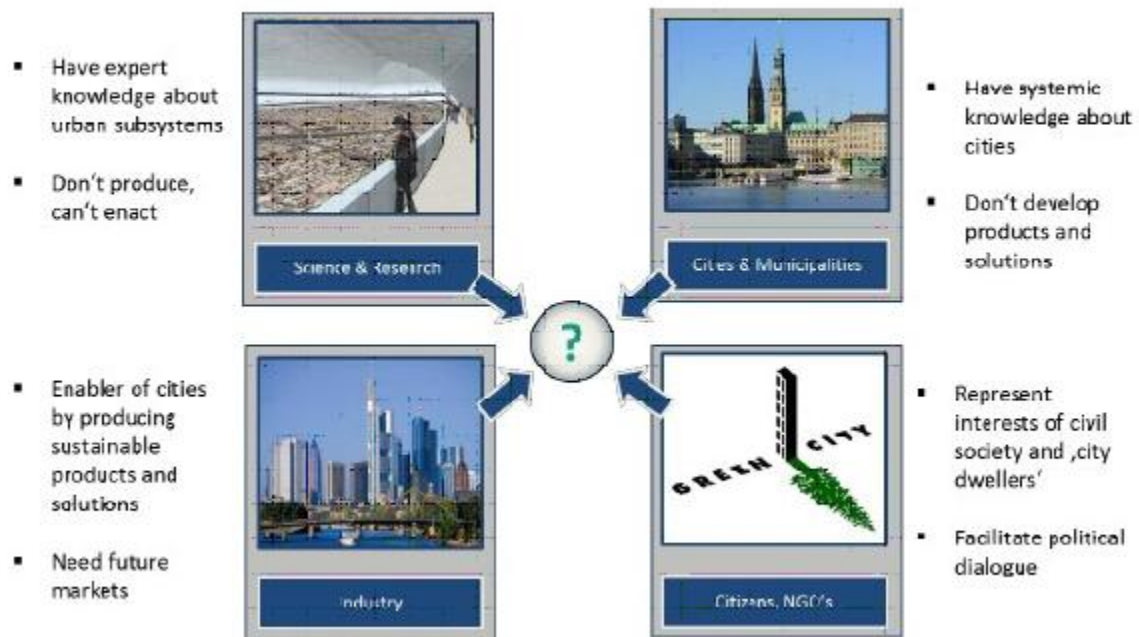


Figure 3: The missing link – interconnection of smart city stakeholders

Smart City demonstrators that have been funded with national or EU grants forced the participating parties to organize themselves in a way that would facilitate the delivery of solutions. Still most consortia that receive public funding are struggling to find the right way forward and to get the most out of their organization. Yet, an important first step has been made.

We have arrived at the point, where businesses and municipalities both are in need for streamlining and upscaling the smart city pilot projects and demonstrators into their core business. Companies want to develop scalable business cases that would help capitalize on the investments that went into the demonstration projects and municipalities want to understand the consequences of streamlining the smart city into their daily agenda for organization, budgets and procurement.

**In essence, cities and companies across Europe are looking for a smart city replication model that would build on a new form of inter-organizational learning from existing first pilot projects and demonstrators.**

It is unquestioned that a new replication model for smart cities will require all stakeholders – business, politics, administration, research and citizens – to adapt and to develop new organizational, economic and process models. At this point we put special emphasis on the role of municipalities in bringing about the change that is necessary for streamlining smart city business into the development and management processes for their cities. Especially the role of municipalities needs reshaping and updating in the face of rapidly changing environments of urban development and an increased necessity to put private money to work for achieving municipal goals.

The new role of the municipality refers to a set of new challenges that need to be dealt with within the political and administrative leadership system of cities, in order to respond to the challenges of the smart city.



Figure 4: Elements of a new municipal role

In a much quoted recent [article](#) Bill Gates emphasizes that the private sector is unable to deal with complex challenges involving common goods like climate change (Bennet 2015). This, in essence, resembles the Nobel-prize awarded research of Elinor Osborn, who showed that the effective management of a natural resource often requires 'polycentric' systems of governance where various entities have some role in the process (Ostrom). Government may play a role in some circumstances, perhaps by providing information to resource users or by assisting enforcement processes through court systems. In cities public infrastructure, public space, air, water, greenery, traffic flows, public safety, street lighting etc. are no depletable natural resources, but they still are common goods that are subject to rivalrousness and therefore need to be governed. In the smart city these goods are becoming linked through another good, whose nature is ambiguous: data. Data is sometimes open (public good) and sometimes only accessible for its owner (private good), which exponentially increases the complexity of accessing, using and benefiting from goods that are part of a smart city. It even questions which goods are public and which are private in a city. Up until now there is no standardized regulatory framework that would be able to deal with this.

Arguing with Elinor Ostrom, each city will need to find its own way of dealing with this dilemma of the commons in the smart city. Yet, municipalities can learn from each other and exchange best practices on what approaches to governing the smart city might work better than others. The URBACT III network **SmartImpact** will deal with this question and support municipalities in their quest for suitable governance models and business models that would allow for an uptake of connected and technology based solutions for a sustainable development of the cities.

It will thereby focus on three core areas that help deal with the challenges outlined above:

### **1. The municipal role in smart city business models and replication**

Smart solutions operate in the private realm and in the public realm. This implies that smart solutions create benefits for different kinds of stakeholders, amongst which the municipality is a core stakeholder. The benefits of smart solutions for municipalities are broad, but they are often difficult to measure and they differ from solution to solution individually. Working with a concept of Smart City Modules will allow the SmartImpact network to identify costs, benefits, risks and the necessary preconditions for a broad range of smart city solutions. This then will lead to a much better understanding of the municipal role in financing, co-ordinating, implementing and operating different smart city solutions. Ultimately it will allow for categorizing Smart City solutions according to their costs and benefits for cities.

### **2. The integrator within the municipality**

Which institutions and structures are most likely to successfully co-ordinate cross-departmental collaboration within the city administrations? Municipalities are dealing with this question in differing ways and come to different organizational and political solutions. Looking at the broad spectrum of organizational approaches within the city administrations will help to understand what structures and frameworks increase the likelihood of successfully delivering on planning, procuring and monitoring complex systems solutions that touch upon various departments and offices (energy, lighting, traffic, waste, public space etc.).

### **3. The Smart City integrator and its role**

Is the municipality the actor that designs, builds, finances and operates smart districts? In most cases it is not. Larger smart city projects that involve infrastructure and real estate need a strong municipal partner but are most often delivered by private entities. But who is the integrator that connects companies, investors, users and the municipality into a systemic process of jointly designing, building, financing and operating semi-public solutions and services? Discussing existing examples of smart city integrators and finding the right approach for all involved cities will help streamline the development and implementation of smart city solutions into the core business of the cities.

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