

SYNCHRONICITY



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Executive Summary

The ambition of SynchroniCity is to create a Global Market for Smart Cities. That would be a major achievement that would enable European companies to scale up, since their target market would be incredibly big in comparison to the current situation, characterized by fragmented markets where solutions are adapted to city contexts according to a multiplicity of criteria. Cities feel the same frustration. While their budgets are constrained they cannot take advantage of the applications and services deployed by other cities unless they (or their suppliers) build everything from scratch. SynchroniCity will not solve all the problems, but will make a sound contribution by deploying a minimum set of interoperability points that will facilitate portability of smart city solutions. They are based on the so called OASC principles and compliance with them can be fulfilled by different platforms, as shown by SynchroniCity, where we have a heterogeneous environment of city infrastructures, data and platforms.

T6.1 is in charge of analysing the business elements and dynamics around SynchroniCity, as well as the exploitation roots that will lead to self-sustained solutions after the project.

D6.1 is part of that work and focuses on understanding the market and its driving forces, as preliminary step to take decisions on the topics mentioned above. D6.1 analyses the market of IoT platforms in general and the context of Smart Cities in particular. We provide insights on the success factors of the IoT market as an enabler of Smart Cities and we reflect on the implications of those factors for SynchroniCity. Elements that you will find in this analysis include -besides the role of platforms as such- Openness and monetization of data; data privacy, security and trust, the regulatory environment, standards and interoperability, the challenge of skills, transparency in the IoT value chain and the need for credible RoI cases that serve as guidance for potential investors and adopters of the technology.

We identify concrete areas where SynchroniCity may have to take decisions looking at its future sustainability –including the platform economy, multi-sided markets and data-related aspects such as the challenge of data silos and the potential of data marketplaces-. D6.1 also illustrates different (financial) collaboration mechanisms between stakeholders that could help in realizing smart city projects. Among them we have found interesting examples under the form of Public-Private-Partnerships, Public-Private-Academic Partnerships, the 4P model that involves People besides the other stakeholders, citizen co-creation, civic crowdfunding (where the citizen gets involved also in the financing process) or the obvious ones of government subsidies and direct service provision. We expect that future work in SynchroniCity will reveal potential new forms of financial collaboration. We are confident that SynchroniCity will motivate some good examples of multi-sided markets that take advantage of the platform economy and lead to revenue channels for different players. At the end of the document we elaborate the action lines for the upcoming period, which will focus mainly on three priorities:

- Work around Scenarios on IoT usage, to understand the business elements of the ecosystem and the interaction between assets and stakeholders, as well as business models in the pilots. Annex 2 of this document anticipates elements of the work on IoT usage scenarios (D6.6) and explains the relationship with other activities of the project, its dependencies and main ambition of the work.
- Cost-benefit and value flow analysis of the cities involved in the project looking at an extension either of the geographical areas, the application domains or both
- Extending the reach of SynchroniCity by involving other cities and aiming at achieving a critical mass of OASC-compliant cities in Europe.

Abbreviations

ARPU	Average Revenue Per User
B2B	Business to Business
B2C	Business to Consumer
D	Deliverable
DIAS	Data and Information Access Services
DOT	Department of Transportation
EC	European Commission
EDSA	European Data Science Academy
EU	European Union
FCC	Future Cities Catapult
GDPR	General Data Protection Regulation
HPC	High Performance Computing
ICT	Information and Communication Technologies
IoT	Internet of Things
JRC	Joint Research Center
KPI	Key Performance Indicator
MOOC	Massive Open Online Courses
OASC	Open and Agile Smart Cities
OSS	Open Source Software
PPP	Public-Private Partnership
PSI	Public Sector Information
RoI	Return on Investment
SCC	Smart Cities and Communities
SCEWC	Smart City Expo World Congress
US	United States
WP	Work Package
WT	Work Task

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1 Introduction

SynchroniCity means meaningful coincidences and therefore, it must not be by chance that 2018 has been a very important year for initiatives dealing with creating a European Data Space where data can flow between countries, but where privacy rights of citizens are preserved. Free flow of data and GDPR represent major efforts in those lines respectively. Both of them are extremely important to the objectives of SynchroniCity, whose ambition is to create a Global Market for Smart Cities. That would be a major achievement that would enable European companies to scale up, since their target market would be incredibly big in comparison to the current situation, characterized by fragmented markets where solutions are adapted to city contexts according to a multiplicity of criteria. Cities feel the same frustration. While their budgets are constrained they cannot take advantage of the applications and services deployed by other cities unless they (or their suppliers) build everything from scratch. SynchroniCity will not solve all the problems, but will make a sound contribution by deploying a minimum set of interoperability points that will facilitate portability of solutions. They are based on the so called OASC principles and their fulfilment can be facilitated by different platforms. SynchroniCity presents different cases with different platform technologies to showcase neutrality with respect to them. IoT acts as the enabling technology to make *all this* possible. It is a major source of data in cities and allows cities to actuate on the infrastructures and physical assets. It is therefore the interface to know what is happening in the city and to react accordingly.

But the world is not only technology, and even though the objectives have proved to be solid and beneficial to Europe, its cities, its citizens and its companies, this concept has to pass the financial exam, as it happens with everything around us. WP6 works precisely on those aspects that will lead the project to a scenario where potential impact is maximized. This includes activities in standards, marketing and communications, KPIs but also exploitation and sustainability. It is precisely under this task (T6.1) where this deliverable makes sense. In D6.1 we analyse the market of IoT platforms in general and in the particular context of Smart Cities. We provide insights on the driving forces and success factors of the IoT market as an enabler of Smart Cities and we reflect on the implications of those factors for SynchroniCity. We identify concrete areas where SynchroniCity may have to take decisions looking at its future sustainability and we illustrate different (financial) collaboration mechanisms between stakeholders that could help in realizing smart city projects. At the end of the document we elaborate the action lines for the upcoming period with the ambition of creating a critical mass of additional OASC-compliant deployments.

Annex 2 of this document anticipates elements of the work on IoT usage scenarios (D6.6) and explains the relationship with other activities of the project, its dependencies and main ambition of the work.

2 Motivation and scope of this work

In the ICT research community, we are very excited to work on technologies, which is the centre of gravity of our job and responsibilities. However, many years working in innovation and the experience gained through them have shown that the best technology is not necessarily the one that succeeds in the market. A suitable and (probably) innovative business model is key to attract customers and therefore make such technology useful in a real context and sustainable from an economic point of view. Other elements like marketing or ecosystem add to the list of key factors nowadays.

SynchroniCity is a project funded by public money (i.e. taxpayers' money) and as such, our responsibility goes beyond delivering a technically advanced framework for Smart Cities. Our responsibility is also working on those elements that will make the solution viable beyond the project duration, resulting in benefits for the cities and their citizens (or said in other words, SynchroniCity should obviously be able to proof a Return on Investment). For this to happen, we have set up a full area of work where project partners, with support and collaboration of external experts and

communities, will analyse major driving forces and inhibitors of the market and will define the strategy to realize the success of SynchroniCity in real environments, in our cities.

A successful strategy should be able to bring benefits/value to all participating stakeholders. This will be further analysed in the so-called Exploitation and Sustainability Plan, a document with different versions along the project duration.

In this deliverable, we anticipate that work by analysing some elements that SynchroniCity has to take into account besides the pure technical considerations and that relate very much to the market it aims to create.

It is a short deliverable that points out critical aspects that should never be subject of analysis at the end of the project, but in its initial phase. It is not our ambition, however, to perform a long market research of the IoT landscape or an analysis of the state of the art of Smart Cities, since this has already been carried out by many others and we do not find so much value in replicating others' work. We will of course stay tuned and will follow up such developments and works as they are available.

3 Is SynchroniCity another Smart City project?

The reality is that it is not. It will of course develop a technical framework and applications, like many others, but this time the aim is not doing something better, faster or reducing the cost of an existing process. The aim is to create a Global Single Market for Smart Cities, and that changes the scope and the perspective we should apply when looking at its results. It will enable companies to target a single market instead of a myriad of fragmented markets, therefore opening up opportunities for all the stakeholders involved, since it will make possible that solutions can scale up. It may sound just as a nice speech, but the implications are of utmost importance.

If you are a company developing smart city solutions you have two options: confining your solution to a restricted environment and customers you normally know or make huge investments to conquer markets outside your boundaries, which is normally a possibility available just to big companies. The other side of the coin is also true. If you are a city you usually have to deal with the list of typical suppliers of the municipality; opening up this circle is probably a painful process that requires a lot of effort and bureaucracy that is not even worth trying. SynchroniCity will break all those rules and the status quo by making possible that solutions can be ported from one city to another one, that their creators can make business in many other cities in Europe if they wish, and that cities can enjoy a richer environment of suppliers and providers, leading to more competition and thus more competitive solutions.

This, in turn, will result in a better negotiation position for cities, which will be empowered to demand more open environments, avoiding vendor lock-in approaches that have been common practice in the last years.

People can move freely (or almost) within the European Union; this is starting to happen also with data thanks to the policy initiatives pushed forward by the European Commission (such as the *free flow of data*). If the Schengen Area (with its population of over 400 million people and an area of 4,312,099 square kilometres¹) allows people to move freely across frontiers and soon we will also enjoy a "Schengen of data", *should not we think as a logical next step that applications and services -based precisely on people and data- should also move across borders?*

The *glocal* perspective (think global, act local) is more needed than ever. While citizens should be provided with personalized services based on their context, the ambition should be global. In fact, deployment of a service or an application in different cities and the way the service itself is provided is all part of the evolving context of an entity, be it a city or a citizen.

¹ Source: wikipedia

4 Where is IoT in this picture?

IoT has become one of the most powerful data sources and makes possible that we are able to sense or monitor what is happening in real life infrastructures and environments. Furthermore, IoT enables us to act on those physical elements. As such, it is a technology that establishes a channel between the physical and the virtual world. The amount of data generated by IoT devices enables the creation of a virtual image of a physical reality, what has been lately coined –especially in the Industry 4.0 domain- digital twin. This opens up enormous opportunities in terms of process improvement, new applications and services. An example of this is the transition from a product-oriented approach to a service-oriented approach. For example, instead of owning a car, many companies have found a business in offering pay-per-use mobility services. In the same way, while in the past drivers had to pay for an insurance based on static parameters, some insurance companies are starting to apply pricing conditions that depend on the driver's behaviour. All this is possible thanks to IoT.

In the case of Smart Cities, the relation is very intimate too. Cities are by default physical places with many infrastructure components, fixed and mobile ones. They are full of sensors and actuators, and the trend of making infrastructures smarter through IoT technologies is growing on a continuous basis. As such, Smart Cities are seen as an obvious market for IoT, while IoT is an extremely valuable tool for Smart Cities to gather a virtual copy of the physical environment (its “digital twin”) and help them to do much more than it has never been possible.

From a technical point of view, IoT presents opportunities and challenges for SynchroniCity. In the path towards a global IoT market, SynchroniCity focuses on the implementation of a minimum set of interoperability points that could help cities and their applications to talk to each other.

This entails the consideration of a high number of IoT providers, protocols and devices. At the same time, we see a wide umbrella of applications consuming data in varied forms. All this calls for inbound and outbound interfaces that all stakeholders use to get integrated into the technical ecosystem and thus, make possible that data provision and consumption happen in a transparent way to these stakeholders through platforms, under the assumption that those interfaces are fulfilled.

5 Where is the money? Not a new question, but still there

The potential impact of SynchroniCity as a project is unquestionable, but we are conscious that this is a step that will have to be followed by other steps in order for this vision to be realized. Cities like Santander, Manchester, Eindhoven, Carouge, Milan, Porto, Antwerp and Helsinki are frontrunners, and we expect others to follow and replicate these efforts as the only way to create critical mass and consequently realize a single, interoperable European space.

Furthermore, our SynchroniCity cities are showcasing the SynchroniCity concept in concrete geographical areas. An operational environment would require extending the pilots to bigger areas of the cities, and finally to the entire surface.

All these deployments constitute a smart city project with investment requirements.

By 2020, the smart cities industry is predicted to be worth \$400bn globally. Many countries are talking about making investments in smart cities, some with quite ambitious visions. India, for example, has pledged a huge investment in 100 smart city projects by the end of 2020. China is exploring how to make skyscrapers better connected with workspaces and the workers inside them. And Dubai has recently outlined its ambition to be the smartest and happiest city in the world. In the US, there is a big problem with infrastructure investment – around \$3tn is needed (the equivalent of the entire federal budget) to repair roads, bridges and city infrastructure. For those tasked with delivering it, there are questions around whether they can make the infrastructure smarter; what's less clear is how governments will get a return on all their investment.

Aleksander Poniewierski²
Global IoT Leader

Upgrading infrastructures is a process that no city can avoid. In the cases of some cities around the world, it is even an imperative and pressing issue due to the deficiencies of such infrastructures, which could cause accidents with fatal consequences³. This is also an opportunity to make them smarter, but as introduced by the text above, who pays for it? According to Black & Veatch⁴, only 16 percent of municipalities surveyed said they could self-fund a smart city initiative.

While population has been increasing, budgets have been decreasing. So, finding a suitable financial model is a pertinent topic that will not disappear just because the technology is very good. In this case, cities will look more carefully at figures than at words, and economists will become more important than engineers.

Previous work suggests different models that are being used with more or less success depending on the case and context. We have extracted a series of models from different sources, including the REPLICATE project⁵, an action funded by the Smart Cities and Communities program of the European Commission that reflects on some of those models after the analysis of lighthouse cities such as San Sebastian, Florence and Bristol.

We have worked over them and we provide below a brief summary of those models, referred to as Business Models for Smart Cities in many documents and blogs. Nevertheless, we are not sure that they fit with the complete definition of a business model, but rather with a part of it, basically referring to the stakeholders involved in the financing structure. SynchroniCity will take them to the environment of its participating cities and will check in practical terms the way they work (where they are used) or could work in future actions. They will be extended when applicable as part of the sustainability work.

5.1 Direct Public Provision

It refers to the ability of a municipality to manage the whole lifecycle of service provision, also covering the costs. No external stakeholders enter into place from a financial point of view, meaning that just few cities with relevant budgets can afford this model for some of their projects. Advantages are that there is no need to negotiate with a third party and that the city has full autonomy to support the social angle of the service (so, it could cover services without negotiating trade-offs with third parties). On the negative side, this model is seen as an inhibitor for innovation.

5.2 Public-Private Partnerships

Based on the definition provided by the PPP for Smart Cities institute⁶, a PPP is a “relationship formed between the private sector and public bodies often with the aim of introducing private sector resources and/or expertise in order to help provide and deliver public-sector assets and services”-

In this model, risk can be shared and balanced; it is considered good from the point of view of innovation, but also replicability and it can be adapted to many different kinds of projects and size of cities. Some of the negative effects reported so far include the fact that private sector prioritizes profitability to social coverage and as such, some communities could be treated unfavourably. It

² <https://www.linkedin.com/pulse/why-might-smart-citys-spirit-key-monetization-aleksander-poniewierski/>

³ According to a survey performed by the International City/County Management Association (ICMA) almost 40 percent of respondents claimed they needed additional money “to sustain infrastructure at a baseline level” and indicated that the current state of their infrastructure is hurting quality of life.

⁴ <https://www.bv.com/reports/2016/smart-cities> .

⁵ <https://replicate-project.eu/>

⁶ <http://www.pppcities.org/resources/glossary/>

therefore means that the RoI case has to be clear to the private sector. Despite that, several sources⁷ indicate that this model is considered the most effective model.

Collaboration between **Sidewalks Labs and the City of Toronto** to revamp the Waterfront area. Sidewalks Labs has committed \$50 million⁸ to an initial phase of joint planning and pilot project testing

CISCO \$1billion City Infrastructure Financing Acceleration Program⁹ to support the growth of smart city infrastructure and applications. Through Cisco Capital and its financing partners – Digital Alpha Advisors, APG Asset Management and Whitehelm Capital – the program provides debt and equity capital to facilitate smart city initiatives and offers flexible financing and payment solutions. For example, cities can choose traditional loans and leases, consumption-based financing, ‘as a service’ financing or concession financing.

Link NYC Free WiFi in New York City¹⁰, a PPP between the city and a consortium of technology companies which generates revenue through advertising.

Examples of PPPs (source: “Paying for Smart Cities: Where is the money”; Bee Smart City)

Looking at Europe, it is worth highlighting the initiative “Smart Cities and Communities” European Innovation Partnership.

5.3 Public-Private-Academic Partnerships

In this model, the responsibility of the result is shared between the public, private, and academic sectors. It is a variation or an extension of the PPP model, and it is normally suited to big investments in ICT projects, where the innovation capacity has to be high. The new actor in this model, Academia/University brings new ideas and important qualifications in concrete research topics. The Replicate project provides some examples of the lighthouse cities of the program, such as the “Bristol is Open” initiative, which is a key resource for the city created in collaboration with the University of Bristol, the City Council and several partners from the media and technology sector, such as Nokia, NEC and InterDigital. The model is also present in Florence, which is collaborating with the Universitat Degli Studi di Firenze (UNIFI) and the Consiglio Nazionale delle Ricerche (CNR).

In this kind of models, it is usually recommended to use co-creation techniques to avoid too technological and disruptive approaches that are not accepted by the society.

5.4 Public-Private-People Partnerships (4P)

This model is another variation of the PPP one. In this case, the citizen is key and pays an important role in the innovation process. Because of that reason, it is considered to fulfil major elements such as economic viability, environmental sustainability and social acceptance, each of them reflecting the priorities of the different stakeholders.

⁷ A survey carried out by Black & Veatch shows that three-quarters of respondents consider PPPs to be the most effective financing model for smart city initiatives, followed by government grants/subsidies (52%); tax incentives (41.7%); and property taxes (12.%). Only 8.1% and 5.5% respectively thought purely municipal or private funds were the way to go. See report in <https://www.bv.com/reports/2016/smart-cities>.

⁸ <https://sidewalktoronto.ca/wp-content/uploads/2017/10/Sidewalk-Toronto-Press-Release.pdf>

⁹ <https://www.cisco.com/c/en/us/solutions/industries/smart-connected-communities/financing.html>

¹⁰ <https://www.link.nyc/>

5.5 Citizen co-creation and co-production

In this case, there is a direct two-way relationship between the public and the local government or administration as major difference with respect to the 4P model. The model does not fit with all types of projects but can be especially useful in cases where the social acceptance is particularly relevant. A lot of information about co-creation is provided by SynchroniCity in WP1.

5.6 Government subsidies

Under this label, we include all those projects that benefit from subsidies from governmental institutions and agencies. Main objective is to create incentives in the market and help to create an ecosystem around which further infrastructures and services will be created.

“India’s Smart Cities Mission¹¹ aims to create 100 smart cities in the country as model for development and to bring improvements to nearby cities and towns. A total of ₹98,000 crore (\$15 billion) has been approved by the Indian Cabinet for the development of 100 smart cities and rejuvenation of 500 others over five years. Each city is expected to receive approximately 100 crore (\$15 million) per city per year. Cities are selected through the Smart Cities Challenge, based on feasibility and potential impact. Each city will create a corporate company headed by a full-time CEO to implement the Smart Cities Mission. Central and state government will provide core funding to the company and it has to raise additional funds through debt or equity”.

“The **Government of Canada¹²** is challenging communities to come forward with their best ideas to improve the lives of their residents through innovation, data and connected technology. Each community must define a Challenge Statement and outline the outcome it aims to achieve by implementing its proposal. One prize of up to \$50 million is available to cities of any size, as well as smaller prizes based on population”

“Australia’s \$50 million competitive Smart Cities and Suburbs Program¹³ supports projects that apply innovative technology-based solutions to urban challenges. Grants of \$100,000 to \$5 million have been made available to cover up to 50% of eligible projects’ costs.”

“Thanks to the **Smart City Challenge¹⁴**, the US Department of Transportation (DOT) committed up to \$40 million to the winning city – Columbus in Ohio – for its idea on how to create an integrated smart transportation system to help people and goods move more efficiently. This was alongside up to \$10 million from Vulcan Inc. to supplement the \$90 million that the city had already raised from other private partners. The DOT also announced an additional \$65 million in grants to support advanced technology transportation projects in cities across America”

Examples from “Paying for Smart Cities: Where is the money”; Bee Smart City

The Smart Cities and Communities initiative of the European Commission’s Horizon 2020 program fits within this model even though could also be considered a combination of some of the models described so far (since co-funding by private sector is also sought and that is why the reference was also included as part of the PPP model).

5.7 Civic crowdfunding

In this case, funds provided by the public and private sectors are complemented by the small financial contribution of many citizens that could be materialized as donations, reward-based schemes,

¹¹ <http://smartcities.gov.in/>

¹² https://www.canada.ca/en/office-infrastructure/news/2017/11/backgrounder_smartcitieschallenge.html

¹³ <https://www.business.gov.au/assistance/smart-cities-and-suburbs-program>

¹⁴ <https://www.transportation.gov/briefing-room/us-department-transportation-announces-columbus-winner-unprecedented-40-million-smart>

community shares or municipal bonds. This model has a high potential in terms of citizen engagement, since there is the need to inform investors about the way the money is being spent. In some cases, participation goes beyond the pure financial aspect.

According to Future Cities Catapult 90% of UK local authorities are not aware of this mechanism despite its revolutionary potential. One of the projects FCC has in this area with civic crowd funder Spacehive and KPMG is intended to demonstrate such potential by supporting the Manchester City Council and the city of Hull. Both FCC and Manchester are partners of SynchroniCity.

6 Driving forces of the IoT market, as explained by experts

The title sounds a bit provocative, but we want to emphasize on the one hand that this work comes from the analysis of hundreds of available reports on the subject (i.e. no additional creativity is provided by SynchroniCity apart from making a critical assessment of the information). On the other hand, the concepts, factors and elements that are pointed out in this chapter seem to have the consensus of the IoT community, and thus they are perfectly accepted, established and taken for granted for our work. That is why we state that they come from “experts” and we do not argue about them.

6.1 IoT Platforms

At the core of IoT capabilities, we find the IoT platforms that connect devices, extract data and provide different functionalities. We have realized that the concept “platform” is used to refer to many different platforms. Some of them are based on hardware, such as Arduino, Raspberry Pi, and Beaglebone Black, which are focused on building hardware prototypes with the appropriate chipsets and connectivity pre-embedded for use by IoT developers, as stated by Global Data¹⁵. Some other platforms manage data connectivity only; a good number of them are built around connectivity management, while some others focus on application enablement. Some providers include as part of the concept services related to infrastructure (cloud, HPC). All in all, we are not surprised that with that variety of functions more than 500 IoT platforms are currently available in the market¹⁶. Yes, 500! And they are not research efforts (this would add a good number of additional platforms to the list), but operational products/assets any organization can use.

Reports point out the penetration of Telecom Operators in this market, who have seen a relevant channel for additional revenues to their communication services, where ARPU has been decreasing in the last years. Thus, IoT provides a logical business path for them. Most documents devote particular attention to IoT platforms in the manufacturing domain or the so-called Industry 4.0 area. Sometimes they are known as Industrial IoT Platforms.

In general terms, even though some platforms address specific verticals, most of them are conceived as horizontal platforms that could be applied to different application domains, and as such, sometimes they are commercialized under different brand names and adapted to different customer segments accordingly.

For an overall understanding of what is expected from these IoT platforms in real terms, we compile in the following list the functionalities that we have extracted from a number of reports and presentations. Some of them may overlap depending on the definition, but the idea is to give a glimpse of what it is available nowadays:

- Connectivity services.
- Device management.
- Vertical-specific end-to-end IoT stacks.

¹⁵ IoT Monetization: Review of IoT Technology and Enabling Platforms (GlobalData, 2018)

¹⁶ Source: IoT Analytics

- Managed services to host, Cloud backend and IaaS
- Consulting and advisory services to help businesses design, create, monetize, and manage their IoT deployments. As part of application enablement we find concepts like ecosystem or marketplace.
- Implementation services.
- Big Data/advanced analytics
- Security components

From a non-functional point of view: pricing options, business model, scalability, usability, interoperability, modularity, Open Source, or partner ecosystem appear as the most cited items.

According to IoT Analytics¹⁷, most vendors cover between 60-100% of the technical building blocks they analyse in their report (included as part of our list), Microsoft and Amazon AWS are clear market leaders, IoT platforms do not share common pricing structures, most platforms have a horizontal approach to end-user markets and work heavily in setting up partnership ecosystems around them, and finally, last years have given birth to a more informed and conscious demand side that requests no vendor lock-in.

6.1.1 Who is part of the IoT platform vendor ecosystem?

ADAMOS IIoTPlatform, BOSCH, Centrsight (Device Insight), Predix, Lumada by HITACHI, OceanConnect by HUAWEI, IBM Watson IoT by IBM, KaaloT, Azure IoT Suite by Microsoft, SmartObjects by MNUbo, ThingWorx by PTC, SAP, MindSphere by SIEMENS, Cumulocity by SOFTWARE AG, DeviceWiseIoT Platform by TELIT are just a sample of those 500 commercial IoT platforms that we mentioned before. Some major providers are represented in the following picture are subject to comparison on a yearly basis by analysts based on their performance and fulfilment of the capabilities that we have previously introduced.



Figure 1. Sample of IoT Platform providers

6.1.2 What about the supply side in Smart Cities?

SynchroniCity is not only looking at the literature, but interacts with major players in the domain and has an active participation in major smart city fora. From an industrial point of view, the most relevant appointment we have on an annual basis to understand both the supply and demand forces is the Smart City Expo World Congress¹⁸ (SCEWC). The 2017 edition reached almost 20.000 attendees

¹⁷ IoT Platforms Vendor Comparison 2018

¹⁸ <http://www.smartcityexpo.com/>

and counted on a very active presence of SynchroniCity. There we could confirm the increasing interest in the market, now driven by the demand side much more than some years ago where IT players were pushing for their technologies to be deployed with a more doubtful RoI for the cities. At this stage, cities acknowledge their problems and needs and look for innovative solutions to address them in a cost effective way. In fact, more than 700 cities from 120 countries were represented.

Looking at the IoT platform angle, as this is the subject of analysis now, we could see exactly the same panorama that has been described in more general terms before. Not all platform providers have their offering for smart cities, but we see many of the aforementioned providers investing in the domain. For this particular sector, we see emerging technological platforms from (physical) infrastructure providers, as a logical evolution of the process of making their infrastructures and systems smarter. Topics of major interest in SCEWC 2017 were, as ranked by the organization: (1) Data, (2) mobility and (3) Sustainability. Finally, a very evident trend is the setting up of ecosystems where corporates collaborate with start-ups.

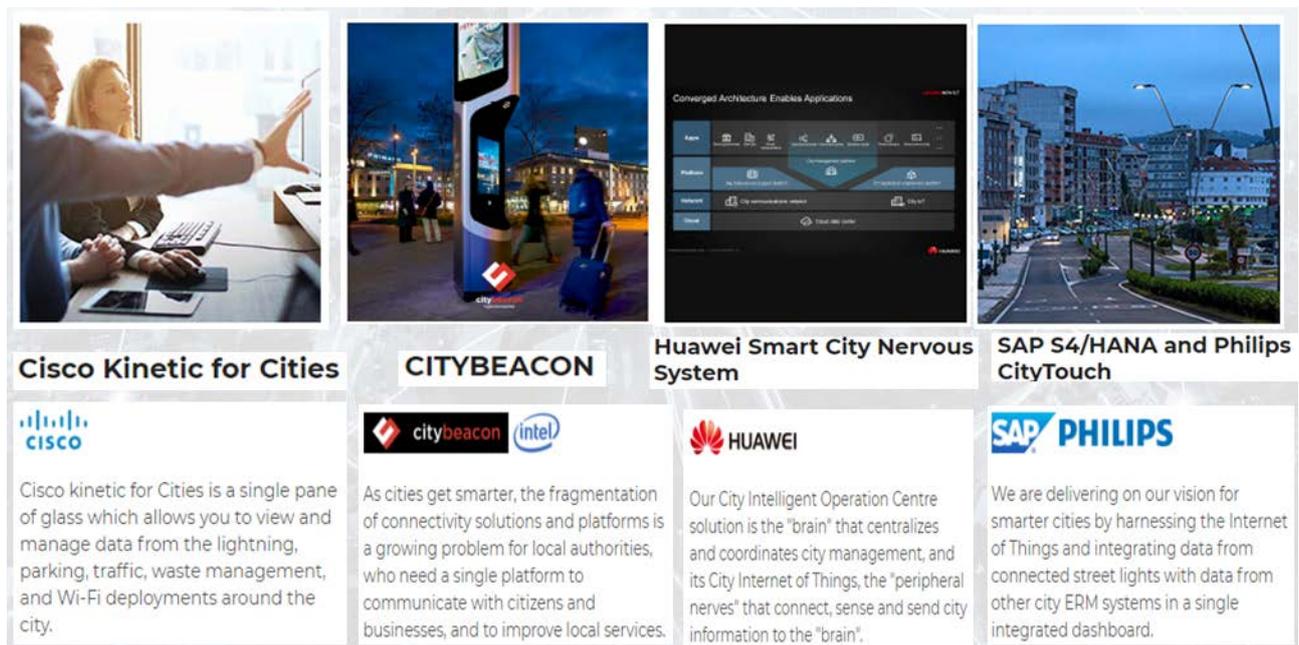


Figure 2. Some Smart City Platform solutions that we could see at SCEWC 2017

6.1.3 Umm...do we need more platforms?

Looking at the list of vendors and number of IoT platforms available in the market one would argue if more platforms are needed. We think this is not needed, even though extensions could be added to existing ecosystems based on the evolution of technologies and needs. This does not mean that no more platforms will appear in the market. That will probably be the case for specific customer segments, especially regarding concrete vertical applications or very specialized requirements of some users (e.g. big versus small firms). In fact, if we follow the Digitizing EU Industry strategy of the EC we can see that a huge investment will be devoted again to platforms or digital platforms, but the focus will be on technology integration, standards and interoperability.

It is in those areas where activities will be reinforced and pushed forward, and it is precisely in those areas where SynchroniCity plays a relevant role when it comes to the Smart City environment. In fact, SynchroniCity adopts a neutral position with regard to platforms. It does not impose one or the other, but suggests platforms that could be helpful in implementing the minimum set of interoperability points inspired by the OASC principles.

Even though Open Source is encouraged because of the principle of openness, we acknowledge that many legacy systems are not OSS. Therefore, solutions should be able to cope with a multiplicity of platforms and systems. For scalability reasons the best way to proceed is to reach consensus

around interoperability points and then provide the information and means to enable players to join the ecosystem. APIs are used as main mechanism for data sharing.

Without any guidance, communication with cities (as main target of SynchroniCity) would probably be unsuccessful. That is why SynchroniCity has made available its Reference Architecture (initial and updated versions in D2.1 and D2.10 respectively) as well as guidelines for the integration of IoT devices in OASC compliant platforms (see D2.6, also available from the SynchroniCity project website).

6.2 Success factors for cross-cutting services and platforms

PWC, in its study on “Cross-Cutting Business Models for IoT” commanded by the EC and presented at the 2017 edition of the Net Futures conference, provides a lot of information about the IoT market and its driving forces to enable cross-cutting business models. From that information, we have paid special attention to the identification of those success factors that will make possible the emergence of cross-cutting platforms, services and business models. We briefly depict and comment them here in connection with SynchroniCity strengths.

- **Openness and monetization of data**

According to Oxford Economics Study, “despite the huge revenue potential of data monetization, only 8% of businesses are actually using more than 25% of their IoT data”. However, most companies recognize the value of data. Challenges like understanding which data is valuable, what can be done with it, data quality, curation or reusability are barriers to maximize the potential value of data. Platforms that ease these operations and facilitate monetization will be the winners. As a result, we clearly see that availability of data sources and therefore access to datasets is crucial and that is why SynchroniCity has a strong focus on making data sources available (a specific KPI on growing amount of data made open by cities is part of our evaluation framework).

- **IoT Platforms**

The concept of platform as an enabler to capture, store, process and expose data, among other functionalities comes again to the picture as the major tool for IoT-based business models and therefore as the basis for the IoT ecosystems. This point was addressed in more detail in the previous section.

- **Security, data protection and privacy**

The more connected we are, the more vulnerabilities we have. In the same way we have ever-growing possibilities to create new applications, we also risk potential attacks that could compromise our security. Let’s imagine the implications of intercepting an infrastructure element of the road and sending wrong data to an autonomous car. At this stage, you have probably imagined what could happen and no more words are needed to understand how important this criterion is. In fact, it is not just you and me. Security concerns are the biggest obstacle in implementing IoT projects according to the IoT Study performed by IDG Research Services in cooperation with SAP, Samsung and other partners. Almost 44% of respondents indicated that in the survey run by the well-known business analyst company, as reflected in the following diagram.

What are the greatest obstacles In the Implementation of IoT projects?

Multiple answers possible. Basis: n = 369



Figure 3. Security is still the most important concern for investors in IoT (source: IDG Research Services)

When it comes to data protection and privacy we see the reluctance of some (most) players to share data, since this is perceived as a sensitive assets and therefore something you may not want to give up to your competitors. Companies still have a lot of doubts about who is the owner of the data (which is normal, because in some cases this is obvious, while in others the situation may be totally open and uncertain). In the specific case of Smart Cities, which is the interesting one for us, data protection and privacy become extremely important. In many applications, data is subject to the new GDPR regulation and there is an inherent fear to lose ownership of data that is produced with public money, especially when cities set up partnerships with private companies, always eager to capture the biggest benefit, which nowadays resides in data. We are all tired of listening that expression of “data is the new oil”, but even if we are tired of so much repetition, who could go against that statement?

Kurtis McBride, co-founder and chief executive officer of Miovision, frames the debate of monetizing Smart Cities in the context of the Center for International Governance Innovation and looking at the Data Strategy of Canadian cities¹⁹. The article brings attention to the growing amount of data generated by Smart Cities thanks to connected infrastructures (mainly enabled through IoT) but also by the interaction of users with that infrastructure. Two main fears or challenges are raised: a) control of data and b) profit from data. The first point is linked to data ownership while the second addresses the exploitation and monetization of data. Cities have to care and react quickly about it before becoming “google cities”, making an explicit reference to big IT companies that have focused their interest on such data.

In Europe, we tend to say that we have lost the battle of B2C platforms (and therefore data) but we still have a stake on B2B platforms. Be this true or not, our cities will probably want to avoid becoming a google city and at the same time making sure that other Telecom or IT giant in Europe does not take all the benefits of public investments. This leads to the conclusion that cities should have mechanisms to control who accesses the data, for what and define liabilities when consequences in

¹⁹ <https://www.cigionline.org/articles/monetizing-smart-city-data>

service provision happen as a consequence of the bad use or quality of the data sets as well because of security breaches.

- **Legislative and regulatory environment**

No regulation is bad; overregulation is bad; where is the middle point that could be considered a suitable solution to this issue? Regulation cannot be the only answer in the same way that technology cannot be the only answer. Combination of both will probably be the closest to the best available solution. According to the University of Colorado School of Law and as described by PWC in its study, main problems in regulating IoT are:

- “Discrimination: big data analysis might lead to illegal economic discrimination
- Privacy: protecting privacy of IoT devices through anonymization is particularly unlikely to succeed
- Security: current data security laws are not yet ready to apply to security problems related to the inherently vulnerable nature of IoT devices
- Consent: end-user consent is not the ideal approach in the context of IoT devices”

However, some progress has been attained in the last year thanks to the approval of the GDPR, in order to overcome limitations of current directives (e.g. privacy-by-design, notification of security breaches, etc.), enforcement of Open Data policies in Member States and support to open up other elements of the city (not only data) that are owned by private companies (such as some infrastructures).

- **Interoperability and standardization**

Business analysts agree on the value of interoperability. According to McKinsey, “situations in which two or more IoT systems must work together can account for 40% of the IoT total potential economic value. Without solving the interoperability concerns, the maximum value of applications would be limited to \$7 trillion by 2025, rather than \$11.1 trillion”. In the same direction goes the assessment of PWC by stating that “Interoperability is a critical source of value in IoT ecosystems”. As we can see in the following picture, it is precisely in smart cities that we find one of the most evident examples of the value potential requiring interoperability.

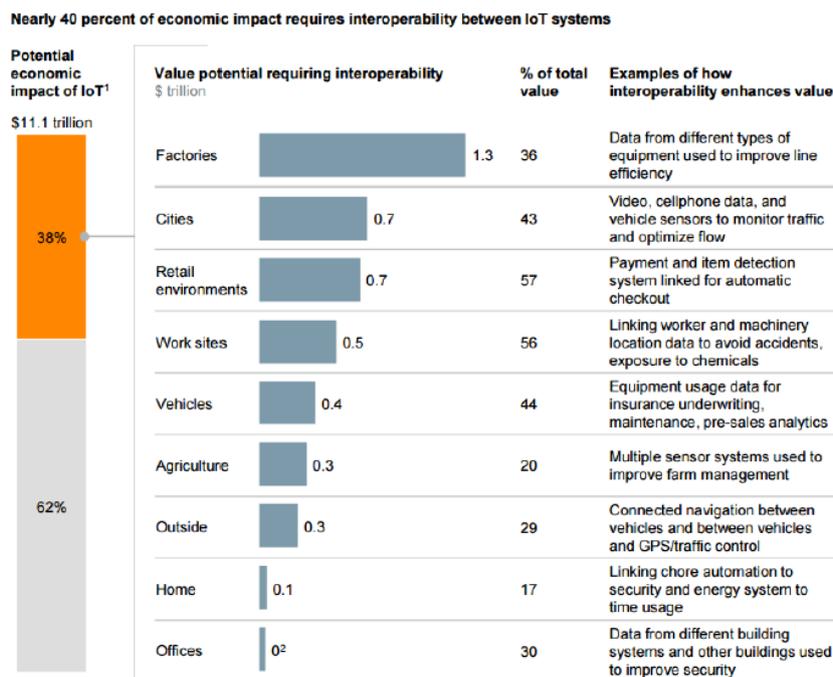


Figure 4. Interoperability is a source of value (source: McKinsey Global Institute Analysis)

Semantic integration and adoption of open standards are vehicles to achieve interoperability, and as such, both of them are used by SynchroniCity.

- **Education and promotion of IoT skills**

The challenge of skills is a long-term problem that unfortunately requires solutions in the short-to-medium term due to the shortage of professionals with the relevant skills to drive the digital transformation of companies (and of course cities). In addition, many technologies will not only make possible that we do the *same* things faster, cheaper, etc, but will change the things we do and how we do them. This requires high flexibility and adaptability for which a great percentage of the population is not ready. SynchroniCity plays the citizen and the cities in the center and maximizes the usage of co-creation tools to ensure engagement of citizens in the innovation process. In fact, reference zones selected for the deployments are Living Labs used by the municipalities precisely for user engagement purposes. As mentioned, not only the final users require those skills; workers in companies and Public Administration will be affected by the same wave of changes. In SynchroniCity we deal in a direct way with the representatives of the Municipalities. It is probably a slow process for some objectives, but that relationship is a very rich one and should not be replaced by a link to the technical provider of the city even though this could seem easier sometimes (especially if you have a technical profile). Initiatives in other programs such as the so called Big Data Value Public-Private Partnership should be analysed for inspiration. For example, the European Data Science Academy (EDSA) has been working on the curricula and competencies of data scientists, and provides a wide range of MOOCS, while projects like BDVe provide skills-related tools such as the Big Data Value Education Hub (a repository that compiles the offering of European masters on Big Data and allows users to filter and do intelligent search) or recognition programs to align curricula with competencies required by industry. This scenario could be easily extrapolated to IoT (acknowledging that some disciplines will probably be common).

- **Transparency in the IoT value chain**

It is demonstrated that customers select IoT vendors by their technological expertise, trust in the vendor, and industry expertise. Trust and transparency are therefore key factors. The picture below shows the result of the answers to that question in the context of the previously referenced “IoT Study” by IDG.

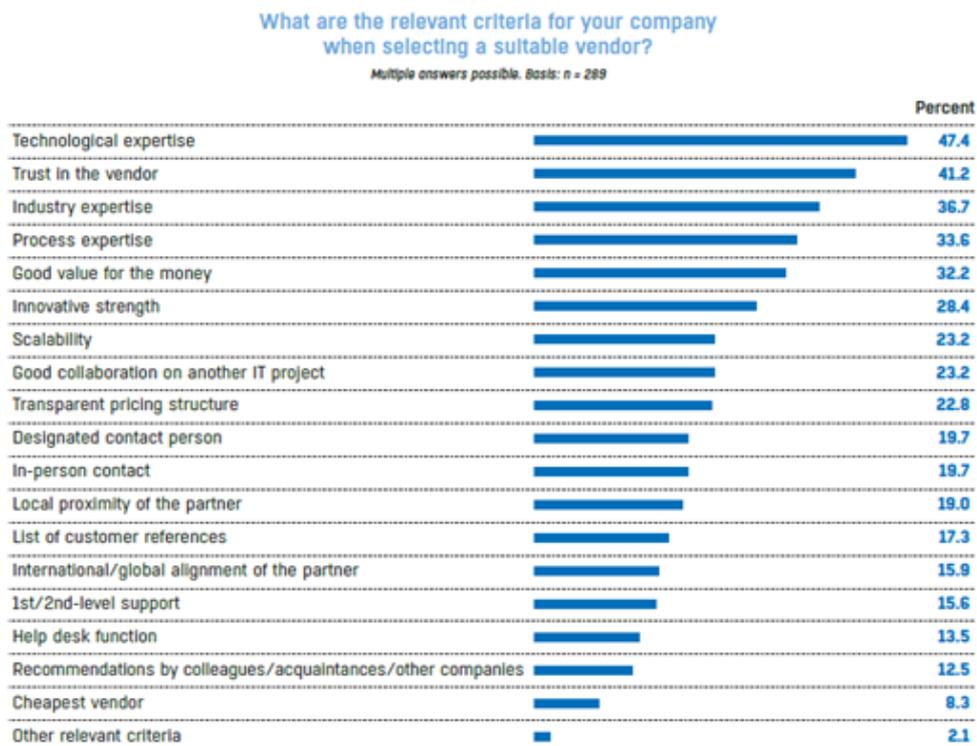


Figure 5. Trust is a relevant criterion to select IoT providers (source: IDG)

- **Demonstrate Rol and value**

The lack of compelling uses cases that exemplify Rol or cost-benefit ratios prevent some organizations from investing in IoT. This is a problem we find in many other technical areas (a clear example is data analytics), where customers have already gone through previous technology waves without clear success and need more tangible expectations before taking a step ahead.

SynchroniCity will collect examples from all the participating cities and will elaborate cost-benefit analysis for all of them. Even though results may not be 100% accurate, since they will be based on limited data sets, they will help us to understand from where we can extract maximum value and will give evidence of major cost elements and most successful business models.

7 Emerging opportunities people (just) talk about

We have decided to create a separate chapter to give visibility to some topics that –even though they are somehow tackled in the previous section- we think that are not sufficiently covered by current activities and reports made available by analysts. They will require more effort in order to understand the implications in the context of SynchroniCity. We have used the title “Driving forces of the IoT market, as explained by experts” in the previous section to refer to the fact that those factors and elements are constantly repeated by consulting companies, IT providers and even policy makers (“the experts”); therefore, someone familiar with IoT would not be surprised about the list exposed there.

In this chapter, we want to go deeper into some factors where the information we have found is rather general and stays in the surface of the challenge or the opportunity. Nevertheless, these elements are essential building blocks to define the SynchroniCity strategy in its widest sense. They could even be differentiating factors to make the outcomes of this project commercially viable and economically sustainable after the project’s financial support.

We have selected three topics, but this should not be understood as if they were the only ones. We will have a look at the real opportunities of the platform economy now that we have seen that IoT platforms are essential elements of the ecosystem; we will try to understand in which way that “oil” (the data) can be widely used and monetized in SynchroniCity and finally, we will reflect about the data silo problem, which affects almost all sectors, including undoubtedly the one of Smart Cities.

7.1 The Platform economy and multi-sided markets

If we have a look at what has happened with companies like Facebook or twitter we realize that they have created ecosystems (or platforms) where different stakeholders have found opportunities and benefits by contributing to it. The same happens for example with operating systems like Android that we have in our mobile phone. The benefit for users does not only come with the basic functionalities of the Operating System or with its performance (even if this is also important). A lot of added value is generated thanks to the contributions of third parties and in this particular case the wide umbrella of applications that are offered to the user.

The platform provider benefits from all these added-value applications, which trigger a critical mass of users. App developers can use a platform that they have not developed and they do not own thanks to the availability of APIs and can address a public that would be totally unreachable on their own. The more applications are available, the more interesting the Operating System (or the platform) is for the user. So, growth on one side feeds growth on the other side, thus, generating what it is known as “multi-sided markets”.

How can this be applied to SynchroniCity? It is exactly the same concept. Cities in our project have different IoT platforms that are compliant with OASC principles. Platforms are the entry point for developers of applications and services (different interfaces could be used depending on the specific application; for example, an app may just consume data accessible through the marketplace, but

could also use other functionalities and interact with the physical infrastructure of the city (that could be the case of an application that turns on the lights depending on the presence of people in the area). The more applications and services are developed on top of the capabilities offered by the Municipality, the more interesting the platform will be for users and for the city. Looking at the fact that a major added value of SynchroniCity is the ability to make platforms “talk to each other” facilitating app portability, the more activity/dynamics happen on it, the more it will be considered as a source for other cities who could benefit from those services. The “data marketplace” part would benefit exactly in the same manner.

Critical mass is therefore an issue when it comes to sustainability.

According to Atos²⁰, there are four factors that must be combined to create an effective multi-sided market: 1) Public Interest (i.e. the initiative must be beneficial to the city and its citizens), 2) Public Engagement (citizens should participate and “feel a measure of ownership”; new apps attract users and creates a snowball effect in which others are encouraged to get involved, 3) Business Viability (“there must be real opportunities for profitable business and a reasonable return on investment”) and 4) Market Opportunities (“one of the most important aspects of the multi-sided approach is that it creates a marketplace in which smaller players can engage and build their own businesses. This is where Smart City initiatives really start to evolve and take off: when innovative smaller companies see new opportunities for services and projects and start to expand and enrich existing initiatives”).



Figure 6. Multi-sided market practices (source: Atos)

SynchroniCity fulfils a priori all the four criteria or is at least building the basis to do so. However, we see how important it will be feeding the ecosystem. Putting the technology and waiting for it to be used will never work. A communication campaign to attract ambassadors, partnerships with major innovation stakeholders in the cities (accelerators, incubators, the startup community in general, but also corporates) will be part of the work SynchroniCity will have to intensify from now on. Winners of the open call will constitute somehow the first validators of the concept and may become such “ambassadors” for SynchroniCity.

7.2 The Power of data, Data Spaces and Marketplaces

IDC²¹ predicts that by 2020, “European organizations will expand external data sources being used in their businesses by at least 3- to 5-fold and their data delivery to the market by 80-fold or more.” According to the analyst firm, the market size is expected to increase by 36.9%, to a value of 75.7 €B in 2020. The total market value of Open Data has an estimated projection of 265- 286 €B for 2020, including inflation corrections.

Based on those predictions there is a clear need in the market for spaces where data can be exposed and accessed. In fact, a relevant amount of money will be invested by the EC in a new generation

²⁰ Position Paper “Smart Economics: a multi-sided approach to financing the Smart City”

²¹ Europe’s Data Marketplaces – Current Status and Future Perspectives (IDC, June 2016)

of industrial and personal data platforms. They can be shaped in different ways, being the marketplace a straightforward structure to make it happen. In the last years, however, we have seen the proliferation of some marketplaces, but not all of them work well. A pre-requisite is that datasets are of interest, big in volume and of high quality. It should be easy to use for both data providers and data consumers and should guarantee secured transactions. We saw before the reluctance of some data owners to share their data because of lack of trust or the impression that current platforms are not secure enough. Therefore, it does not matter if the model is centralized or decentralized, but security at all levels is a must. Once again, dynamics will be created only if a critical mass is achieved. Availability of high-quality datasets requires efforts and resources in curating data and performing the necessary data management actions. In this respect, any mechanism to facilitate integration and combination of heterogeneous data sets will be highly appreciated by the user. If we look at examples of big investments made by the European Commission on data platforms, we can learn some lessons. The previous version of the European Data Portal contained a lot of datasets but they were not easy-to-use; the result was that few companies were accessing it and capitalizing such investment. The same happens in the domain of Earth Observation, where Europe has invested enormous amounts of money. Copernicus data has been available and accessible for free for several years with little success. This was an evident consequence of the difficulty users had to access such data and perform analytics on top of them. Data was there, but there were no suitable mechanisms to generate value out of those data or said in other words, data is not valuable if it cannot be transformed into knowledge. As a result of this, the EC has invested in what it is called DIAS²² (Data and Information Access Services), i.e. a platform layer that facilitates access and advanced analytics on Copernicus data. Five contracts have been awarded to different European consortia to realize such data platforms and exploit the full potential of Copernicus data.

SynchroniCity has the ambition to foster data sharing in smart cities and some of our KPIs are aligned with the expected growth of data to be made open and available by cities. Decisions that could be relevant at the next stage have to do with the intention to deal just with open data or facilitate transactions that involve closed data. In addition, an important element we will have to analyse is the cost of performing some data management operations (e.g. data curation and cleansing). The effort this entails should not be disregarded and may require a business model where users pay for some services, helping cities to cover at least the operational costs. This reflection can be extended to the service infrastructure used by cities, where models like PPP could be exploited. In a more ambitious scenario, cities could think about enabling “data enrichers” to create layers of added-value services on top of the data. This will attract users but on the other hand will generate a source of revenue for all these players. In the case of open and publicly funded data, some of the revenues should obviously come back to cities and citizens. Business models will have to be driven by a fair distribute of value and revenues.

We will pay attention to the usage of resources made by the winners of the SynchroniCity Open Call to understand strengths and weaknesses of the marketplace and react accordingly.

Some examples of current and emerging data marketplaces, as described by the IDC report include Data.com/Salesforce, Experian plc, Oracle BlueKai, Microsoft Azure Marketplace, Amazon AWS Public Data Sets, Google Public Data Explorer, Datamarket/Qlik or DAWEX.

We finish this chapter with a concrete case of an Open Data Portal that could trigger some inspiration:

The British Ordnance Survey ltd Open Data Portal

As a non-profit organization, this British government organization, the oldest national mapping agency in the world, provides maps and other geographic data to consumers, government and businesses: for instance, to utilities who are planning installation and maintenance of infrastructure. Their mission is to promote the re-use of Public Sector Information (PSI). To this end they offer open data services as well as premium data services with a licensing model.

²² <http://copernicus.eu/news/upcoming-copernicus-data-and-information-access-services-dias>

Source: Europe's Data Marketplaces – Current Status and Future Perspectives (IDC, June 2016)

7.3 The Data Silo problem

As we have seen through some of the referenced studies, most of the benefits will come from the integration of different data sources and the repurposing of data (i.e. using data for purposes for which it was not initially through about). But we still live in silos; that is the reality. Current structures do not support data sharing between sectors, between applications or between systems. Just looking at Public Administration a lot of data is provided in different formats just for concrete operations, despite the fact that changes in the tendering processes could oblige or encourage service providers to provide by default data generated by their processes in specific formats. In this WP we will look carefully at the usage of data made available by the cities and to which extent different sectorial or application-based datasets are combined by SMEs and start-ups to give birth to new applications. An assessment will be made and actions will be defined in accordance to the results.

8 And now, what? Next steps for SynchroniCity

SynchroniCity is now more or less at its halfway point. While the first phase of the project has focused on translating OASC principles to concrete technical decisions and assets that have given birth to the reference architecture, data models or guidelines, as well as preparing the Open call, the second part will address the deployment and piloting phase, with high involvement of the cities, the winners of the open call (a part of the IoT ecosystem generated around the city platforms) and the validation of the interoperability principles defined by OASC and implemented by SynchroniCity. We will see how attainable is the ambition of creating a global Smart City market, starting with a European version of it. The second phase will also be crucial to understand the dynamics of the ecosystems, the usage of resources, barriers, opportunities, value flows and business models. Furthermore it will be time to think about who pays for what and make sure that the investments made by SynchroniCity translate into value for all the involved stakeholders and become sustainable over the time. In this context we see a transition from the pilots deployed in SynchroniCity to full operational solutions. This transition would require additional investments and the decision-making process will imperatively require a careful cost-benefit analysis.

SynchroniCity will mainly work in the following areas regarding exploitation and sustainability:

- Scenarios on IoT usage, to understand the business elements of the ecosystem and the interaction between assets and stakeholders, as well as business models. See annex II for an introduction on this subject.
- Cost-benefit and value flow analysis of the cities involved in the project looking at an extension either of the geographical areas, the application domains or both
- Extending the reach of SynchroniCity by involving other cities and aiming at achieving a critical mass of OASC-compliant cities in Europe. For this, the OASC association will be instrumental and SynchroniCity should be used as proof of concept to help cities that adhered to the OASC manifesto to take a step further in the implementation of their strategies

8.1 The role of OASC in extending the reach and replicating efforts

OASC currently accounts for 117 cities from 24 countries and regions in Europe, Latin America and Asia-Pacific. SynchroniCity has an advantageous starting point, because projects usually define their target audience as potential users or customers that are out of the solution development. So, the speech to convince that target audience about the value is a critical point of success. However, cities in OASC have already committed to OASC principles and as such, they do not need to be convinced about the benefits of what SynchroniCity is doing. Rather than that, they need to be supported and accompanied in the process to go from the strategy to implementation, from the analysis to

deployment. And this requires resources. Yes, that is the tricky point where successful ROI examples of the cities participating in SynchroniCity will be of enormous help. In addition, we will look for funding opportunities that can ease the process of external cities.

The difficulties of entering the ecosystem of cities as well as the interest to become part of it will be measured by the results of the Open Call, where cities were also invited to participate.



Figure 7. Map of OASC cities in Europe (source: OASC²³)

8.2 Capturing funding and capitalizing Structural Funds

Since financial support will be needed to jump from a large scale piloting phase to a full deployment scenario, SynchroniCity will work in the second phase of the project in identifying potential funding opportunities, investors and corporates that see in PPP models with cities a good business opportunity. In this context, and even though it is just an example of what can be explored, we will check planned structural funds investments in smart cities in different European regions. This will give us a view of the potential that exists in each Member State and regions within them and will help to prioritize actions.

²³ <http://oascities.org/list-of-cities/>

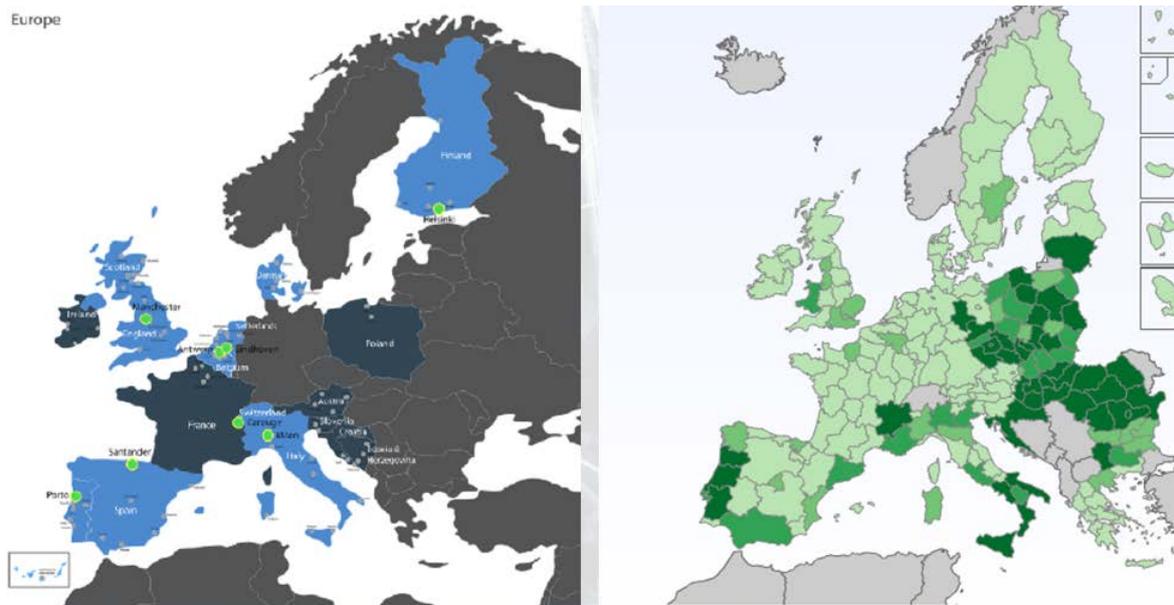


Figure 8. SynchroniCity Cities vs. Planned ICT Investments under ESIF in Smart Cities

According to the Smart Specialization Platform maintained by JRC²⁴, the planned ICT Investments under ESIF for Smart Cities will reach 2012 Million Euro. Placing the map of SynchroniCity cities and the planned investments we can see that some synergies could be exploited in some of the countries already covered by SynchroniCity. Nevertheless, the highest potential is in Eastern Countries, where major investments will be made in improving infrastructures, which could be capitalized by OASC to make those cities not only smarter, but also more interoperable with their neighbours in Eastern Europe.

9 Conclusions

The analysis reported in this document points out major challenges for the successful development of IoT ecosystems in general and in smart cities in particular, but also driving forces and success factors that could maximize the potential impact.

Most of them are common to the priorities signalled by AIOTI in its article “IoT-enabled Smart Cities: 3 priority areas in 2018”²⁵.

Major findings of AIOTI include: There is no ‘one-size-fits-all’ connectivity solution; Open Data is improving but is still fragmented and static; city projects are still vertically integrated and developed (and conceived) in silos; reusability of components is still rather limited, but some cross-domain use cases are emerging; scalability is very important, but clear RoI is a pre-condition for it; no single platform will dominate the market (this document points out that more than 500 IoT platforms are currently available in the market); Public Safety use cases will have an impact on IoT platforms. From these findings AIOTI proposes three major directions for future work, notably: Development of commercially viable cross-application use cases (looking at economic sustainability), development of solutions for data exchange and management and scaling stream processing capabilities of current IoT platforms. SynchroniCity will contribute specifically to the first two priorities and is fully aligned with that vision. D6.1 provides views on the market of IoT platforms and the major forces of the IoT landscape, it reflects critically on some of those factors and brings to the discussion some elements where SynchroniCity may have to take a concrete position looking at the future operation of the IoT ecosystems. The future is open.

²⁴ <http://s3platform.jrc.ec.europa.eu/ict-monitoring>

²⁵ <https://news.itu.int/iot-enabled-smart-cities-3-priority-areas-2018/>

10 Annex I Business models workshop @Living Labs Days

In 2017 SynchroniCity made sound contributions to the Living Labs Days event (Krakow, August 2017) looking at the business side of the discussion. We run a workshop together with the U4IoT action of the program, where attendees could *play* with “stakeholder profiles”, understand some co-creation mechanisms and use the business canvas model to define business models for different smart city applications.

We tried to encourage people to think about the data cycle, inherent costs to the processes and how data could be monetized, as well as risks of managing personal data (GDPR). Even though some interesting ideas were discussed, we realized that a) on the one hand dialog is not so easy when you have to deal with a multiplicity of profiles (supply versus demand side), languages and interests and b) on the other hand most stakeholders were not ready to jump into the details, having just a very general view of what data could mean in future smart city applications.



Smart City Ecosystem Innovation by means of Stakeholder Profiles & Business Model Canvasses

Workshop organizers:

Nathalie Stembert, Ms. Nuria de Lama

Description:

During the workshop “Smart City Ecosystem Innovation by means of Stakeholder Profiles & Business Model Canvasses” a concise training on Stakeholder Profiles was provided. The ‘Stakeholder Templates’ that are part of the U4IoT Co-Creative Workshop methodology were utilised to explore Smart City solutions from a stakeholder and end-user perspective. The stakeholder profiles were co-created in four phases, a Co-analysis, Co-design, Co-evaluation and Co-implementation phase. In these phases the profiles were generated and role-played by the participants of the workshop. Based on the generated profiles empathy was raised in order to enable SynchroniCity partners to identify themselves with the needs of the respective stakeholders and end-users.

The first half of the workshop consisted of a concise training on the Co-creative Workshop Methodology provided by U4IoT. The training enabled participants of the workshop to co-create use cases and gain insights in the needs of stakeholders by means of Stakeholder Profiles. The second half of the workshop was initiated by a concise training on Business Model Canvasses. Participants of the workshop collaborated with city representatives to create a Smart City IoT Ecosystem.

Aim:

The aim of the workshop was to introduce the Coordination and Support Action User Engagement for Large Scale Pilots in the Internet of Things (U4IoT) and the Large Scale Pilot (LSP) project SynchroniCity to OLLD attendees, among others LSP partners, city representatives, other stakeholders and end-users.

Methodology:

Based on the context of the SynchroniCity project use cases were created by means of the ‘Use Case Template’. The ‘Stakeholder Templates’ were then

utilised to explore Smart City solutions from a stakeholder and end-user perspective. Both templates are part of the U4IoT Co-Creative Workshop methodology. The insights generated from the first part of the workshop were meant to be implemented in the second half of the workshop on Business Model Canvasses to inform a Smart City IoT Ecosystem.

Outcome:

Informed by the SynchroniCity project and attending city representatives two use cases were co-created (in terms of who, what, where, when, why and how) by the participants who attended the workshop. Each group chose the three main stakeholders in their use case and worked in pairs of two participants on their Stakeholder Profiles. Due to the limited amount of time only the Co-analysis and Co-design section of the Stakeholder Profiles were completed.

Surprising insights:

- The workshop provided relevant learnings for the U4IoT Co-Creative Workshop Trainings. The Stakeholder Profiles can inform several sections of the Business Model Canvass and could provide a new view on comparing value propositions for a broader IoT ecosystem.
- Insights generated during the workshop were very beneficial for LSP partners from the SynchroniCity project and city representatives that attended the workshop. Two relevant use cases were developed. One of the use cases turned out to be also relevant in the context of other cities, providing great opportunity to be used in Smart City ecosystem development.

Next steps:

U4IoT will continue to support the LSPs in the LSP-Programme to engage end-users in their projects. The Co-Creative Workshop Methodology will be utilised for Co-Creative Workshop Trainings with LSP partners. Learnings from this workshop will be used to inform these trainings. The insights from this workshop will be integrated in the SynchroniCity project and will among others inform the design and development of a Smart City IoT ecosystem for the 11 reference zones within the project.

Figure 9. SynchroniCity workshop at Living Labs days (Krakow, August 2017)

11 Annex II. Introduction to Scenarios on IoT Usage

As part of the Sustainability Plan of SynchroniCity the project has planned an analysis of the way IoT is used by the different stakeholders in concrete applications and which business models are the most successful ones (including emerging business models enabled by the assets made available by SynchroniCity). The main purpose of this activity is understanding the consumption of resources, potential sources of revenues, major barriers experienced by the different typology of users but looking especially at the users of the OASC-compliant platforms, i.e. IoT providers and app developers, identification of new opportunities, etc. These insights should be used as feedback for the technical team but also as very valuable input to define the sustainability model once the project is over.

This is a practical activity that should have roots on the hands-on experience of the project and as such, it should be activated when start-ups and SMEs resulting from the Open Call process are actively working in their applications and services. It is also very much related to field activities, since we need to understand the interactions between stakeholders and also between apps, data, people and infrastructures, i.e. SynchroniCity “assets”. The late launch of the Open Call makes this activity dependent on the new timing and as such we consider that it will be more productive for SynchroniCity to work in the right timeframe than carrying out a desktop research disconnected from the reality of the project.

In any case, as source for inspiration and anticipating the work that will be performed in D6.6 we include here three types of information: 1) some illustrative and real smart city use cases where innovative and creative ways to fund activities (business models) have been applied; 2) a sample of operational IoT-based solutions for smart cities that can already be found and accessed through the Smart City Solution Database of Bee Smart City, and 3) the business canvas model that will be used as starting point for analyzing value flows in the IoT usage scenarios of SynchroniCity, taking as inspiration the work performed by the Replicate Project (an Innovation Action funded by the Smart Cities and Communities initiative).

11.1 Multi-sided market initiatives in Smart Cities

We give visibility here to some initiatives that fall under the concept of multi-sided markets and where we see different possibilities in terms of value creation for different stakeholders as well as potential ways to monetize data. The examples have been extracted from the position paper on Smart Economics published by Atos and previously referenced in this document.

Case 1. Energy and costs

“This project began with a city government seeking to achieve a significant reduction in its energy bills. To do that, the best available option was to replace the existing conventional street lighting with new generation LED technology, which requires only 30% of the energy now being spent on lighting the city. Unfortunately, the city had no way of paying for such an ambitious project from its own current income, so it approached a leading technology company, headquartered in the city, and proposed a joint venture approach.

The result has evolved to become a true multi-sided solution, in which the new LED lighting also includes sensors that can be used to measure traffic flows at specific points in the city in real time. This data is then monetised in a variety of ways.

- The company providing the new lighting is able to sell sensor detail to manufacturers for use in navigation systems
- Automotive companies purchasing this data gain an extra differentiator and their products attract a price premium

- Drivers now lose less time in jams, as they are automatically routed around them, and are guided directly to available parking spaces
- The city, having upgraded its lighting and gained a permanent reduction in energy costs, also gains revenue from better utilisation of parking spaces and reduction in air pollution as cars don't need driving around to find a parking place
- More visitors are attracted to the city, which benefits many of the companies trading there.

Case 2. Revitalising the city centre

“Many cities are concerned about how to reverse the general trend towards city centres becoming less attractive to visitors and less profitable to traders, due to concerns about safety and a general reduction in prosperity as a result of the post 2008 recession.

The CityPulse initiative uses data from different sources such as cameras, 3D sound detection systems and social media. The cameras count the number of people passing specific points going in and out a designated area, calculating the length of time people stay in this area, the 3D sound system measures not only the sound level and how this changes but also identifies alterations in the sound spectrum: when people start shouting for instance. Combinations of data from this variety of sources will enable data to be analysed to identify specific patterns of behaviour and indicate anomalies, including incidents of violence.

When activity that can be seen as not normal is identified the city authorities can respond in a graded way. This can begin with changes to the intensity and colour of street lighting, move onto traffic diversions and go all the way up to deployment of emergency response personnel exactly where and when it's needed. In this way, it is possible to manage the city and reduce the potential for incidents and deal with them fast and efficiently, making better use of limited resources and reducing problems for citizens. This approach contributes to public safety and makes the city a more attractive place to live. In turn, this leads to improved business prospects for traders in the city centre and encourages more people to spend time there.”

Case 3. Connected Public Transport

“Efficient public transport is a basic and essential requirement for a successful city. Passengers in their many thousands spend time on trains and buses every day- sometimes a lot of time, depending on the levels of congestion and the distances being travelled. If this time is effectively wasted then the people concerned will be frustrated and the city will cease to be as attractive to businesses, their employees and ordinary citizens as it could be.

By providing a reliable, high quality wi-fi “Connected Transport Platform” to passengers throughout their journeys it is possible to improve quality of life, make more efficient use of time and attract new citizens and businesses to the city. Building a connected transport platform requires input from multiple providers, including train and bus manufacturers, infrastructure networks, communication operators and broadband providers. They all need to benefit from their investment.

- Train and bus operators will gain revenue because passengers will be likely to select connected services rather than conventional travel options
- Service providers will gain additional traffic to their sites, increasing sales and other revenue sources
- The platform host (which could be the city government or partner) will gain revenue by charging for access to the platform
- Passengers will gain free broadband access in return for agreeing to the use of some of the data they provide:
 - This data can be sold under strictly controlled conditions to drive additional revenue growth

- It also provides a basis for development of new services provided by 3rd parties to the traveller, like use of office desks at railway or bus stations in the event of delays.”

All these examples would require a more in-depth analysis of the real flow of value and if possible to some extent quantifications of such flows. This exercise will be applied to SynchroniCity cities and some of the applications and solutions that will be deployed as a result of the Open Call. The analysis of the same application deployed in different cities will also help to understand the conditions that maximize the potential value, including those that depend on the city infrastructure and context but also the ones associated to the selected business model.

11.2 Smart City Solution DataBase

The Smart City Solution Database provided by Bee Smart City contains –at the time of submitting this document- 507 solutions from 6902 members and 469 cities.

As such it is a good reference to understand what is going on and which applications are already available. For illustrative purposes we report here some of those solutions based on IoT and falling under application lines included in SynchroniCity. From the database we can derive that The Netherlands has a very active app development ecosystem, with Amsterdam as leading city. Far from that country and still in Europe we find Germany and UK ranked fourth and fifth respectively. In terms of domain, Smart Government is the most popular one, with Smart Environment and Smart Mobility follow, very much in line with the priorities identified by the cities in SynchroniCity.

Z-Node Smart Waste Management & Smart Logistics Solution (Bochum)



Zolitron is a company based in Bochum (Germany); they develop holistic IoT and industry 4.0 solutions based on their unique Micro-Energy-Harvesting sensor technology and a cognitive Z-Cloud Analytics platform. Data of cities and companies is collected and analysed to establish innovative business or service models - especially in recycling and smart waste management.

City Alerts (Amsterdam)



City Alerts is a platform where relevant information is exchanged between emergency services during emergency incidents. It allows the instant sharing of data in between all emergency services (e.g. police, firefighters, ambulance). Every party which is involved in an emergency situation is quickly notified. The platform also uses a color-coded system where the relevant information can quickly be extracted. The color-coded system is also non-privacy-invasive which allows the transfer of otherwise not legally sharable information.

VayaMoja App (Johannesburg)

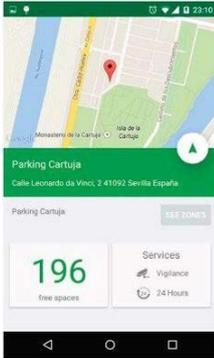
Public transportation app to foster ecomobility. It provides information to citizens on the availability of public transport, including up to date bus routes and timetable as well as on the closure of roads. The app was developed for the Eco-Mobility festival 2015, in first place, but soon the public transport mobile app solution appeared to turn into a citywide solution. The festival's intention was to foster an ecomobile future by demonstrating that public transport, walking, cycling and other forms of ecomobility are enjoyable.

Cargohopper (launched in 2009 in the city of Utrecht)

Cargohopper is a company that produces E-Trucks. The electronic trucks replace the common trucks from the city districts resulting in reduced air pollution and noise. Cargohoppers are small electric vehicles built in two different versions. Cargohopper I is a small vehicle, around 1.25m broad, but 16m total length with three box body trailers. It is able to drive 20km/h and has a maximum range of 30 km. Cargohopper II is created to deliver pallets and containers. Therefore, it has an attached

trailer and is able to drive 60km/h with a range of 200 km. There is a distribution centre outside of the city which supplies these vehicles with the shipment to deliver it directly to the customers. Since 2009, Cargohoppers deliver within the inner city of Utrecht. In 2013, Enschede also decided to go with it. Amsterdam participates since 2014 and Groningen since 2015. These vehicles are the only ones in the Netherlands to drive in the city besides the Dutch postal service, and the delivery services TNT and DHL.

WeGo&Park - An intelligent parking space detection system (launched in 2015 in Sevilla, Spain)



WeGo&Park is an intelligent parking space detection system that is based on a novel detection method using distributed video processing in real time from a network of cameras strategically placed to cover the desired parking area. This kind of solution is much more economical and versatile than ground based sensors. Parking availability can be searched by users of any type of vehicle. Thanks to the system, they will be able to quickly and simply find available parking in their driving vicinity or close to their destination, avoiding unnecessary lost time. The camera technology reduces infrastructure costs when compared to implementation of sensors on the pavement.

11.3 Business Canvas as tool for business analysis of IoT usage scenarios

Previous examples show the way IoT is used in different contexts with a business purpose; furthermore, the multi-sided market initiatives depicted above complement how data can be monetized and the way different stakeholders can get benefits from their contribution to the (platform) ecosystem. In SynchroniCity would like to extract reference examples too, to get a myriad of applications and services and understand the way they exploit IoT technologies and data and which business models are applied (and which are the results). This will require going through real deployments, which is the focus of the Open Call that closes on September 30.

In order to extract maximum information about value flows we will use the Business Model Canvas (BMC) approach. SynchroniCity will explore different tools and methodologies that can facilitate the work, but at this stage we have ended up with two variations of such model that will be more suited to our objectives.

The first one is the **City Model Canvas**, which emerges from BMC for mission-driven organisations and from the 'triple layered' BMC and has been proposed by the Replicate project.

The second one is the **DemoX framework** supported by Siemens. It is a conceptual model (with canvas) in the form of an ontology describing the aspects of supply and demand trends in data-driven ecosystem. It helps to understand the opportunities along the data value chain, which is an obvious element of interest for SynchroniCity.

Both of them are illustrated in the following pictures.

6. Key partnerships <i>Who can help the city deliver the proposed value to the beneficiaries? Who can access key resources that the city council does not have?</i>	7. Key activities <i>What must the city council do to create and deliver the proposed value?</i>	2. Value proposition <i>What specific problems does the proposed service solve or alleviate?</i>	4. Buy-in & support <i>Whose buy-in is needed in order to deploy the service (legal, policy, procurement, etc.)?</i>	3. Beneficiaries <i>Who will directly benefit from the proposed services?</i>
	8. Key infrastructure & key resources <i>What key resources does the city council have to create and deliver the value?</i>		5. Deployment <i>How will the city solve the problems of the Value proposition specifically?</i>	
9. Budget costs <i>What costs will the creation and delivery of the proposed services entail?</i>		10. Revenue streams <i>What sources of revenue for the city do the proposed services provide? What other sources of revenue does the city have?</i>		
11. Environmental cost <i>What negative environmental impacts can the proposed services cause?</i>		12. Environmental benefits <i>What environmental benefits will the proposed services deliver?</i>		
13. Social costs <i>What are some of the potential social risks that the proposed service entails? Who is most vulnerable as a result?</i>		14. Social benefits <i>What social benefits will the proposed services bring about? For whom will these benefits materialise?</i>		

Figure 10. City Business Canvas model, as proposed by the Replicate EU Project (source: “Smart and sustainable? New business models for smart city services” (ESADE; May 2017)

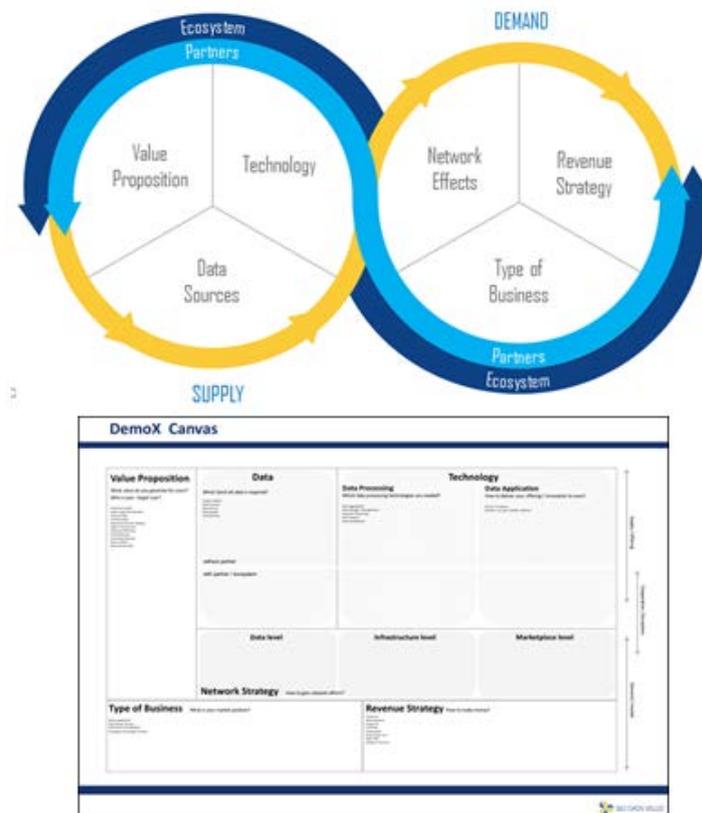


Figure 11. DemoX Framework and Canvas (source: Siemens, BDVe project)