FINEST Twins: platform for cross-border smart city solutions

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FINEST Twins: platform for cross-border smart city solutions

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ABSTRACT

The FINEST Twins aims to build a smart-city Center of Excellence (CoE) based in Estonia capable of mobilising all leading actors and stakeholders in Estonia and establish a solid long term partnership with their Helsinki region counterparts, capitalising on the macro region's scientific knowledge, innovativeness and entrepreneurship. The smart city CoE will focus on mobility, energy and built environment glued together by governance and urban analytics & data and aims to match leading smart city research centers globally. The FINEST Twins develops the cross-border knowledge transfer infrastructure (Urban Operating System) through real-life pilots capable of attracting international expertise and investment, as well as acting as a springboard for the exportation of Finnish-Estonian knowledge and combined service solutions on a global scale.

CCS CONCEPTS

• **Social and professional topics → Computing technology policy → Government Technology Policy**

KEYWORDS

smart city, digital single market, interoperability, cross-border services, public service provision

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1. INTRODUCTION

The FINEST Twins looks into how to achieve digital single market in the urban context. By fact, most digital services are local and by large, most of them are developed in isolation from the neighbouring local governments, either national or international. In the digital area, this is a huge challenge, as independently developed digital services tend to be locked-in to specific standards making future cross-border services challenging.

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Information-and Communication technologies (ICTs) are aggressively reformulating the borders between the countries, at least the virtual ones. ICT breakthroughs like Facebook, Skype, Google and LinkedIN have clearly changed the understanding of the world map: if you can get online, there are no borders, at least in online communications services.

On the other hand, the picture is different if we zoom into the regional levels where each municipality tailors its own electronic services: local services are often developed in isolation with small or little attempts to co-design the services jointly with neighbouring cities in order to offer the cross-border services area for their citizens. Digital urban services are still developed and analysed from the "closed-borders" perspective, disregarding every-day commuters and the fact that, at least technologically, services can be easily scaled over the borders.

Tallinn and Helsinki (two Northern-Europe capitals) are selected for the following reasons: proximity (the two cities are just 80 km apart by sea); high-level commuting frequency (there were 8 million passengers between Tallinn-Helsinki in 2016 whereas Estonia's entire population is just 1.3 million) and digitalisation (Finland has very strong digital industry, strongly rooting from Nokia. (E-)Estonia, on the other hand, is highly appreciated for its electronic government). Economically, the cities are not the "in the same league:" Estonia is a post-soviet country still trying to catch up whereas Finland is a well-developed western country. Estonia's GDP is 2.5 times smaller than Finland's.

2. FINEST TWINS INITIATIVE

The FINEST Twins focuses on developing new Smart City state-of-the-art solutions and testing them in the cross-border environment. It is a partnership between Tallinn University of Technology, Forum Virium Helsinki (Helsinki City), Aalto University and the Ministry of Economic Affairs and Communications of Estonia.[1]

Smart City, an ICT-enabled city, has a huge market potential across the world. As the urban population continues to grow, cities and governments are investing heavily into digitalisation. India has recently launched an initiative to build 100 smart cities,[2] in China, there are dozens of smart cities in an advanced stage of development and 200 more on the way,[3] there are several initiatives across the Europe (PlanIT[4] in Portugal), Arab Emirates (Masdar[5]), Singapore (Tianjin[6]), South Korea (Songdo) etc. Some of these initiatives reach to tens of billions of euros, making the full market potential in hundreds of billion euros.

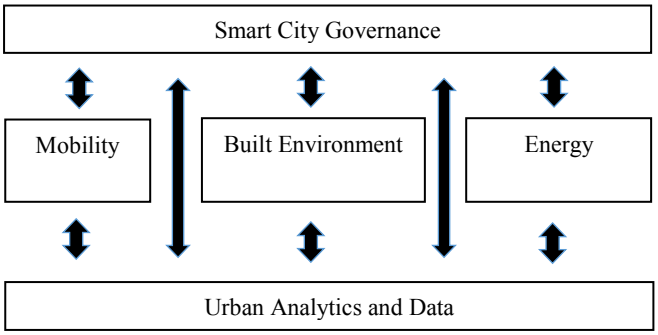
The aim of the FINEST Twins is to establish a smart city Center of Excellence, based in Tallinn. Clearly, both Finland and Estonia

[1] See also: www.smarttwincities.eu
[2] http://www.citymetric.com/india-s-new-government-spending-700m-new-smart-cities
[3] http://www.citymetric.com/skylines/can-hundreds-new-ecocities-solve-chinas-environmental-problems-1306
[4] http://www.urenio.org/2015/01/26/smart-city-strategy-planlt-valley-portugal
[5] http://www.masdar.ae
[6] https://en.wikipedia.org/wiki/Sino-Singapore_Tianjin_Eco-city

have strong digital industry but this is less and less capitalised in the financial terms. The Finest Twins postulates that the smart city is "the next big thing" for Finnish, Estonian, European and global digital industry. The bottom-line is a top global knowledge base through research actions that will be actualised through real innovation activities and standards. In Finest Twins, researchers will be working with the companies. Out of funds (estimated € 5 mln annually), approximately 60-70% will be for research activities and 30-40% would go directly to innovation pilots.

The main focus areas are Mobility, Built Environment and Energy. Supportive layers are Data Architecture and Smart City governance (see figure 1). In other words, the Finest Twins will pilot **new mobility solutions** such as Mobility as a Service, mobile positioning data, twin ports, intelligent street crossings, automatic vehicles etc (some pilots in the preparatory phase), **new built Environment solutions** (zero-energy houses, new generation heating solutions, planning of large-scale real estate projects) and **new energy solutions** (smart grids, optimisation of energy demand to avoid peaks, connected meters and sensors), see also figure 2.

Figure 1. Finest Twins focus areas



The FINEST Twins CoE will also contribute to the emergence of Digital Single Market in the urban context. By fact, most current digital public services are local and by large, most of them are developed in isolation from neighbouring governments, either local, national or international. In the digital area, this is a huge challenge, as independently developed digital services tend to be locked into specific standards making future cross-border services improbable. Clearly, frequently commuting citizens and travellers prefer cross-border smart city services, but public authorities fail to provide such systems. The FINEST Twins guarantees to change this by effectively designing truly ubiquitous urban services and effectively testing them on cities all around world and also globally. The ubiquitous solutions not only contribute to strengthening the Digital Single Market by increasing the aggregate supply, but also mitigate digital divide and empower local communities.

Figure 2. Finest Twins R&I pilots

The roots of this project lay in Finland and Estonia. In Estonia, the societal use of ICT is the most developed globally exemplified by widespread take-up of innovative mobile and e-applications. The strong scientific and technological capacities of Finland match well with the Estonian entrepreneurship dynamics, especially in ICT. The FINEST Twins model will capitalize on these initiatives aggregating current research, innovative services and solutions into integrated service solutions capable of creating additional added value to its users all around the world. The FINEST Twins attracts international expertise and investment, as well as, act as a springboard for the exportation of Finnish-Estonian knowledge and service solutions on a global scale.

3. TALLINN-HELSINKI CHALLENGE

Two European capitals, Helsinki and Tallinn, are in a very unique situation. Helsinki, the capital of Finland, belongs to one the wealthiest region in the EU. Tallinn, the capital of Estonia, is among the catching-up regions. There is approximately three times wage difference between the two capitals while being physically only 80 km apart (see the figure 3). A talented PhD student from Tallinn can earn more taking on a cleaning position in Helsinki compared to continuing to pursue an academic career at home; a skilled construction worker in Helsinki earns more than an average professor in Tallinn. Between the two small nations (combined population of 7 million), there is a high commuting frequency. Approximately every 15-20th Estonian lives in Finland and commutes back to Estonia on a regular basis. For Finland, Estonia is the most popular investment and tourism destination, every fifth Finn stays overnight in Estonia each year. The two countries speak unique Finno-Ugric languages, and there is a strong feeling of kinship between the countries. In terms of innovation, both countries are particularly strong in digital innovations. Despite being one of the better performers in scientific excellence among the Eastern European countries, having one of the most advanced e-governments[7] and enjoying fast catch-up towards the European averages, Estonia still lags behind Finland in widespread research excellence.

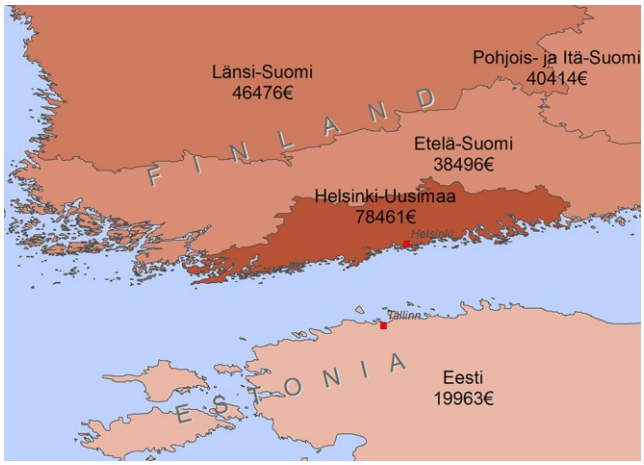


Figure 3. GDP per inhabitant, 2013 (source: Eurostat)

Finland has one of the most envied education systems globally on all levels and the second highest public Research and Innovation (R&I) intensity of all EU Member States.[8] Finland is among the top 5 countries globally for academic citations per capita, above the UK and the US.[9] Estonia, a low-performer, has 3.3 times less citations per capita, the aggregated country-level h-index difference is 2.7 times. In terms of disciplines of FINEST Twins

[7]http://www.bloombergview.com/articles/2015-03-04/envying-estonia-s-digital-government
[8]https://ec.europa.eu/research/fp7/pdf/country-profiles/finland/country_profile_and_featured_projects.pdf
[9]http://academia.stackexchange.com/questions/18767/research-publications-per-capita

(Computer Science, Energy, Engineering and Social Sciences), the biggest lag in citations and h-index is in Computer science and Engineering, the smallest one in Energy and Social Sciences, see the table 1 below.

In the case of access to research funding, the picture is very similar. Finland ranks fifth in the EC Innovation Output Indicator whereas Estonia is 19th (out of 28, in 2014). In volumes, Finland received € 867 mln from FP7, compared to Estonia with € 89 mln,[10] the per capita difference is 2.4 times. In the comparison of our two core partner universities, TUT received € 11 mln against Aalto's € 76 mln. When controlling for size (Aalto is roughly 2 times bigger[11]), Aalto received 3.8 times more from FP7 than TUT.

1996-2014	EE citations per capita	FI citations per capita	difference	EE h-index	FI h-index	difference
All fields	0,24	0,79	3,3	162	443	2,7
..in Computer Science	0,0017	0,0053	3,1	41	138	3,4
..in Engineering	0,0030	0,007	2,4	48	144	3,0
..in Energy	0,0007	0,0008	1,2	31	71	2,3
..in Social Sciences	0,0018	0,0025	1,4	40	106	2,7

Table 1. Estonian and Finnish citations per capita.[12]

In addition, the Estonian ICT deployment has not been leveraged in commercial. The IT sector that Estonia is renowned for does not generate significant export revenues. IT services exports in 2014 constituted only 1.3 % of total export revenue. The reason for this is that so far Estonia's e-government solutions have lacked international scalability. This has various reasons: first, lack of policy initiatives directed at ICT exports; second, labour shortage in the ICT sector; and third, perhaps most importantly, lagging interdisciplinary R&I activities that would utilise ICT solutions in other sectors of the economy as well. The CoE will directly alleviate the latter via concentrated research efforts and teaming up with the key Finnish R&I players.

4. VISION AND KEY OBJECTIVES

VISION: The FINEST Twins project's vision is to build an ICT-driven Smart City Centre of Excellence (CoE) based in Estonia capable of mobilising all leading actors and stakeholders in Estonia and establish a solid long term partnership with their Helsinki region counterparts, capitalizing on the macro region's scientific knowledge, innovativeness and entrepreneurship, and act as a reference and hub for cross-border scientific and innovation cooperation projects and ventures. The FINEST Twins CoE will be a true joint venture between the metropolitan region of Helsinki-Uusimaa[13] (onwards referred to as Helsinki region) and Estonia, establishing the EU cross-border Smart City solutions and a demo lab capable of attracting international expertise and investment, as well as, acting as a springboard for the exportation of Finnish-Estonian knowledge and combined service solutions on a global scale.

Key objectives

1. Scientific, innovation and business related co-operation between Helsinki and Estonia in the Smart City fields of living, mobility and environment. Promoting efficient exchange of knowledge, building a joint research portfolio, supporting faster cross-border take-up of Smart City innovations.
2. Joint-production of cross-border services in order for both regions to benefit (economies of scale, better added value services, et al.). The CoE will bring together all main public and private actors, facilitating communication, networking and the building of long-term cooperation and true partnerships in macro-region.
3. Developing FINEST Twins cities (macro-region) as one integrated Smart City open "living laboratory" acting as a test bed for new innovations, and focusing on close-to-market innovations, city-driven innovations and open engagement of local innovator ecosystems.

5. SELECTED DOMAINS

"A Smart City is a city seeking to address public issues via ICT-based solutions on the basis of a multi-stakeholder, municipally based partnership."

The above definition is part of a 2014 study published by the European Parliament [1]. Although the authors claim it to be a working definition, it is based on the meta-analysis how Smart City has been conceptualised previously. The FINEST Twins Smart City vision encompasses not ICT as a technology driver in a broader scope including socio-economic, governance and multi-stakeholder aspects such as the use of social participation to enhance sustainability, quality of life and urban welfare. The key point in the continuous and successful development of a Smart City is to understand, that it is not a one-city game. It is a combination of not only multiple stakeholders from municipalities, research, businesses and citizens, but also partner cities, regions and nations. The future FINEST Twins Smart City CoE will mainly focus on the following three Smart City areas: Living, Mobility and Environment. These three areas are aligned with Helsinki region key strengths both in terms of research and innovation outputs, as it can be demonstrated by the numerous publications and pilot actions currently in place across the region, and are also a key priority for Estonia.

There are as many 'Smart City' definitions as there are 'Smart City' projects. The following figure 4 illustrates a common view on Smart cities focus areas and impact measurement indicators.

The thematic areas, in accordance with the most recent study on Smart Cities published by the European Parliament[14], are the following:

Smart Living:

- ICT-enabled life-styles, behaviour and consumption
- Healthy and safe living in a culturally vibrant city with diverse cultural facilities
- Good quality housing and accommodation
- Smart Living is also linked to high levels of social cohesion and social capital.

Smart Mobility:

- ICT supported and integrated transport and logistics systems.

[10] http://ec.europa.eu/research/fp7/index_en.cfm?pg=country-profiles
[11] weighted difference between academic staff and students
[12] www.scimagojr.com
[13] http://ec.europa.eu/enterprise/policies/innovation/policy/regional-innovation/monitor/base-profile/helsinki-uusimaa/helsinki-uusimaa-region
[14] http://www.europarl.europa.eu/RegData/etudes/etudes/join/2014/507480/IPOL-ITRE_ET(2014)507480_EN.pdf

- For example, sustainable, safe and interconnected transportation systems can encompass trams, buses, trains, metros, cars, cycles and pedestrians in situations using one or more modes of transport.
- Smart Mobility prioritises clean and often non-motorised options.
- Relevant and real-time information can be accessed by the public in order to save time and improve commuting efficiency, save costs and reduce CO2 emissions, as well as to network transport managers to improve services and provide feedback to citizens.

Smart Environment:

- Smart energy including renewables, ICT-enabled energy grids, metering,
- Pollution control and monitoring,
- Renovation of buildings and amenities, green buildings,
- Green urban planning,
- Principals: resource use efficiency, re-use and resource substitution
- Examples: street lighting, waste management, drainage and water resource systems that are monitored to evaluate the system, reduce pollution and improve quality

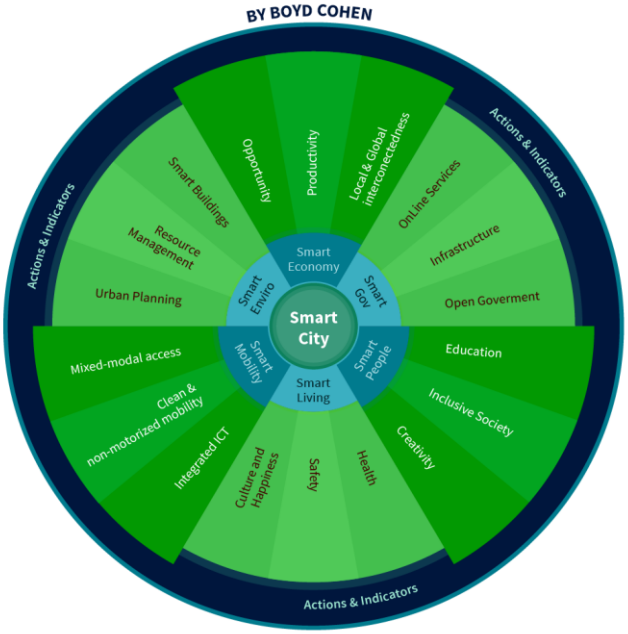


Figure 4. The Smart city wheel by Boyd Cohen

6. KNOWLEDGE TRANSFER INFRASTRUCTURE: URBAN OS

Currently, globally leading smart city solutions follow two distinct patterns: first, building entire cities or parts of cities from the ground up based on smart city technologies; or, second, incrementally adding layers of sensors, opening up data for existing services. For regions aiming to catch up, neither alternative is satisfactory: the former demands enormous resources not available and the latter follows too slow a pace to advance public service reforms, digital common market and competitiveness. For catching up purposes, FINEST Twins proposes the following path: the creation of an Urban Operating System that is available for local and cross-border solutions. Such an approach follows from strategic plans developed by European Innovation Partnership on Smart Cities and Communities. Equally importantly, FINEST Twins will utilise open software and platform standard solutions developed in the context of FIWARE Smart Cities and Open and Agile Smart Cities (OASC) initiatives in order to ensure replicability and more importantly, scalability. Estonia's public ICT infrastructure based on open standards – x-road[15] – has brought Estonia and Finland globally to the cutting edge of e-government solutions and offers a unique opportunity to develop an Urban OS. This allows us to build an integration architecture for connecting sensors, the x-road for things.

The Urban OS is a crucial research infrastructure needed for the smart city CoE. The aim is to add the things layer to the x-road by developing an open and interoperable platform for connected sensors. In practice, the Urban OS is also a platform for joint R&I pilots with public sector involvement, associated companies and citizens as end-users. We have teamed up with recognised companies that are willing to invest into joint smart city pilots, and build on top of the excellence research the centre will produce. This combination will ensure that partner companies can make CoE developed research-intensive smart city solutions exportable and sell them globally. In essence, the Urban OS enables and ensures knowledge transfer between practical needs of cities and companies, and research streams.

The FINEST Twins CoE has pre-agreements with renowned ICT-focused companies (F-Secure, Tieto, TeliaSonera and Siemens) for initial joint pilots in the fields of smart city. In the case of our partner companies, F-Secure is interested in cyber security aspects of smart cities; Tieto's and TeliaSonera's interests are tied to Data Architecture development; Siemens is interested in the Built Environment solutions. In addition, there are negotiations in process with Ericsson and Telia for joint 5G pilots (Telia Estonia is planning to invest for 5G stations in Tallinn already in 2018), both plan to co-operate with FINEST Twins, although the terms are not yet finalised. In addition to the current pre-agreement with Siemens, they are also interested in Smart Energy pilots.

In addition to working with large companies, we have a very strong connection to all smart city related clusters in Estonia (e.g., ICT Cluster, Smart City Lab, Tehnopol Science Park and Rakvere Smart House Competence Center) which facilitates the creation and development of direct relationships between academia and private and public sectors as well as between local firms and some of the global smart city market value chain leaders..

Technological change in the world economy is constant but not continuous; it occurs in massive surges of change [2]. Over the last 200 years the Western countries have experienced five successive waves of revolutions centred on the technologies with pervasive application potential. The most widely accepted theoretical framework for discussing technological change and the creative destruction they generate is the techno-economic paradigm shifts approach by Chris Freeman and Carlota Perez, which is based on Schumpeter's business cycles and Kondratieff's long wave theory [3]. The theory states that in order to realise the full potential of the new wave of technological revolution, the clusters of technologies should be coupled with sets of best practices and a stable socio-institutional framework for supporting their creation, take-up and diffusion. This highly contested societal embedding of new technologies has historically resulted in large-scale economic, political, cultural, spatial and psychological changes, both intended and unintended, beneficial and harmful. Since the 1970s, the world economy has witnessed

[15] https://www.ria.ee/en/x-road.html

the emergence of a cluster of information and communication technologies, which is interpreted as the fifth techno-economic paradigm.

According to Carlota Perez, we are currently entering the phase of deployment in which the fusion of new technologies, best practices and the supporting institutional framework enables the realisation of the full gains of the paradigm. In order to make use of the emergent paradigm various technological, organisational and institutional rearrangements are required.

As the rapid rise of sharing economy shows, habitation (city) itself will be the era-defining business model through which ICT paradigm spreads. Accordingly, digital layers of cities will be fundamental to the socio-economic development of coming decades. The CoE will create such a digital layer through research and innovation actions via building the Urban OS.

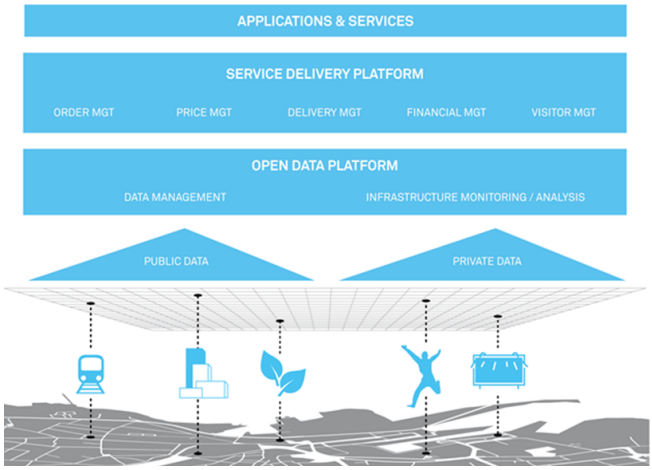


Figure 5. Urban Operating System

The concept of Urban OS is simple (see the figure 5): deploying a network of sensors that can capture real-time data from a myriad of things occurring in the city, and connect such sensors to an urban information system helps to analyse better and transform such data into knowledge. We can create new types of urban efficiencies, products, and services for the people of the cities. In turn, they access an open-access digital services delivery platform using anything from a smartphone or a laptop all the way to digitally enhanced infrastructures such as responsive public spaces, intelligent transport systems or smart energy infrastructure among others. The city becomes a permanent platform for interaction that provides a unique mix of services to each user. Furthermore, by giving users the capabilities of developing their solutions and services we create a more inclusive and bottom-up model of both social and economic development while jumpstarting local dynamics.

Urban OS Architecture

The data management layer provides standardisation and storage function for the platform facilitating analysis of long-term sensor data. Urban OS would be the primary conductor of various data streams used by the various digital services between two cities.

Integrating data streams

Ubiquitous sensors and sensor networks are increasingly providing data sources of different contents, formats, and qualities. Integrating diverse data sources allow developing applications that would not be possible by using single sensor network. When integrating data from heterogeneous sources, syntactic, schematic, and semantics diversities of the data schemas are challenging problems. Through an Operating System, data from diverse sources is translated into a common language and visual interface.

Data processing functionality

The Urban OS will offer businesses, citizens, and governments the ability to combine real-time data from across some data streams to create and up-to-the-minute picture of urban material flows and dynamics. In addition carrying data from providers to consumers, the Urban OS will allow clients to process quickly, manipulate and visualise the data of data streams. Through the platform, applications can also be published and shared among users.

Scalability and flexibility

Agile development processes have dramatically changed the way technology is being implemented. Shorter cycles allow to constantly adapting to changes or new conditions. The OS platform will be designed to meet current needs without compromising the ability of future generations to meet theirs. At the moment we can assume hundreds of data streams, with individuals contributing this number easily into the thousands. Taking into account the overall input load and the numbers of potential clients, and doing a quick approximation, we could easily end up with up to one million messages per second. The OS platform will be designed to deal with, initially, a small load, but at the same time, it will need to be designed to scale to hundreds of machines to deal with the additional load.

Inhabitants as actuators

Truly smart cities will emerge as inhabitants and their many electronic devices are recruited as real-time sensors of daily life, agents for sensing and reporting their individual experience. Offering a real-time view of how human, material, digital and financial resources travel through the landscape of their daily lives will perceptually expand each citizen's sphere of responsibility from the domestic space to the space of the city - the city becoming the smart meter of all these factors. In a digitally augmented smart city, civic zones can be transformed into responsive environments through technological mediation. This would change the passive inhabitants of the city to active participants of spatial scenarios, and the public spaces from areas of transit to urban destinations.

During the last decade, there have been large investments in smart city research, innovation and systems uptake in Europe and globally. The European Innovation Partnership on Smart Cities and Communities (EIP SCC) forecasts the market for smart city solutions in 2020 to be € 1.3 trillion, with current market-size estimates being at € 200-400 mln annually. Many of the CO^2 reduction targets require further smart city R&I activities to be realistically achievable. Also, the public funding for smart cities has been vast: just the Future-Internet PPP (FIWARE)[16] programme consists of only € 300 mln of EU funding with many of its application domains being in the context of cities. This is the societal context and the market and public sector demand for the FINEST Twins R&I.

The Urban OS builds on the previous R&I investments and the existing collaboration on this domain: it brings in the "best pieces, knowledge and middleware that are pragmatically needed" to execute state-of-the-art smart city R&I in a real-life cross-border ("Digital Single Market") setting. The approach follows closely and contributes to the developments of:

[16] https://www.fiware.org/tag/smart-cities

- EIP SCC Urban Platform[17] (project partner FV-Helsinki – Helsinki City Innovation company – has 3 commitments to EIP SCC; project partner University of Tartu representatives are in the EIP SCC "sherpa group");
- Open and Agile Smart Cities Initiative,[18] which links to FIWARE and the development of common standards by cities (project partner FV-Helsinki is founding member of OASC)
- EIT Digital[19] development in the smart spaces, urban life and mobility action lines (project partner Aalto hosts EIT Digital node in Helsinki and project partner FV-Helsinki is associate partner in EIT Digital);
- CitySDK[20] is a "service development kit" for cities and developers that aims at harmonising application programming interfaces (APIs) across cities. CitySDK APIs enable new services and applications to be rapidly developed, scaled and reused through providing a range of tools and information for both cities and developers (the project was led by FV-Helsinki with 8 cities as partners: Amsterdam, Barcelona, Helsinki, Istanbul, Lamia, Lisbon, Manchester and Rome).
- SELECT for Cities[21] is a R&I pre-commercial procurement led by Helsinki together with Antwerp and Copenhagen, which will develop a number of platform prototypes, capable of integrating the current cities OS, IoT and all Smart eco-systems and data, for transforming cities into large scale IoT Living Labs. FV-Helsinki is the coordinator.

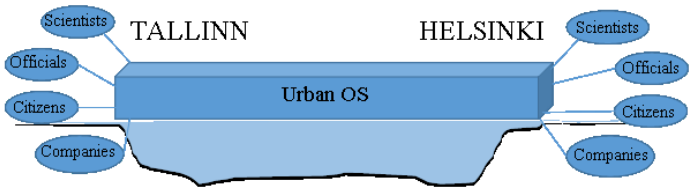


Figure 6. The Urban OS model for cross-border R&I collaboration

The urban OS is a digital layer of cities that functions in real time, is both public and private, integrates diverse data streams and offers data processing functionality and scalability/flexibility. Within the urban OS, companies can create new products and services, the public sector can enhance existing and create new services, and citizens can be empowered to be more actively involved in cities' socio-economic developments. The FINEST Twins proposes to create the urban OS for the Helsinki-Tallinn region, which is a great test-environment for teaming with strong scaling potential to other cross-border regions. The FINEST Twins aims to be the first Cross-Border test-site for two-city joint digital services (see the figure 6) by connecting all the key actors in the region through joint R&I pilots. This is well supported by the joint take up of x-road for the real-time data exchange between Estonia and Finland and our plan to develop the sensors exchange layer on it, the x-road for things.

Critical to the CoE R&I initiatives will be the design and implementation of the digital-technologies platforms that will enable it to create a real-time cross-border sensing environment as well as to provide a new layer of shared services and opportunities to its inhabitants and users. Rather than a top-down system supplied by an international technology leader to improve efficiency and security, the Urban OS is imagined as an open network that is able to create sustainable wealth and encourage local economy. Through the Urban OS, the city becomes not just a R&I testbed but also a platform to innovate upon.

7. CONCLUSIONS

This paper gave an overview of how cross-border cities can offer joint services via open ecosystem (Urban OS). The cities of Tallinn and Helsinki are very different on the economic level and therefore, joint platform for smart city services can effectively serve as a knowledge transfer mechanism from more advanced region (Helsinki) to the catching-up region (Tallinn). A strong common element of both cities is strong digital infrastructure and potential for interoperability of services.

The key point to understand a winning smart city is to understand that this is not a one-city nor one-country game. No matter how big a city (Tokyo, Sao Paulo), any local government is too small to create a real ecosystem of cutting-edge agile and adaptive governance solutions (predictive analytics, Internet of Things and Big Bata technologies). The first instalments have led to inflexible "smart cities in a box" or "smart countries in a box," which are ageing fast, and from which solutions do not scale elsewhere.

There is a need to start from simple and widespread urban services through collaborative joint cross-border hands-on pilots e.g. public transportation tickets and mobile parking for eterogeneous cities) and practice joint procurements for nnovative solutions. Standardisation is also the key to cross-order urban services. The real threat is that if local municipalities o not manage to innovate from bottom-up jointly with eighbouring cities (both national and international), then all the ross-border solution will be enforced top-down or aggressively linked to global business vendors.

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