Intelligent governance of large urban systems
For the first time in history, a majority of mankind are living in cities. While the continuous flow of technological innovations goes a long way in solving some of the pressing issues brought by this massive urbanization, the “software” required to adequately address this radical transformation - the institutional framework - often lags behind. Fortunately, as this edition of NIQ shows, multiple initiatives including an active involvement of the citizens have been undertaken to tackle some of the challenges.

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P.S.: This edition of NIQ marks the end of my editorship. Future editions will be under the expertise of Aris Christodoulou (<aris.christodoulou@epfl.ch>)

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Dossier

3 EDITORIAL
Intelligent governance of large urban systems
Guest editor: Matthias Finger and Mohamad Ali Mahfouz

4 MULTI-SECTOR
Cognitive cities and intelligent urban governance
Ali Mostashari, Friedrich Arnold, Mo Mansouri, and Matthias Finger

8 MULTI-SECTOR
New challenges in the evaluation of Smart Cities
Patrizia Lombardi

11 TRANSPORT
Intelligent governance of large urban systems: What is at stake regarding transport issues?
Yves Amsler

15 CASE STUDY
Comparative performance assessment of Smart Cities around the North Sea basin
Andrea Caragliu, Chiara del Bo, Karima Kourtit and Peter Nijkamp

18 CASE STUDY
SCRAN: Assembling a community of practice for standardizing the transformation of eGovernment services
Mark Deakin

22 CASE STUDY
Supporting sustainability through smart infrastructures: the case of the city of Amsterdam
Joost Brinkman

Articles

26 ICT
Innovative ICT solutions for monitoring and facilitating international trade
Eveline van Stijn, Bram Klievink and Yao-Hua Tan

30 Books

31 Conferences

34 Announcements
Intelligent governance of large urban systems

Matthias Finger\textsuperscript{a} and Mohamad Ali Mahfouz\textsuperscript{b}

With urban population expected to reach 70\% by 2050 and the number of megacities (10 Mio.+ inhabitants) expected to increase to 30 by 2025, unprecedented problems are raised in matters of planning, developing, managing, and governing urban infrastructures (e.g., energy, transport, water, waste, and communications) to sustainably and cost effectively provide the necessary resources and services to urban dwellers.

In parallel, cities are becoming relevant political and institutional actors, next to and sometimes even more importantly than nation-states. Similarly, associations of cities evolve into global actors, next to and sometimes even more importantly than inter-governmental organizations.

Also, Information and Communication Technologies (ICTs) are rapidly and systematically being deployed in urban infrastructures (e.g., sensors, RFIDs, cameras) as well as among users and citizens more generally (e.g., smartphones), generating enormous amounts of data.

In parallel, users and citizens become ever more active participants in urban decision-making, be in matters of planning or interactive usage of the infrastructures.

All four above trends combined lead to unprecedented challenges of and opportunities for the governance of urban infrastructures, combining the omnipresence of the ICTs with the active involvement of urban users and citizens in collective problem solving.

This edition of the Network Industries Quarterly focuses on the Intelligent Governance of Large Urban Systems (IGLUS), specifically looking into the use of ICTs for managing complex urban infrastructures such as power, water or transport. While this edition’s focus is closely aligned with the increasing global interest often referred to as “smart city” or “digital city”, it provides new points of views or angles such as the use of citizens as sensors for urban infrastructure operational performance in what Mostashari et al referred to as a “cognitive city”, or the use of an Analytic Network Process (ANP) model for evaluating policy visions of smart cities as described by Lombardi.

Other detailed topics include a description by Amsler of the current obstacles in large urban transport systems with a series of potential guidelines to alleviate those challenges, as well as a series of thematic case studies on smart cities implementations in different geographic areas such as the North Sea basin, or on the Amsterdam Smart City project covering some of its technological and governance challenges.

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Cognitive cities and intelligent urban governance

Ali Mostashari, Friedrich Arnold, Mo Mansouri and Matthias Finger

In a cognitive city, the citizen becomes an active element of urban governance, not only through civic participation, but also through serving as a sensor for the operational state of the urban infrastructure.

Providing adequate services to the megacities of the future requires a fundamental rethinking of urban governance. Leveraging information technology and imbedded intelligence, coupled with innovative service provision and governance structures, can allow cities to deal with the complexities of the fundamental shift from a nation-state mindset to cities as the centers of global competition and cooperation. This has resulted in an increasing interest in concepts such as “wired city”, “smart city”, “intelligent city”, “digital city” (Hollands, 2008) and, as we propose in this article, “cognitive city”. We distinguish the term cognitive from all the other variants of information-centric cities by the fact that cognition also implies the existence of learning, memory creation and experience retrieval for continuously improving urban governance.

Cognition and urban systems

Mitola (2000: 4) defines a cognitive system as follows: “Cognition centric systems, briefly, are systems with many richly interacting adaptive components that include human beings and other cognitive entities with sufficient awareness, reconfigurability, learning, language, autonomy, and cooperation capabilities at multiple scales to adaptively yet predictably synthesize the intended sustainable, responsible individual and collective behaviors”. This applies quite well to networked infrastructure systems such as transportation, energy, telecommunications, emergency services and utilities among others. Such networks, when enabled cognitively, “can perceive current network conditions, and then plan, decide and act on those conditions. The network can learn from these adaptations and use them to make future decisions, all while taking into account end-to-end goals.” (Thomas et al., 2006)

The cognitive ability of a system allows the system to deal with complex operational environments much more efficiently (Sheard and Mostashari, 2009) and allows past experience to be leveraged for improved responses to changes in the environment. A cognitive system can be defined as one that is able to behave in the following manner (Mostashari et al., 2011):

- Sense individual internal and external changes
- Perceive the overall picture that these changes represent
- Associate the new situation with past experienced situations and identifying potential responses
- Plan various alternatives in response to the change within a given response timeline
- Choose a course of action that seems best suited to the situation
- Take action by adjusting resources and outcomes to meet new needs and requirements
- Monitor the behavior of the action taken and learn from its impact

In short, a cognitive system is one that learns and adapts its behavior based on past experiences and is able to sense, understand and respond to changes in its environment. It is important to realize the role of the individual citizen and social institutions in making a city more cognitive. In fact, one of the distinguishing characteristics of a cognitive city with strictly sensor-ridden urban infrastructure is the need for a paradigm shift of how a city is governed and how decisions flow across various stakeholder environments.

Citizens as human sensor networks

The ubiquitous availability of smartphones in many countries heralds an era where individual citizens can act as sensors for urban service performance in real time. Current existing apps on smart phones already provide one-directional information to travelers on traffic conditions, accidents, service outages, etc. on the supply side of urban infrastructure services. In the cognitive

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context, there would also be information flow from the citizens (service users) to service providers on the consumption side of such services.

An important consideration for leveraging citizens as information providers in the urban environment is the issue of data privacy and security. This is an important area of research and policy within the cognitive city context. However, if only 1-2% of the urban population is willing to play an active role in the cognitive grid in exchange for better information access on urban infrastructure services, the implications would be dramatic. The details of such information exchanges have to be worked out in detail in each case, but current research at our research group focuses on frameworks and tools that enable such discussions between city governments and their constituents.

Cognition and intelligent urban governance
We define urban governance as the collective set of processes by which service provision and consumption is dynamically negotiated and adjusted by all relevant stakeholders (government actors, infrastructure service providers, as well as individual and corporate citizens). Governance in an urban environment is complicated by the fact that the interests of the various stakeholders are either ill-defined or non-aligned with one another. This type of complexity (called evaluative complexity) often means there is no optimal solution to a system, but that a satisficing solution will need to be explicitly or implicitly negotiated among stakeholders (Mostashhari and Sussman, 2009). An illustrative example of this may be a transportation service for the elderly, where the municipal transportation agency might value efficiency (timeliness and cost) and the elderly customers might value being treated with dignity and respect. Another example might be the potential conflicts between economic growth and environmental sustainability.

Hence in order to make effective governance possible, it is important to have a variety of key performance parameters (KPPs) for each infrastructure system that encompasses the different needs of diverse stakeholders within the urban context. Additionally, there are overall systemic KPPs that need to be defined that can assess the state of urban infrastructure service provision in the short, medium and long-term. In the real-time realm the focus is on immediate (operational) response to situations, whereas in the medium and long-term the focus is on continuous improvement of the overall quality of the lives of citizens. Cognition plays a role within all these three timeframes. In particular, cognition allows cities and stakeholders to see the impact of policies over the medium and longer term horizon on the performance metrics of interest to the stakeholders.

Figure 1 shows the flow of data, analysis and decisions between the infrastructure systems, the data collection centers and the stakeholders (users) in the case of the urban transportation infrastructure. Similar flows can be mapped for energy, telecommunications, emergency services, water systems and other urban infrastructure services. Here the users are actors and the centers represent different functions for which the key performance parameters are measured.

![Figure 1](image-url)
Integrating cognition in urban service processes

Mostashari et al (2011) developed a cognitive process architecture framework (CPAF) that allows individual system processes to become more cognitive. The framework was initially applied to a seaport, but can be applied to any large-scale infrastructure network. This process-based approach has the advantage that a city can gradually implement cognition by prioritizing its most important service processes. The CPAF framework is outlined in Figure 2 and includes a cognitive architecture (design) stage and a cognitive process (operational) stage that interact on a constant basis. In the cognitive architecture stage, the key performance parameters are agreed upon by a group of stakeholders and key environmental parameters (general contextual conditions that can be considered inputs to the system) are also identified. Based on the desired KPPs and KEPs, the sensor architecture (including types, locations and network configuration) is designed and contextual scenarios of infrastructure systems performance under different environmental parameters can be constructed. Actions related to dealing with these scenarios can be defined and the relevant actors identified. In the cognitive process stage the system becomes operational and measures any changes to the KPPs and KEPs, identifies what scenarios such changes represent, uses its past experience to develop response alternatives, makes tradeoffs based on stakeholder values and implements the action. By monitoring the results of the action and learning heuristically over time, the architecture becomes enriched with additional scenarios and the cognitive process starts anew.

Institutional changes for intelligent governance of cities

A cognitive city changes the way it is governed, as citizens become active data generators but also active consumers of urban information. The transparency that a cognitive city provides will put the burden of performance on the shoulders of urban service providers, but it will also result in more efficient and effective resource allocation decisions. This is a fundamental cultural shift that goes beyond sensor technologies and machine learning.

Additionally, the issue of diverse stakeholder
values will make a unified, objective measurement of urban performance very challenging. Instead, it is more likely that in a cognitive city stakeholders will choose their own set of performance metrics of interest in assessing how well urban infrastructure services are provided. Many of these metrics may not be measurable through technological sensors, but may be provided by human sensors (qualitative assessments by citizens). Together these metrics can provide a more holistic perspective on the performance of urban areas.

Conclusion
The cognitive city is a paradigm that leverages information technology and artificial intelligence along with human cognition for improving decision-making and resource allocations in urban services delivery. A cognitive city is one that learns and adapts its behavior based on past experiences and is able to sense, understand and respond to changes in its environment. The role of the individual citizen in shaping a cognitive city is critical in the success of its governance processes, as is the integration of diverse performance measures that reflect the values of various stakeholders in the urban environment.

References
In the recent Smart Cities debate, appropriate metrics are required in order to establish the contribution that ICTs are making toward sustainable development of cities.

The European Union has placed great faith in the transformative power of Information and Communication Technologies (ICTs). These digital technologies are being expected to deliver against a wide range of EU policy imperatives. These relate not just the achievement of the so-called Knowledge Society, but also to implementation of Sustainable Development (SD). Given the breadth and depth of these ambitions, it is difficult to exaggerate the importance of successful exploitation of ICTs to the delivery of SD in Europe (Lombardi et al., 2009).

There is an implicit assumption in the current debate on ICT, which is reflected in a number of significant policies and strategies put forward for achieving SD in cities, that the implied ‘soft transformation’ from resource-intensive traditional industries towards much more resource-efficient knowledge and service industries of a dynamic information society will contribute to achieving more SD (Deakin, 2010). This assumption has not been proved yet and new metrics are needed to measure progress, that is to establish the contribution that ICTs are making to overall social and economic progress as well as to environmental advancements (Lombardi, 2011).

Smart Cities evaluation problem

Particularly evident is the problem in the recent Smart Cities debate where the absence of any commonly agreed terminology to describe ICT-driven innovations and developments has left the community without the vocabulary to discuss such matters and agree upon what they mean (Torres et al., 2005). According to Deakin (2009) this debate has been hampered, not so much with the need to agree on a standard representation of e-service developments, but by the lack of a robust statistical base to measure them. For instance, it is often claimed that some cities are smart in the way they use ICTs to develop e-services. Claims made about their use of ICTs to innovate and develop e-services testify this. Recent surveys of these developments, however, also serve to raise a number of questions about whether such ICT-driven innovations are smart and whether cities should be creating opportunities for online services offering 24/7 access (Lombardi et al., 2009).

Smart cities evaluation framework

The triple helix model has recently emerged as a reference framework for the analysis of knowledge-based innovation systems. It relates the multiple and reciprocal relationships between the three main agencies in the process of knowledge creation and capitalization: university, industry and government (Etzkowitz, 2008).

In order to explore the concept of Smart City, a revised triple helix model has been recently proposed by Lombardi et al. (2011). It involves the civil society as one of the key actors, alongside the university, the industry and the government (Etzkowitz and Zhou, 2006). This advanced model presupposes that the four helices operate in a complex urban environment, where civic involvement, along with cultural and social capital endowments, shape the relationships between the traditional helices of university, industry and government. The interplay between these actors and forces determines the success of a city in moving on a smart development path.

This framework has been used for classifying Smart City performance indicators and for structuring an ANP, Analytic Network Process (Saaty, 2005), an exercise aimed at investigating the relations between Smart Cities components, actors and strategies to which the Smart Cities are moving to. This exercise has been conducted within a focus group, involving a number of experts in different disciplines.

Smart Cities’ components

Although there is no agreement on the exact definition of a Smart City, a number of main dimensions of a Smart City have been identified: technology, education, health care, energy, mobility, administration and governance. These dimensions have been classified into the triple helix model, which has been used to create an ANP for structuring and investigating the relations between Smart Cities components, actors and strategies to which the Smart Cities are moving to. This exercise has been conducted within a focus group, involving a number of experts in different disciplines.
City can be identified through literature review and includes: smart economy; smart mobility; smart environment; smart people; smart living; and smart governance (Komminos, 2002; Giffinger et al., 2007; Shapiro, 2008; Van Soom, 2009). These dimensions connect with traditional regional and neoclassical theories of urban growth and economic development. In particular, the dimensions are based 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.

The term Smart City is not used in a holistic way but with reference to various aspects which range from ICT-districts to smart inhabitants in terms of their educational level. In addition, the term often refers to the relation between city government and citizens (e.g., good governance or smart governance). There is often a strong reference to the use of modern technology in everyday urban life, which includes innovative transport systems, infrastructures and logistics as well as green and efficient energy systems. Additional ‘soft factors’ connected to urban life for a Smart City include: participation, security/safety, cultural heritage. In conclusion, the literature review reveals the following main dimensions (or clusters of aspects): Smart Governance (related to participation); Smart Human Capital (related to people); Smart Environment (related to natural resources); Smart Living (related to the quality of life) and Smart Economy (related to competitiveness).

Assessing the Smart City’s performance
Sixty indicators have been selected from literature review including EU projects’ reports and Urban Audit dataset and indicators selected from statistics of the European Commission, European green city index, TISSUE, Trends and Indicators for Monitoring the EU Thematic Strategy on Sustainable Development of Urban Environment and Smart Cities ranking of European medium-sized cities. These have been classified in the five aforesaid clusters of Smart Cities components. Furthermore, a number of relations between these indicators have been identified by way of an Analytic Network Process (ANP), an advanced version of the Analytic Hierarchy Process (AHP). The ANP model consists of clusters (i.e., groups of homogeneous elements of a decision problem), elements (i.e. nodes of the network), interrelationship between clusters, and interrelationship between elements. It allows interactions and feedback within and between clusters and provides a process to derive ratio scales priorities from the elements (Saaty, 2005).

The final ANP model is a structured network composed by the six aforesaid clusters (Smart Governance, Smart Human Capital, Smart Environment, Smart Living and Smart Economy) in each of the four helices of University, Industry, Government and Civil Society, acting as a “control hierarchy” for this model. Each clusters include a number of indicators which are connected and have relationships between them. As an example, Figure 1 shows the relationships identified in the Civil Society sub-network. One can recognized there are two kinds of interdependences: one between elements (indicators) related to different clusters (“external” connection) and one within the same cluster (“internal” relation). The latter one is identified as a “loop”. Among the external connections, there are either mono-directional relationships, when one indicator is depending on another, or bidirectional relationships, when the dependency between indicators is reciprocal. An example of bidirectional relationship is the one connected the Smart Human Capital cluster with the Smart Living one by means of indicators such as “Museums visit per inhabitant”, “Theatre & cinema attendance per inhabitant” and “Total book loans and other media per resident”.

Pilot evaluation of the EU Smart cities visions
The above model has been used for evaluating the four EU policy visions of Smart Cities by 2050, as derived from the

Figure 1 | The Civil Society sub-network

Network Industries Quarterly | vol. 13 | no 3 | 2011 9
“Urban Europe” Joint Programme Initiatives (Nijkamp, Kourtik, 2011):

- **The Connected City** (smart logistic & sustainable mobility). The image of a connected city refers to the fact that in an interlinked (from local to global) world, cities can no longer be economic islands in themselves (‘no fortresses’), but have to seek their development opportunities in the development of advanced transportation infrastructures, smart logistic systems and accessible communication systems through which cities become nodes or hubs in polycentric networks (including knowledge and innovation networks).

- **The Entrepreneurial City** (economic vitality). This vision assumes that in the current and future global and local competition, Europe can only survive if it is able to maximize its innovative and creative potential in order to gain access to emerging markets outside Europe; cities are then spearheads of Europe’s globalization policy.

- **The Pioneer City** (social participation & social capital). This vision refers to the innovative ‘melting pot’ characteristic of urban areas in the future, which will show an unprecedented cultural diversity and fragmentation of lifestyles in European cities; this will prompt not only big challenges, but also great opportunities for smart and creative initiatives in future cities, through which Europe can become a global pioneer.

- **The Liveable City** (ecological sustainability). The final vision addresses the view that cities are not only energy consumers (and hence environmental polluters), but may – through smart environmental and energy initiatives like recycling and waste recuperation – act as engines for ecologically-benign strategies, so that cities may become climate-neutral agents in a future space-economy; cities in Europe are then attractive places to live and work.

The results show that the Entrepreneurial City is the policy vision with higher priorities in all the sectors considered in the model, i.e. Universities, Government, Industry and Civil Society. This means that a high degree of entrepreneurial activities and a constant flow of new firm creation is a prerequisite for finding a new role within the new global economic landscape. Innovation and creativeness are thus the necessary ingredients for entrepreneurial cities in Europe.

Although the proposed evaluation model and pilot exercise still requires testing and further application with the participation of real city stakeholders, it offers a reflexive learning opportunity for the cities to measure what options exist to improve their performances.

References


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Intelligent governance of large urban systems: What is at stake regarding transport issues?

Yves Amsler

Intelligent governance of large urban systems requires adopting measures impacting transport conditions which improve over time accessibility, quality of life and value for money for all current and future stakeholders.

Concentration of activities in urban areas is a phenomenon which dramatically increased in the twentieth century, and which is still speeding up worldwide. Taking Europe as an example 72% of people now live in urban areas, a figure projected to rise to 84% by 2050 (EC, 2007). Around 85% of the European Union Gross Domestic Product (GDP) is realized in cities. Urban traffic is responsible for 40% of CO₂ emissions and 70% of emissions of other pollutants arising from road transport.

Large Urban Systems – with a population of a million and over – have a crucial need of high accessibility to all facilities concentrated in urban areas. Economic development relies on a skilled and mobile workforce. Whatever the large conurbation organization, the use of transport modes – and especially motorized transport modes – is all the more necessary as the urban activities have been functionally separated along decades.

Urban transport is an economic and social issue which requires strong regulation from different levels of public authorities due to the huge externalities produced by land use and transport. Several studies performed by or with the support of the International Association of Public Transport (UITP, <http://www.uitp.org>) are presenting results of worldwide benchmarking on key urban transport economic factors (“Mobility in Cities Database”). The works of the Victoria Transport Institute (<http://www.vtpi.org>) also provide detailed analysis on these issues.

When considering private cars, these externalities are most often negative ones. As a matter of fact the transport capacity for traffic and parking is unable to follow the increase in number of vehicles generated by a lax land use and traffic management policy and by the ever increasing car ownership rate (e.g., in the USA, there are now more cars than people able to drive them). Private car negative externalities include:

- Urban space consumption: any road lane cannot offer more capacity than 700 cars per hour (urban street) or 2000 cars per hour (expressway); each car needs a parking place on either end of the trip. A rail line carries over 5000 passengers per hour at street level in case of light rail and up to 60000 passengers per hour on a single track in case of regional metro (e.g., the RER line A in Paris offering a commercial speed of 48 km/h);
- Fatalities and injuries resulting from road traffic accidents, mostly involving pedestrian knocked over by cars;
- Fossil fuel energy consumption contributing to global warming and compromising the security of energy supply;
- Traffic congestion generating air pollution and noise, detrimental to health;
- Infrastructure and parking areas leading to the destruction and decomposition of urban fabric.

Public transport is serving all categories of customers, including those which shall never have access to a car, and offers positive externalities to economic actors taking advantage of public transport services without using them. These so-called “indirect beneficiaries” are multiple: a) car users, which travel time decreases when more people shift to public transport, b) employers, getting a larger access to manpower, c) department stores and retailers, increasing their customer market and d) property developers and real estate owners.

There is a huge competitive advantage of public transport and soft modes against private car within concentrated (dense) urban areas. First, the cost of transport for the community, expressed as a proportion of the urban GDP,
is halved when comparing cities with low and high shares of public transport, walking and cycling. For example, the cost of transport represents more than 12% of the local GDP in Houston or Sydney, but only 6% in Tokyo or Hong Kong. Second, energy consumption for transport by inhabitant is divided by a factor 4 when comparing cities such as Houston or Chicago, where the majority of trips are made by private cars and cities such as Warsaw or Hong Kong, where public transport, walking and cycling are highly used. Third, policy-driven strategies are much more effective than purely technology-driven strategies to tackle the issue of energy efficiency, pollution and climate change. While the car industry is still dreaming of a “2 litre/100 km car”, regular public transport already achieves this performance every day with conventional technologies.

Intelligent governance of large urban systems is internalizing properly the positive and negative externalities of urban transport over time for the benefit of all social categories.

Major obstacles to intelligent governance of large urban systems

Despite the advantages of “soft modes” (public transport, walking and cycling), large urban systems suffer from the pressure of private and commercial road vehicles, still treated as a privileged transport mode. There are numerous reasons for that. Many citizens are reluctant to use public transport (even when highly performing) due to a misconception about the public transport services (e.g., feeling of insecurity). Many cities have grown up in the last fifty years in such a way that “soft” transport services cannot be fully effective. Priority has been given to individual housing and car-dependant allocation of activities, boosted for years by a positive image of private car; leading to urban sprawl increasing the number and length of motorized trips and creating social segregation. Public transport is hugely fragmented within large urban systems. Urban transport solutions have to answer a very large variety of door-to-door mobility needs from a large variety of social categories uneasy to monitor, and there is no simple and no “one fits all” policy. As a global market, international co-operation on public transport is limited to the promotion of best practices (e.g., in the EU through the covenant of mayors, ELTIS, CIVITAS). In terms of public transport market organization, competition is now ruled in the EU by the regulation (EC) 1370/2007 on public service requirements. However public transport operators are providing services under short term public service contracts (5-10 years) and face a shortage of public funding, leading to focus on daily and local solutions at all level, while the creation of new public transport infrastructure is often the only way to tackle the progressive congestion of rail systems. The development of local public transport is also suffering from the ‘navel-gazing’ of Competent Authorities (CA) in charge of city land use and city transport, and from the very high number of authorities in charge of a specific element of the global urban puzzle. At the same time, car use restraint policies have a political cost, and support to public transport an economical cost increasing the short term burden on local public budget and local tax-payer. Long term investment in urban transport infrastructure is antagonistic with the short term elective mandate of CAs (5-7 years).

Different authorities at local and national and European Union levels often have contradictory policies. For instance, the car manufacturers have been able to make the political decision-makers decrease the cost of purchasing and using cars (e.g., in France grants given to scrapyard – ’prime à la casse’ - and suppression of the “vignette”, annual tax on vehicle use). The use of private car, the less sustainable urban transport mode in large urban systems, is often restricted by local authorities but is still made everyday more attractive by national and EU initiatives on e-car safety, electro-car mobility and intelligent car driving assistance. Finally, while land use and transport policies are interdependent, other policies have a direct impact on urban mobility: in many countries, a political pressure is made on public transport operators to cut their budget (e.g., in Germany more than half of the car fleet is made of company cars, with companies offering a parking space at the workplace). Tax breaks for company cars and fuel represent over EU a subsidy of €54bn and an increase CO$_2$ emissions from Europe’s cars by 4-8% (<http://www.transportenvironment.org/News/2011/3/First-moves-on-company-cars/>).

With regard to intelligent transport systems (ITS) innovation impacting urban mobility is very present at the metropolitan city level (e.g., travel planners and integrated contactless ticketing) but usually for the benefit of the local citizen only (in some case the national traveler), so the public transport market as a whole is weakened in its competition with private car when harmonized ITS are at stake.

Challenges and guidelines for intelligent governance of large urban systems

Shared understanding of major stakes by local competent authorities

Local competent authorities need sharing understanding of the local situation and accepting measures to be
achieved, through a long term political agreement on a sustainable mobility strategy over the whole metropolitan area. This strategy has to give priority to the use of sustainable transport modes, and especially public transport by rail.

A common understanding of a local situation depends on sound planning, based on detailed socio-economic analysis. Comprehensive databases have to be developed and maintained over large periods of time to allow for the development of the numerous studies supporting the decision-making process.

For large urban systems, databases have necessarily to cover:

- Detailed socio-economic data resulting from periodic population and employment census using Geographic Information Systems (GIS);
- Detailed travel data per mode, per purpose and per period of the day, including on transfers along the transport chain, from actual origin to actual destination;
- Development of traffic and travel forecast models taking into account the impact of the evolution of land use patterns and socio-economic behavior of citizens.

The quality and comprehensiveness of these databases and models and of their updates are directly influencing the quality of master plans, urban mobility plans and all kinds of alternative analysis and feasibility studies required to forge a conviction about the measures to be adopted.

A challenge is to actively influence citizens’ mobility behavior with measures and policies that further encourage the use of public transport.

Inter-institutional coordination between politico-technical stakeholders

Tackling the complexity of large urban systems cannot be achieved without a proper coordination of strong and sound administrative bodies. Authorities have to be created at the political level which territory of competence is that of the entire metropolitan area, and which domains of competence cover at least policies and management of land use, traffic and parking, and public transport. They have to be properly coordinated with regional and national governments - examples of such authorities are the Greater London or Singapore.

However the implementation on site of sensitive decisions like the creation of new infrastructure or the restriction of private car use and reservations of road lanes for public transport requires some kind of “championship” able to ensure the stability of the political decisions over time.

Perennial regulatory and financial framework

Large urban systems have huge financial needs. Sustainable urban mobility depends on perennial funding schemes based on regulatory, fiscal and taxation systems in line with the transport and land use objectives. Conditions which make public transport more efficient and profitable have to be defined. Earmarked taxations supporting public transport development have to be put in place. Road pricing is one of such measures contributing to a modal shift from private car towards more sustainable transport modes, but any other solution aiming at the same result is welcome (e.g., the French “versement de transport” or the German taxation of fuel).

Application of the subsidiarity principle

Large urban systems are all unique, when technical solutions have to be put in place. Intelligent governance means avoiding decisions at no cost for those taking them which are not supported by rigorous impact assessment studies, which do not acknowledge the variety of the local situations and which may harm local transport stakeholders.

Support public transport as a global market in a global economy

Local authorities have necessarily a “city-centric” approach of mobility policy, as only very few of their citizens leave occasionally the metropolitan area. Political and technical cooperation with other local, regional or international authorities is however needed to face macro-economic challenges, such as the creation of high speed rail links, long distance freight corridors, or structural and cohesion requirements.

Local authorities may influence the technical framework of global competition between private car and public transport provided that they are convinced that a technical co-operation of major players at international level brings an added value for balancing the current competitive advantage of private car.

A major challenge is a cultural one: common concepts cover in fact different understandings, databases are not comparable and there is no common language for public transport travelers (a GPS can talk to a car driver in his mother language; nothing equivalent is available for public transport at the international level).

UITP is proposing urban mobility stakeholders to join a “PTx2” initiative aiming through appropriate cooperation at doubling the market share of public transport worldwide within twenty years. UITP is also involved as a co-coordinator of the public transport sector in major European Research projects:

- EBSF, the European Bus System of the Future;
Together with UNIFE representing the rail manufacturing industry in Europe, MODURBAN, URBAN TRACK and MODSAFE focusing on urban rail systems;

Together with the manufacturing industry (THALES as coordinator), SECUR-ED targeting mass transportation security.

UITP and UNIFE through their joint “Urban Rail Platform” launched an initiative towards standardisation in the field of urban rail, which is now supported by the European Commission through the mandate M/486 given in spring 2011 to the European standardisation organizations (CEN, CENELEC, ETSI).

Other initiatives are still pending in the field of ITS (e.g., smart cards interoperability between cities, or travel planners useful for the European traveler). Intelligent governance should not only ease the travel of vehicles in urban areas, as currently supported at national and European political level. It should first target the mobility of citizen leaving their car at home.

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Note
UITP is organizing a conference on 5-7 October 2011 in Gothenburg, Sweden, on “Innovative governance and demand management to achieve sustainable mobility in your city”.

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A solid knowledge base in combination with innovative entrepreneurship and creative communities are likely to be the prominent success factors putting cities at the forefront of new and innovative developments.

A Smart City is characterized by a clever combination of investments in – and a clever use of – resources (in particular, human, social, creative, infrastructural, technological and business capital) that fuel sustainable economic growth and produce a high quality of life, under conditions of a wise management of natural resources and a broadly supported governance system (see Caragliu et al., 2011, 2012). A series of contributions on the attributes and success factors of Smart Cities can be found in a forthcoming issue of the journal Innovation (2011).

A prerequisite for Smart Cities is the existence of and access to a strong local knowledge base. Such a knowledge base should have a broad base, in which both frontier research and standard research are performed in a balanced combination, while ensuring a sound mix of blue sky research and applicability. Thus, all quadrants of the so-called Pasteur quadrant are to be developed from a balanced perspective in a Smart City (see Figure 1).

The smart combination of all four elements in the Pasteur quadrant in an urban context is, however, not yet sufficient to bring cities at a competitive edge in a global network economy. Knowledge has to be produced, but it should also be disseminated, accessed, absorbed and utilized by all stakeholders in the urban arena (Nijkamp and Kourtit, 2011).

In the past decades we have witnessed a drastic transformation of ‘ivory tower’ research towards a linear transmission model from knowledge producers (mainly universities) to knowledge consumers (mainly industries and governments), later on followed by interactive science communication models, science valorization and commercialization initiatives, and recently more (pro-)active science marketing programs. In a more general context, we observe also a transition from Mode 1 to Mode 2 in the Gibbons/Novotny terminology (Gibbons et al., 1994; Nowotny et al., 2001), with increasing emphasis on open innovation systems ranging from national to regional or local ones.

An important visual and analytical tool to map out the above mentioned knowledge force field is offered by the so-called triple helix model (Erkowicz and Leijdesdorff, 1997). Clearly, the triple helix model is only a stylized representation of a complex knowledge fabric. It has recently been generalized towards a multiple helix model (Caragliu et al., 2012), which is mapped out in Figure 2. A main question is of course whether sufficient data are available to represent in a comparative sense the smartness (in terms of input or resource indicators) or the socio-economic achievement (in terms of urban output or performance indicators). This calls for applied comparative case study research. For various indicators (e.g., GDP, population, employment, human capital, infrastructure, business, cultural heritage, urban amenities) a wealth of information is available on European cities. For others indicators such as e-Government, ICT quality, social capital, public participation, leisure patterns, segregation, it is much more demanding to acquire relevant information. Of course, Eurostat data, Urban Audit data, EVS data or

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ESS data may offer some assistance, but it is rather cumbersome to build up a comparative and complete data system on all Smart Cities in Europe. For that reason, we have restricted ourselves to a comparative in-depth analysis of nine cities.

**Smart Cities around the North Sea Basin: A comparison**

In our empirical analysis we have focused on 9 Smart Cities in various countries around the North Sea basin, viz. Bremerhaven, Edinburgh, Karlstad, Kristiansand, Lillesand, Groningen, Kortrijk, Osterholz, and Norfolk. All these cities – or sometimes urban areas – have decided to participate voluntarily in a collaborative project (that enjoys an academic network labelled SCRAN (Smart Cities Regional Academic Network) and works on 9 North-Sea cities) that would focus on the conditions for and implications of Smart City initiatives, in particular from the perspective of knowledge, ICT and creativity.

For a systematic comparison, a joint data base had to be designed that was acquired from different sources (European, national, regional and local) as well as from interviews with city officials. These data were collected from the perspective of the multiple helix model (see Figure 2).

First, a so-called Knowledge Economy Indicator (KEI) was calculated – an average of economic growth factors, institutional support systems, educational facilities, human resources, effectiveness of innovation systems and ICT absorption – for each of the 9 participating cities. Next, a set of data was collected for assessing the attributes of Figure 3(a), the multiple helix model. Clearly, the hexagonal multiple helix model is still limited in its scope. And therefore, we may design a generalized triple helix model, which contains much more detailed information. The empirical representation of this new triple helix model can be found in Figure 3(b).

These patterns show quite some variation among the 9 Smart Cities under consideration. Cities can of course use this type of information for a benchmark analysis of their performance. But it is also an intriguing question whether the 9 cities concerned can be ranked according to their relative socio-economic achievement levels.

**Performance measurement of Smart Cities**

Performance analysis has become an important tool in plan or project assessment, especially in a comparative context. Examples are cost-benefit analysis, cost-effectiveness analysis, balance score methods, or benchmarking analysis. In all cases, the aim is to obtain insight into the relative efficiency of an organization, as compared with others. One of the more sophisticated and increasingly popular methods for judging the comparative achievement of organizations is Data Envelopment Analysis (DEA). DEA finds its origin in activity analysis, and more specifically in multi-product linear programming analysis (see Charnes et al., 1978). It has found a great diversity of applications all over the world. Its main idea is to find a numerical expression based on a performance...
score ranging from 0 to 1, with 1 being the highest score or the highest efficiency level. We refer to Suzuki et al. (2011) for DEA applications to smart infrastructures or to smart regions.

Application of DEA by mean of the so-called CCR-method to our sample of 9 cities with a further subdivision over the periods 1999-2002 and 2003-2006–leads to the following results (see Figure 4): 3 to 4 cities belong to the category of efficient cities, while for all others there is still scope for an improvement of their performance. Clearly, 3 to 4 cities have an identical efficiency score, which means that they are all located on the efficiency frontier. But this does mean that it is equally easy for these cities to maintain their position or to improve their future position. Thus, the marginal improvement efforts may vary considerably among these actors. By taking into consideration the marginal improvement efforts of these actors, a so-called super-efficiency analysis may be carried out (see Suzuki and Nijkamp, 2011; Suzuki et al., 2011; Nijkamp and Suzuki, 2009). The results of this super-efficient DEA are also presented in Figure 4.

This diagram shows much more variation over the entire set of efficient cities, which means essentially that in the long run there is ample space for improvement among all cities. Thus, the use of DEA allows an informed discussion on the relative achievement levels of these smart cities, in particular since this analysis offers clear information on the strong points of a city as well on the weak points which need due care.

Concluding remarks
Modern cities are faced with grand challenges of a varied nature, ranging from ecological sustainability or climate-neutral architecture to new socio-economic opportunities or global accessibility. Clearly, improvements in urban transportation and communication systems, socio-economic and demographic balanced development and smart governance systems are of critical importance for the success of Smart City strategies. But a solid knowledge base in combination with innovative entrepreneurship and creative communities are likely to be the prominent success factors for sustainable urban development.

References
CASE STUDY
SCRAN: Assembling a community of practice for standardizing the transformation of eGovernment services

Mark Deakin*

Attention is drawn on the triple helix model of knowledge production and the web-services assembled to support the development of the SmartCities (inter) Regional Academic Network as a community of practice for standardizing the transformation of eGovernment services.

The following is drawn from the capacity-building outcomes of the North Sea Interreg 4B project (2008-2011) known as SmartCities. In particular, the development of the inter-regional academic network that underpins the SmartCity venture and which supports the project’s capacity-building aspirations.

Attention is drawn to the University-Industry-Government collaborations (triple helix) underlying the Web 2.0 service-orientated architecture of this knowledge infrastructure and deployment of such technologies as an enterprise for organizations to learn about how such a community of practice (CoP) works to standardize the transformation of eGovernment (eGov) services.

Each academic institution (university) within SCRAN is expected to work alongside industry and government, contributing specific expertise towards the development of their eGov service programs. In this respect, Edinburgh Napier University focused on the methodology of the venture. Of particular importance to SCRAN is the three-way partnership between the Universities, Industry and Government that captures the science and technology around which the ‘triple helix’ of regional innovation turns.

The triple helix

Our reading of the triple helix relies heavily upon the representation by Etzkowitz and Leydesdorff (2000, 2002). Unlike their representation, however, our take on the triple helix does not rest at the level of institutions, but the CoPs whose expertise represents the a priori knowledge base for the model, the learning this supports and intellectual capital of the participants it rests on. In this regard Amin and Cohendet’s (2004) reading of such models is useful since it is knowledge-based and founded on an enterprise architecture geared towards the development of learning communities, organized around cities and the intellectual capital of their regional developments (see also Amin and Roberts, 2008).

From here the organizational means needed for university and industry to deploy ICTs in the development of eGov services, can be explored in terms of their institutional capacities. That is to say, explored in terms of their capacity to assemble a CoP capable of not only customizing the development of the eGov services making up the SmartCities venture, but co-designing them in a way which allows the regulative standards of the user-profiles this produces to be mainstreamed across the North Sea region.

SCRAN’s take on the triple helix

As the main exponents of the triple helix, Etzkowitz and Leydesdorff offer a particularly insightful critique of so-called “mode 2” accounts of innovation, but limit their representation of the model to those institutional relations surrounding “University, Industry and Government” involvement in the knowledge economy of regional systems. Here attention focuses on the production of knowledge by Universities and Industry as an index of intellectual capital. That tied up in the artefacts of innovations which are patented by industry and licensed in line with the standards laid down by Government to regulate such developments.

While offering many critical insights into the political economy of the triple helix, it is also noticeable these studies reveal little about either the social-basis of University, Industry and Government involvement, or the technical infrastructures of their regional innovation systems. The tendency of such studies to focus on the University and Industry of regional innovation systems and to ignore the technical infrastructures of Government, has in turn led

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some to question the usefulness of the triple helix as a well-grounded and secure model of knowledge production. From this it is clear SCRAN’s take on the triple helix needs to develop practical guidelines on how to use the triple helix and these require to take account of not only the social basis, or technical infrastructures of the model, but all three strands of the helix (i.e., University, Industry and Government alike). The unique nature of this academic network rests with understanding that triple helix models are not limited to concerns which revolve around the theoretically-informed research of technical development opportunities, but extends into the methodology of their application.

Figure 1 sets out SCRAN’s attempt to overcome the methodological challenges and associated risks such a process of knowledge production raises. In this regard it offers an initial representation of the triple helix this network advances to begin meeting them. As can be seen, the three institutional dimensions of SCRAN are represented as the intellectual capital, wealth creation and regulative standards of eGov service developments and that knowledge-base which is managed by SmartCities as part of the North Sea’s regional innovation system.

Set out as the actor-network matrix of such institutional relations, it is universities, industry and government which make up the columns of the matrix and their respective contributions to the generation of intellectual capital, wealth creation and regulative standards of those developments that make up the knowledge production of the left hand rows.

**SCRAN’s triple helix**

This first institutional step into a formal representation of SCRAN’s triple helix is then given content by means of the analytical spaces the matrix opens up for the SmartCities venture and opportunity collaborations of this kind offer such partnerships to cut across the North Sea’s regional innovation system. This networking of SmartCities as a regional innovation system in turn relates the universities engaged in the generation of intellectual capital, industry involved in the creation of wealth and government regulating the standards of the service development (i.e. the generation and wealth of eGov service developments) back to those actors associating with one another as a community of learners. What the wealth created by this process of knowledge production contributes by way of and through this learning organization is then represented in the right hand column of the matrix. This is shown in terms of the advantage which the SmartCities venture constructs as a platform of wealth creation regulating the development of eGov services.

All of the aforesaid is then captured in the far right-hand column and in terms of what the knowledge produced by the SmartCities venture contributes to the development of eGov services as part of this regional innovation system. That is to say, by way of and through the associated capital of a community set up to regulate the customization of eGov service developments, the wealth created from their co-design and intelligence this generates about the user-profiles of the North Sea’s regional innovation system.

**The triple helix of Smart Cities**

Revealing how the triple helix of the SmartCities venture can be mutually advantageous is however, not so simple. This is because proving that it is socially-inclusive, equitable and justly participative, is something which requires the academic community as a whole to accept the value of SCRAN’s proposal to ‘invert’ the normal representation of the model’s institutional relations. For without the ‘need to turn these relations up-side down’, it is not possible to bottom-out the knowledge-base of the capital associated with this venture nor the intellectual wealth needed to be creative in meeting the regulative standards of this as a baseline requirement. That baseline which in institutional terms set up the network as a socially-inclusive and justly participative community, capable of not only generating the intellectual capital
emerging from, or wealth created by the SmartCities venture, but standards surfacing to regulate their eGov service developments.

Figure 2 attempts to underscore this contribution as a second-order configuration of the triple helix for SmartCities. For this configuration shows the university as being responsible for building the capacity of the enterprise architecture and business models acting as a platform for the industry of cities to be smart in co-designing the development of eGov services with customized, multi-channeled access, targeting specific user-profiles as components of the North Sea’s regional innovation system.

Represented in this way, it is possible to be specific about the duties and responsibilities of SCRAN’s triple helix. For as figure 2 shows, while the work-based learning, knowledge and understanding packaged together under the titles of capacity building and co-design provide the backdrop to SCRAN, it is not proposed the SmartCities venture should cover all of them as components of the North Sea’s regional innovation system. Rather it suggests SCRAN should use the triple helix as a means to cut across them, concentrating the efforts of the network’s associated communities on engaging their practical skills in learning about how to build the capacity needed for the intellectual capital of this knowledge-base to underpin the co-design, monitoring and evaluation requirements of eGov service development programs.

The knowledge base and learning curve of SCRAN’s triple helix
Organized in this way, it is possible to see the knowledge-base and learning curve of SCRAN’s triple helix. What this also illustrates is the step-wise logic of SCRAN’s particular take on the institutionalization of the model. In particular the fact it builds off a given knowledge-base and is creative in using the wealth of industry underpinning this enterprise architecture and supporting the business model of the SmartCities venture. Those architectures and models that are important to SCRAN because they provide a platform for the associated capital of the communities which the network serves, to:

- Learn about what co-design and multi-channeling means for those developing such eGov service programs;
- Gain a knowledge of the way to not only monitor, but evaluate their implementation as part of a regional innovation system.

Towards a pedagogy for the SmartCities venture
Of course, for universities to be part of something more than an informal social network means the academic content of the capital associated with any such learning organization demands a pedagogy. In particular a pedagogy capable of constructing a knowledge of what is needed for the wealth created to be regulated in such a way their governance meets the requirements of the SmartCities venture.

The content of this learning organization in turn provides the platform for what might best be termed: the critical ‘building-blocks’ of Smart Cities and eGov service developments this program offers. As critical components of Smart Cities they all need to be linked together and require to be connected with one another as part of a network. In light of this critical insight, it is the networking of the social capital underlying this process of knowledge production and supporting the North Sea’s regional innovation system, the SmartCities venture is now turning particular attention to (see Deakin, 2010, 2011; Leydesdorff and Deakin, 2011a, 2011b; Cruickshank, 2011). For it goes without saying that any claim made about networks being innovative has to extend beyond the name they are known by and into the means by which this serves the community. That
is to say beyond the notion of an “inter-regional academic network” for Smart Cities and into the means which are deployed by their “partnerships” to support such a “trans-national” program of eGov service developments.

References

Supporting sustainability through smart infrastructures: the case of Amsterdam

Joost Brinkman*

Cities are the best platform to build a movement towards a more sustainable future. The Amsterdam Smart City program showcases how to accelerate the energy transition.

With more than half the world’s population living in densely populated cities, cities are the best platform to share energy, ideas and enthusiasm to build a movement towards a more sustainable future, enabled by a new generation of grids. Some of the key questions are how to create initiatives with substantial impact to reach sustainable energy and carbon reduction goals, how cities can mobilize their inhabitants to sense the urgency and take action, and how cities mobilize businesses to realize technologies that support the energy transition. Together with the local grid operator Alliander, the Metropolitan Area of Amsterdam recognized and acted on this challenge.

Climate goals of Amsterdam
The city of Amsterdam has set a number of climate goals with challenging deadlines:
• 40% CO2 reduction in 2025 from a 1990 baseline;
• 20% energy reduction in 2025 from a 1990 baseline;
• Municipal organization CO2 neutral before 2015.

At the same time the required upgrade of current electricity grids presents the perfect opportunity to implement Smart Grids, since they are also seen as a key enabler to address climate issues through the use of two way communications to maximize energy efficiency.

Re-inventing itself
The City of Amsterdam is an old city, but it has a strong tradition of reinventing itself. Reinventing itself, but at the same time making use of the same infrastructure that is already available. The old canal-houses used to be warehouses but are now being used for living and offices. Canals we partly put into roads, but were still following the same route. During the last couple of years things have been changing rapidly. The use of technology is not only changing but becoming more pervasive, and the ambition of Amsterdam to become a Smart City has grown, making use of this technology to become more efficient—in terms of its resources like energy and traffic, but also more efficient with its human capital. The essence of a Smart City in Amsterdam is that citizens of Amsterdam are enabled to make smart choices and have the opportunity to be smart entrepreneurs. New infrastructures like smart energy grids and fiber optic to the home are available to support this.

Amsterdam Smart City
Amsterdam together with the grid operator Alliander recognized these challenges and opportunities. They have designed and initiated a program to make a substantial impact on the energy transition need. The program focuses on four areas (sustainable living, working, mobility and public space), corresponding to the largest CO2 emitters (which can be customized for other cities). It is enabled by intelligent technologies like smart meter or smart grid technology. In order to maximize the result of this joint effort from the partners, the end-users that will ultimately have to make the energy transition are approached along two complementary paths:
• Application of innovative technology results in a technology push to sustainable behavior;
• Stimulation of behavioral change creates a demand pull for more sustainable technology.

Alliander will be leading the energy transition and smart grid development in close cooperation with the end customers and public and private partners. Thus Alliander fulfills its core task of creating a grid suited for future de-
developments and potentially could commercially leverage its smart grid knowledge with other grid operators.

The program, its intermediary results and the main policy, governance and technological challenges in creating innovative, economic viable infrastructure concepts that are scalable to have impact, as well as challenges in ensuring rigorous execution of selected initiatives are described hereunder.

The Amsterdam approach
The essence of the Amsterdam approach is that ‘Living Labs’ are being used for the pilot-projects. There are no traditional laboratories involved in the experiments. Pilots focus on real life experience and potential adaptation of technology and services. Obviously the role of consumers differs per type of service. For instance, the willingness to invest in energy saving can be a very passive action like putting money in a solar panel. Behavioral change to reach the same effect on the other hand is maybe even more important to reach ambitious goals.

The main objectives of the Amsterdam Smart City program are to:

1. Create collaboration and public-private partnerships;
2. Gain knowledge in behavioral change;
3. Stimulate technical innovations regarding energy saving;
4. Disseminate knowledge.

Although individuals and businesses everywhere are willing to change, too little action has been taken so far due to the limited capabilities and different interests of separate stakeholders. The required parties do not team up, resulting in too little projects being initiated. There is a gap between intentions and actions; by setting up a platform for public and private partnerships Amsterdam Smart City tries to fill this gap.

In order to create successful initiatives with substantial impact to implement Smart Grids and reach the sustainable energy and carbon reduction goals, the key challenge is to bring the required parties together and initiate action between these parties.

Over a period of two years Amsterdam Smart City has initiated 16 projects. The projects are focusing on areas such as sustainable living, sustainable working, sustainable mobility and sustainable public spaces. Amsterdam Smart City tests different initiatives to determine which initiatives and processes are suitable for large-scale implementation. All gained knowledge and learnings are shared broadly.

Amsterdam Smart City is designed as an accelerator for climate and energy programs, bringing parties together and initiating projects that reduce CO₂ and yield local best practices for full-scale roll out.

The program is based on the following four key principles:

- Collective effort: the momentum for CO₂ reduction is stopped without result if any of the required parties in society does not cooperate. Therefore a collective effort of activating and involving all parties is required to realize CO₂ reduction;
- Technology push and demand pull: stimulation of behavioral change creates a demand pull for more sustainable technology. Application of innovative technology results in a technology push towards more sustainable behavior;
- Research and knowledge sharing: learning is one of the most important aspects of these pilots. Partners should be willing and eager to learn and share their learning among others;
- Economic viability: economically non viable initiatives will never be applied on a large scale. Only economically viable initiatives (for all the stakeholders) are interesting enough to be applied on a large scale and can therefore have a large CO₂ reduction impact.

The key differentiator of Amsterdam Smart City is the process it uses to develop new cooperation and new projects. During the ‘concept development’ phase of each project the rough ideas are detailed and the appropriate partners are invited to join the project. Due to the fact that Amsterdam Smart City doesn’t have financial benefits or dependencies from the program, it is recognized as a ‘trusted advisor’.

After the concept development phase the roles and activities of different partners are written down in the Project Initiation Document, signed by all partners and the project is officially launched. One of the partners will be responsible for project management and the Amsterdam Smart City platform will from that stage only have a supporting and monitoring role.

Initiated projects
The 16 projects initiated by Amsterdam Smart City have a strong focus on the actual users: citizens, small and medium enterprises, tenants, and children, to mention just a few.

Sustainable living: all the households in Amsterdam are jointly responsible for approximately 33% of the overall volume of CO₂ emissions in the city. The key focus of sustainable living projects is to create awareness amongst residents and to reduce energy consumption in the households.

Sustainable working: Amsterdam features everything from one-person businesses in old canal-side houses to
some multinationals in modern office buildings and everything in between. Most of the city’s companies can still make significant progress with regard to sustainability and energy consumption. Users must become aware of their energy consumption patterns in the working environment and they must be stimulated to reduce energy consumption. The sustainable working projects focus on energy savings, sustainable housing and business processes.

Sustainable mobility: given the number and diversity of transport in Amsterdam, a great deal of progress still needs to be made in the area of CO$_2$ reduction. The purpose of sustainable mobility projects is to research Sustainable means of transport and the infrastructures required to implement it. This could be the implementation of new transport concepts for waste collection or something like the installation of charging points for electrical vehicles.

Sustainable public spaces: the success factor for a sustainable public space is the awareness of the energy consumption in the applicable public space, as well as the reduction of that energy consumption. The projects focus on sustainability in schools, hospitals, libraries, streets, and so on.

**Involvement of partners and citizens**
Amsterdam Smart City, together with partners, continuously initiates new projects. Relevant partners ensure realization. Together with a growing alliance of partners, a constant flow of pilot projects is started in all four focus areas. Partners join Amsterdam Smart City for three reasons. First, the partners are able to put sustainable entrepreneurship into practice in Amsterdam. Second, they gain expertise by supplying their products and services to the members of the partnership. Third, the expertise enables partner companies to develop proven products that are suitable for large-scale implementation.

The typical partners joining the program are grid operators and utilities, governmental organizations, housing corporations, Port of Amsterdam, technology startups, universities, financial institutions, telecom and ICT companies, transport and waste management companies.

In all pilots there is a close contact with the partners running the projects. Moreover, in order to maximize knowledge dissemination several types of communication activities have been initiated for both partners and projects:

- Regular updates on the running projects;
- Amsterdam Smart City newsletter;
- Interactive Amsterdam Smart City website;
- Amsterdam Smart City network groups, for instance on LinkedIn;
- Partner events, every six months for all partners.

Knowledge exchange, information and networking are at the heart of these meetings. Deep dive events are initiated for specific topics (sustainable offices, housing co-operations, etc);

- Press releases to gain free publicity.

The involvement of citizens depends on the specific project in one of the focus areas (living, working, mobility and/or public space). In each of the running projects analyzing the behavior of the energy end-user is the focus areas. Involving the energy end-user (citizens) is essential for Amsterdam Smart City, since the tested technologies are useless without the acceptance and experience of the energy end-user. As mentioned before the stimulation of behavioral change creates a demand pull for more sustainable technologies. In one of the projects an ‘open innovation’ method was used to obtain reactions and answers from the inhabitants of Amsterdam to overcome the barriers for energy consumers to become energy producers.

How successful has the activity and practice been...
and what difficulties have been faced? Have any changes been made as a result of an evaluation? For every project as well for the program platform there are several evaluation moments. Learning from our experience and sharing this knowledge broadly, in Amsterdam, the Netherlands and abroad is at the heart of the Amsterdam Smart City program.

For the research being conducted in all pilot projects, the following points are essential. First, create the same conditions (e.g., did the pilots have representative groups?). Second, the value case is essential, but learning must be made explicit for:

- People: what is acceptable, when do people act?
- Process: delivering the innovation: how and by whom?
- Technology: can it be scaled?
- Cooperation: what project partners are essential?

Key learnings

Thanks to the activities of Amsterdam Smart City and their broad focus, the entire Amsterdam region receives an economic impulse. The impact is even increased by the indirect collaboration that originates from the Amsterdam Smart City effects: an unexpected enormous international recognition and interest contribute to the city’s marketing goals.

The key learnings for the overall Amsterdam Smart City program are the following:

- Cooperation between different stakeholders takes time and stakeholders should be open to cooperate;
- The main challenge in implementing new technologies is not the technology but the adaption of the end users;
- Ease of use and financial benefits are the key drivers to seduce consumers.

The main goal of Amsterdam Smart City pilots is to learn how these different co-operations are created and how the behavior of end-users can be changed. Because Amsterdam Smart City focuses on the possibilities of energy reduction in Amsterdam, the first crucial step towards a more sustainable environment is being made.

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In today’s global, networked economy, goods often travel a long way around the world across the international supply chain from suppliers to manufacturers, buyers, and sellers, before reaching their final destination in our homes and businesses. This movement of goods across national and regional borders is highly regulated: governments seek control to counter issues with for example fraud, smuggling, safety, and counterfeiting. Especially since 9/11 they have also taken additional security measures to limit the risk of (terrorist) attacks. At the same time, governments aim to facilitate trade by reducing administrative burdens, ensuring “smooth” logistics, and increasing competitiveness – a seemingly contradictory objective with accomplishing control (Tan et al., 2011).

To exert its control function, government obliges businesses to submit a large amount of data through the use of documents and certificates, and Customs officials and other agencies conduct physical inspections on the goods. Both come at a price, for government as well as business. Containers that are inspected typically need to be transported elsewhere in the ports and have to stay there longer. In some cases, the shipment might even become worthless: if, for example, the container contains perishable food products, the load might be spoilt before all relevant documents are gathered, all tests are conducted, and the cargo is cleared. The data exchange poses an administrative burden. According to the Asia-Pacific Economic Cooperation Business Advisory Council (1996), each international trade transaction requires an average of 40 documents to meet rules and regulations set for international trade and transport. These documents have a large overlap regarding the data elements: the same data have to be submitted more than once, to different government agencies, and at different points in the supply chain. Costs may also arise from typing and other errors. If something goes wrong with the data exchange, the goods again may be delayed at the border (Tan et al., 2011). The use of Information and Communication Technology (ICT) has become more and more important in this international trade setting.

ICT for international trade
Let us briefly look into the situation in the European Union (EU). Overall, the existing ICT infrastructure in the EU is highly complex and there is no definitive alignment across the EU yet (Van Stijn et al., 2011). Many efforts have already been made to move from a paper-based exchange of documents, to a paperless environment using ICT. These undertakings have predominantly involved the replacement of paper documents with electronic versions, originally using Electronic Data Interchange (EDI) and nowadays also incorporating web-based solutions. Early on, each Member State essentially developed and implemented its own information systems, without coordination at the EU level. More recently, several programs, including Customs 2013, coordinated by the Directorate-General Tax and Customs of the European Commission (EC), have been set up to implement common EU-wide systems. The requirements for these systems, like the New Computerized Transit System, Excise Movement Control System, the Export Control System, and the Value Added Tax system, are set at the EU-level and Member States – and businesses – are obliged to adopt them. Because each of the common system typically covers only a specific procedure, silo automation remains and businesses have to modify and extend their own enterprise systems every time a new EU-wide system is introduced (Van Stijn et al., 2011). For example, an impact assessment study related to the introduction of only the Export Control System in only one EU Member State (United Kingdom) reveals that the estimated costs for the approximately 83,000 affected businesses are a one-time investment of up to € 7.5 million transition costs, and an additional average annual costs of up to € 1.1 million (HM Revenues and Customs, 2009).

ARTICLE

MULTI-SECTOR

Innovative ICT solutions for monitoring and facilitating international trade

Eveline van Stijn¹, Bram Klievink² and Yao-Hua Tan³

The use of information and communication technology (ICT) for international trade is increasingly important. The EU-funded projects ITAIDE and CASSANDRA propose further innovations to solve the trade control and facilitation dilemma.

In today’s global, networked economy, goods often travel a long way around the world across the international supply chain from suppliers to manufacturers, buyers, and sellers, before reaching their final destination in our homes and businesses. This movement of goods across national and regional borders is highly regulated: governments seek control to counter issues with for example fraud, smuggling, safety, and counterfeiting. Especially since 9/11 they have also taken additional security measures to limit the risk of (terrorist) attacks. At the same time, governments aim to facilitate trade by reducing administrative burdens, ensuring “smooth” logistics, and increasing competitiveness – a seemingly contradictory objective with accomplishing control (Tan et al., 2011).

To exert its control function, government obliges businesses to submit a large amount of data through the use of documents and certificates, and Customs officials and other agencies conduct physical inspections on the goods. Both come at a price, for government as well as business. Containers that are inspected typically need to be transported elsewhere in the ports and have to stay there longer. In some cases, the shipment might even become worthless: if, for example, the container contains perishable food products, the load might be spoilt before all relevant documents are gathered, all tests are conducted, and the cargo is cleared. The data exchange poses an administrative burden. According to the Asia-Pacific Economic Cooperation Business Advisory Council (1996), each international trade transaction requires an average of 40 documents to meet rules and regulations set for international trade and transport. These documents have a large overlap regarding the data elements: the same data have to be submitted more than once, to different government agencies, and at different points in the supply chain. Costs may also arise from typing and other errors. If something goes wrong with the data exchange, the goods again may be delayed at the border (Tan et al., 2011). The use of Information and Communication Technology (ICT) has become more and more important in this international trade setting.

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On top of that, each national Member State still has a certain degree of freedom to adapt these common systems to fit with national legislations, procedures and existing legacy systems. Especially multi-national companies will have to introduce separate interfaces for each EU country (Henningsson and Henriksen, 2011). It also poses difficulties with pan-European interoperability, meaning that the information sharing and coordination between the European government agencies is not yet widely facilitated.

Though the national and common systems contribute towards efficiency improvements, further innovation is deemed necessary. The basic premise is that the use of innovative ICT can improve information sharing between business and government, enable new approaches to monitor and control international trade, and lead to improved trade facilitation. Thus ICT innovation is seen as a means to fulfil the following three goals (Van Stijn et al., 2011):

1. Efficiency improvement (e.g., administrative burden reduction): harmonizing the data used on the different documents to avoid redundancy and ensuring that data can be exchanged electronically among the different actors;
2. Effectiveness improvement (e.g., coordinated inspections): coordinating the processes of all government control agencies involved and performing similar activities only once, specifically regarding the physical inspections of the goods;
3. Strategic changes (e.g., risk-based governance): implementing changes in data sharing processes and control procedures enabled by technological innovations.

Parallel to its own efforts and that of the Member States, the EC has made funding available for several research projects to help achieve these ambitious goals and encourage further innovation. We will provide more detail on results from the ITAIDE project (Information technology for adoption and intelligent design for e-government, <http://www.itaide.org>), which ran from 2006 to 2010, and relate to its follow-up, the CASSANDRA project (Common assessment and analysis of risk in global supply chains, <http://www.cassandra-project.eu>), a three-year project that started in June 2011.

Risk-based governance and the information pipeline

Given the volumes of international trade transactions and container movements on a daily basis, it is virtually impossible to physically check all goods. Governments want to catch as many as possible of the ‘bad guys’ and interfere as little as possible with the ‘good guys’. In this context, risk-based governance is one of the proposed strategic changes, which means that a distinction is made between trusted trader networks, with secure trade lanes, versus high-risk flows. Those in a trusted trader network will achieve benefits like faster clearance at the border. Those that are considered high-risk can be better targeted, improving the effectiveness of inspections and leading to higher hit rates.

Trusted traders are considered to be those that are in control of both the physical flow of goods and the information flow. This requires transparency and visibility in the supply chain, which can be achieved by the introduction of ICT innovations. The ITAIDE project demonstrated for example the usefulness of smart container seals in combination with new web-services based on open standards (Tan et al., 2011). The key ideas underpinning these innovations are the piggy-backing and the data pull principle. Businesses in the supply chain already have established their own extensive information systems where they in principle collect all the information relevant for government to monitor trade. Governments can piggy-back on this information, making use of the available business data rather than gathering the government documents. This is also an essential step towards “pulling data”, accessing the information directly from the business source when needed. This would help to counter issues with mistakes and misinformation and make obtaining real-time data a possibility (Tan et al., 2011). The CASSANDRA project sets out to make optimal use of these principles as a prerequisite for establishing the new risk-based approach with its work on a so-called ‘information pipeline’ (Hesketh, 2010; Overbeek et al., 2011) as illustrated in Figure 1.

The information pipeline makes use of transaction-related data – both commercial data and container tracking data – that is fed into the pipeline by the supply chain partners and then shared between the relevant partners in the supply chain and with the government authorities that require this information for risk assessment and other government purposes. Thus, the pipeline is intended to be used for data sharing and crawling. Instead of building a completely new portal or platform, the pipeline is virtual, in the sense that the existing supply chain solutions are taken as the basis and that the CASSANDRA project will work on bridging these heterogeneous systems with ICT innovations in order to achieve a pipeline that consists of interoperable solutions that can communicate in an open, flexible, and standardized manner.

Network collaboration and policy making

Conceptually, the solutions proposed by ITAIDE and CASSANDRA may appear simple, but their actual realization in the EU is a complex task. It concerns not only technological, but also managerial, financial, social, political, institutional, and legal matters. Even more so, a
particularly large and complex network of stakeholders are involved in and affected by the development and implementation of such a solution. Agreement and commitment have to be obtained at the EU as well as at the national Member State levels and with other key players. Though they may be challenging, successful collaboration and policy making processes are vital (Van Stijn et al., 2011).

Research in the ITAIDE project has yielded a multi-level network model which distinguishes between four levels of stakeholders, namely: 1) national stakeholders, within a Member State, 2) national stakeholders, in another Member State or another region/economic zone, 3) stakeholders at the regional/economic zone, and 4) international stakeholders (Rukanova et al., 2009; Van Stijn et al., 2009). One can think of Tax & Customs, the Veterinary agency, the Ministries of Agriculture, Health, ICT, and Economics, trading businesses (both large multi-nationals and small companies), carriers, shippers, logistic service providers, port authorities, national industry associations, IT providers, consultants, and academics at levels 1 and 2. The Directorate Generals of the EU, and regional industry associations such as the European Shippers Council, the European freight forwarders association CLECAT, are representatives of level 3. Examples of stakeholders at level 4 are the United Nations (e.g., UNECE and UN/CEFACT), the World Customs Organization (WCO), the International Organization for Standards (ISO), and other international standardization organizations such as GS1 (Overbeek et al., 2011; Van Stijn et al., 2011). This level is important to consider because of the efforts to develop for instance a cross-border data model, that can be used to achieve further standardization and interoperability.

Overall, the network is characterized by large amounts of inter-organizational and international stakeholders and by a high diversity amongst them: they come from different backgrounds, sectors, cultures, fall under different political and legislative regimes in different countries, and have different – sometimes conflicting – understandings and interests. Successful collaboration and policy making is dependent on many things. One of the key vehicles used in the ITAIDE project, which will also be applied in CASSANDRA, is the so-called Living Lab approach (Tan et al., 2011). Within Living Labs, actors from business and government cooperate to develop and evaluate new ICT solutions for international trade in a real-life pilot setting. These public-private partnerships are facilitated by the research environment, where partners from academia and other research institutions can provide a “neutral ground” for the interactions, aiming to initiate and facilitate processes of consensus building, networking and policy making. Successful collaboration between stakeholders during the design and piloting phase improves the chances of jointly coming to win-win solutions. Also, these processes ideally pave the way for collective action, to come to institutional change and adoption of the solutions (Van Stijn, 2009). It is essential to formulate the constraints and incentives imposed by government to steer the efforts in the right directions. We consider it highly valuable in this context to build upon the Institutional Analysis and Development (IAD) Framework (Ostrom, 2005). This comprehensive framework provides for example insights in the interactions between actors that occur at different levels (e.g. operational, monitoring, and constitutional), and how rules are employed to order relationships. Ostrom’s work also offers a set of design principles for institutional change.
Conclusion
Governments play a large role in the context of international trade as they aim to safeguard societal values and minimize security risks and so on. Control of the movement of goods across the supply chain comes at a cost, whereas it is also a key objective to facilitate trade. The use of ICT has long been recognized and used as a means to achieve efficiency improvements, but new innovative solutions are seen as enablers to fulfil both objectives. The current European situation is highly complex, not only because of its prior ICT infrastructure and the way in which common systems are developed, which has led to limited alignment. Its organization with the 27 Member States also means that the ICT-related innovations take place in a very large scale, diverse and complex stakeholder network, in which many actors have to be brought together. Next to the efforts of the EU and its Member States, the European Commission has provided funding for research and innovation projects in this area, like the ITAIDE project (2006-2010) and the CASSANDRA project (2011-2013). Based on the ITAIDE principles of piggy-backing and data pull, the latter not only aims to develop and evaluate the ‘information pipeline’, but CASSANDRA also intends to create an environment in which consensus building, network collaboration, and policy-making can successfully take place. Similar to ITAIDE, real-world research settings that are called Living Labs will be used for this purpose as well. Work on the IAD Framework (Ostrom, 2005), focusing on understanding and changing institutions, is of high relevance and will be further pursued. All in all, the topic of ICT in international trade is of great interest and importance to government, business, and researchers alike.

References


Acknowledgements
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Update on books in the areas of competition and regulation of network industries

NEWLY ARRIVED – UPDATED SEPTEMBER 2011


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<aris.christodoulou@epfl.ch>


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GOTHENBURG, 5-7 OCTOBER 2011
UITP Conference - Urban governance: getting people on board!
This conference proposes to share and promote good practices in the fields of urban governance and transport demand management. By transferring the knowledge of international mobility experts, this event will look to inspire and raise awareness among mobility professionals, local officials and urban planners.

FLORENCE, 6-7 OCTOBER 2011
Workshop on Performance in Network Industries
The workshop aims at investigating how the concept of performance is understood and implemented by the various actors across sectors and across countries.

BERLIN, 7-8 OCTOBER 2011
Infraday
The 10th conference on applied infrastructure research will be looking at institutional models in infrastructure sectors and discussing conceptual issues and empirical evidence.

FLORENCE, 14 OCTOBER 2011
European Urban Transport Regulation Seminar
The 1st EUrbanTRF will open the series of discussion events dedicated to urban transport at the Florence School of Regulation with a focus on the role, functions and status of transport authorities. It will gather stakeholders such as the EC representatives, local Transport Authorities, operators, infrastructure managers, funding bodies and academics.

GRONINGEN, 21–23 NOVEMBER 2011
Energy Delta Convention
A high-level energy platform with a unique interdisciplinary platform for senior business, science and government experts. In 2011, it will deal with gas quality and energy transition, smart energy grids and the Hanse energy corridor.

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Interested candidates are invited to submit a letter of application, along with an up-to-date CV to Professor Matthias Finger <matthias.finger@epfl.ch>.
The Transport Area of the Florence School of Regulation (FSR-T)

The Transport Area of the Florence School of Regulation at the European University Institute is concerned with regulation of all transport modes and markets (including the relationships among them). FSR-T activities are currently on rail and air transport regulation and, from June 2011, they will include urban public transport regulation. Later in time, FSR-T will commence organizing events and research on road and waterborne transport regulation.

FSR-T work includes research projects (mostly in partnership), stakeholders’ discussion events, training and dissemination actions. FSR-T activities are developed with the aim to:

- contribute to the development of Europe’s regulatory policies
- develop such regulatory policies on the basis of policy relevant solid intellectual research
- involve all important stakeholders so as to ensure that its contribution is relevant
- become a point of reference for transport-related regulatory theory and practice

Funding of the FSR-T activities is ensured by donors, who are regulated or non-regulated companies with an interest in the subject matter, which pay an annual fee.

The academic quality of the FSR-T activities is guaranteed by a Scientific Committee.

FSR-T: Forthcoming Events

<table>
<thead>
<tr>
<th>Mode/Market</th>
<th>Title</th>
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<tr>
<td>Urban</td>
<td>1st EUrbanTRF (European Urban Transport Regulation Seminar)</td>
<td>14 October 2011</td>
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<tr>
<td>Rail</td>
<td>2nd Florence Workshop on Rail Transport Regulation</td>
<td>28 November 2011</td>
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FSR events are on invitation only: please contact the coordinator should you wish to obtain more information or attend.

FSR-T: Contacts

Director: Prof. Matthias Finger <matthias.finger@epfl.ch>
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For up-to-date information on FSR-T: [http://fsr.eui.eu](http://fsr.eui.eu) and choose the transport link on the menu bar.

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The Transport Area is one of three subject areas — Energy, Communications and Media, Transport — of the Florence School of Regulation (FSR, [http://fsr.eui.eu](http://fsr.eui.eu)) at the Robert Schuman Centre for Advanced Studies (RSCAS) of the European University Institute ([http://www.eui.eu](http://www.eui.eu)). The Energy (Electricity and Gas) Area is directed by Professor Jean-Michel Glachant, and the Communications and Media Area is directed by Professor Pier Luigi Parcu.

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Fourth annual conference of the multidisciplinary journal *Competition and Regulation in Network Industries*

**25 November 2011**

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Residence Palace, Rue de la Loi 155

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