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Written By	Dr. Haydee Sheombar (Erasmus University Rotterdam) Dr. Marcel van Oosterhout (Erasmus University Rotterdam) Ir. Devin Diran (TNO) Dr. Samaneh Bagheri (Erasmus University Rotterdam) Dr. Claus Popp Larsen (RISE)	
Checked by		
Reviewed by	Graham Colclough (Urban DNA) Kubeczko Klaus (AIT) Håkan Perslow (RISE)	01-10-2020 14-08-2020 13-08-2020
Approved by	Klaus Kubeczko – innovation manager Albert Engels - Coordinator	11-11-2020 11-11-2020
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Project partners:
01 - GEMEENTE ROTTERDAM (ROT)- NL
02 - UMEA KOMMUN (UME) - SE
03 - GLASGOW CITY COUNCIL (GCC) - UK
04 - RISE RESEARCH INSTITUTES OF SWEDEN AB (RRI)- SE
05 - ISTITUTO DI STUDI PER L'INTEGRAZIONE DEI SISTEMI SC (ISSINOVA) - IT
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34 - ~~RISE ACREO AB (RA) – SE~~
35 – ENECO Warmtenetten B.V. - NL

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RUGGEDISED – 731198
D6.6 – Governance, trust and smart city business models: the path to maturity for Urban Data Platforms

Public (PU)

RUGGEDISED DELIVERABLE D6.6

Governance, Trust and Smart City Business Models: the Path to Maturity for Urban Data Platforms

Dr. Haydee Sheombar (Erasmus University Rotterdam)
Dr. Marcel van Oosterhout (Erasmus University Rotterdam)
Ir. Devin Diran (TNO)
Dr. Samaneh Bagheri (Erasmus University Rotterdam)
Dr. Claus Popp Larsen (RISE)

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Abstract

Urban data platforms (UDPs) are successors of open data platforms and are expected to help fast track and upscale smart city initiatives. Many (local) governments take the lead in their design and management. In practice, the justification of UDPs is either one of vital infrastructure or one of just another ICT project requiring a rigorous financial business case. Trust in the platform and the governance of the platform are the key success factors for UDP adoption and use. It is still early days for UDPs in Europe. A study among 80 cities in Europe shows that so far about 30% of the cities have an operational UDPs: many cities are still in the exploring and planning phase. The future of these platforms really depends on whether they are envisioned, designed and managed well. This report draws on a wide consultation with managers and city policy makers, two consecutive surveys, a Delphi study with 30 global experts and sixteen master thesis projects. It proposes (i) a Conceptual Framework for UDP value creation, (ii) a preliminary version of a UDP Maturity Model, (iii) a *triple bottom line* Business Model Canvas for UDPs, (iv) a UDP engaging Business Model Canvas, and (v) a UDP Development Approach. This report can guide policy makers and business innovators in designing and building UDPs as part of their smart city strategies.

Key words: Smart City – Urban Data Platform – Business model – Governance – Trust – Triple bottom line – Vital public infrastructure – Open Data – City data – Ecosystem

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SEPARATE DOCUMENT

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- Survey 2019
- Delphi round 1
- Delphi round 2

RUGGEDISED

Designing smart,
resilient cities for all

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Addendum to the Final Report	**Research Instruments**

Executive Summary

Platform business models are today well established and highly successful. Everyone knows the scope, reach and power of platform businesses such as Amazon, Uber and Airbnb. Also, platforms such as Google's and Apple's operating systems Android and iOS penetrate virtually all parts of our society. They enable anyone to develop apps for smartphones and sell them in Google's Play Store and Apple's App Store for everybody to use. Such platforms create their own ecosystems but are also enablers of or key components in multiple other ecosystems.

Urban Data Platforms (UDPs) are a relatively new phenomena and their aim is to unlock and exchange city data – be it data from the government, citizens, universities, or companies. The **purpose** of these platforms is, in order of rising aspiration, one or a combination of the following four objectives: 1) to improve city services, policies and decision making 2) to foster economic innovation and entrepreneurship 3) to create more sustainable and resilient cities and 4) to foster social innovation and sustain democracy. Because UDPs and their objectives are firmly rooted in the public domain, they are confronted with a far more complex governance, political and moral context than the commercial platforms mentioned above. However, most of the `logic and mechanisms` of building and running a successful platform still apply. A true UDP will have a scope beyond the boundaries of a single organisation. We define a UDP as follows.

> An Urban Data Platform (UDP) uses digital technologies to combine and enable data flows within and across city systems. The UDP adds value by nurturing the cities' ecosystem and enabling the trusted sharing of data in a manner that creates public and private value and stimulates innovation.

Please note that 'city' denotes more than just the 'municipality', i.e. city systems are not confined to municipal systems, but include systems and data of all possible actors in the cities' ecosystem (see Figure 1). These actors may supply and sell data to the platform or build new business models on top of the platform. The term citizen refers to the inhabitants of a governed space, e.g. a city.
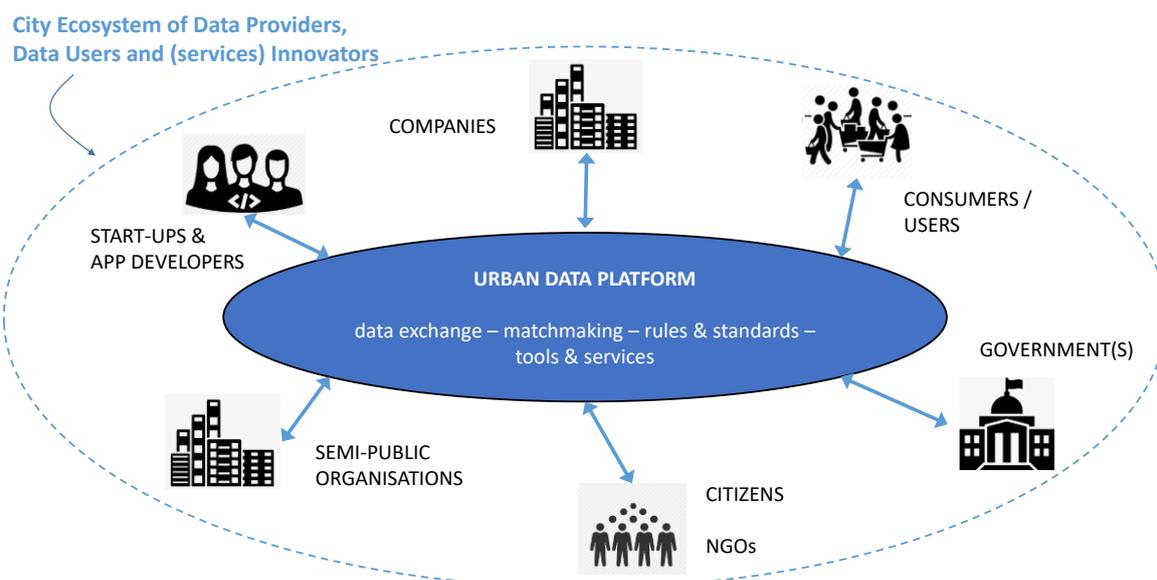

Figure 1 – Schematic depiction of a UDP and its Ecosystem

An Urban Data Platform should not be confused with an Open Data Platform (ODP) which generally provides a unilateral source of open government data. A UDP handles open data (open to all with no restrictions) as well as proprietary data (shared with restrictions) and is not necessarily owned and managed by the municipality like ODPs are. The manager of the UDP is the target audience of this report, and the aim is to describe ´the UDP state of play´ in Europe and to unearth and explain the success factors for UDPs.

Each of the three main RUGGEDISED cities Rotterdam, Glasgow and Umea has taken their own approach to developing their UDP. And although the differences in the paths they take can be explained by the differences in the starting point and contextual challenges, ultimate purpose, and investment strategy, a stepwise approach toward an innovative UDP-model has been distilled from the work done by these cities. The separate Ruggedised deliverable D1.6 is a development guide that provides an overview of the aspects and considerations and describes possible courses of action. This practical **Development Guide** in combination with the more **Conceptual UDP Design Framework**, the **UDP Maturity Model**, and the **UDP and Smart City Business Model Canvases** provide policy makers and strategist with a toolbox for their continuing journey of achieving societal value by UDP (re)design, UDP operation and UDP adoption and use.

The question is whether UDPs can copy the success of established platform businesses, whilst considering the urban context and societal purpose of UDPs. The findings in this report are based on two consecutive **European surveys** of UDPs (n = 30 and n = 80) and a balanced public-private sector **Delphi panel** of 30 global experts. Only 45% of UDPs surveyed are consistent with the definition given above, meaning that they are developing UDPs that include data from other organisations and possibly also citizens. And even though many cities have the ambition to develop a full scope UDP fulfilling all four objectives mentioned before, today as the data suggest, there is a significant **'ambition-realisation gap'**. Our research identified two main factors that should be addressed to close this gap: trust and governance. After discussing these two factors we will also summarize our findings on citizen engagement, platform capabilities, business models, and critical infrastructure.

Trust in the context of UDPs can be broken down in three forms. First, there is trust of the users of the platform in the technological components the platform. Security and protection of private data are major determinants of this trust in the underlying technology. The second form of trust is that of users in the organisations in control of the platform, i.e. the platform manager, owner and financer. Especially for the platform manager, our respondents indicate that today there is a gap between the desired and actual level of trust. The third and maybe the most elusive form of trust is mutual trust between the public and private partners that own, finance, manage and build the platform. Also here we see a big **trust gap**, which according to our data seems to be rooted in history. Our data reveals that the public sector is mainly distrusted because of their poor technology capabilities and track record with ICT projects. The private sector, on the other hand, is distrusted for instance because of their "single-minded pursuit of profit" and their perceived strive for vendor lock-in. **Collaboration** requires trust, but collaboration also builds trust. "Just collaborate" is one expert's recommendation to crack this practical chicken-or-egg problem. Collaborative experience in the quadruple helix, i.e. between government, companies, universities and citizens is seen as a good way to improve mutual trust.

Governance is an encompassing concept, and in our study, we have adopted the World Economic Forum description of governance. Five elements can be distinguished in the governance of UDPs:

1) Institutional arrangement 2) Principles 3) Controls 4) Data governance and 5) Revenue model. The **institutional arrangement** is defined as the combination of platform management and platform ownership. Almost two thirds of platforms in Europe are today both owned and managed by the government. Public private partnership account for 17-18% of platform management and ownership. Finally, the private sector owns 10% of the UDPs and manages 15% of them. The actual development and building of the platform, which strictly speaking is not part of the governance, is outsourced to the private sector in at least half of the cases. This dominance of governance by the government could either be explained by the fact that many UDPs are successors of Open Data Stores, or by the desire of governments to deliver public value and UDPs are vehicles that do just that.

Governance **principles** in the context of UDPs are interoperability, openness and transparency. Most UDPs strive for interoperability with other UDPs, but at a later stage. Openness refers to restrictions about who can participate on the platform: is it open to all or can you join by invitation only? Transparency refers to the extent to which the platform manager gives insight into how the platform and its algorithms work, and in the usage of data on and by the platform (without compromising privacy). As transparency breeds trust, this principle is one that all UDP managers must get right. **Data governance** within the platform manager's organisation as well as within the wider ecosystem of the platform lays the foundation for the quality of data exchanged on the platform. The research did not cover existing **revenue models**. With 60% of UDPs currently being financed by internal municipal funds and given that most UDPs are still in the development phase, defining the revenue model, i.e. how the UDP is sustained in the long run, is not the highest priority.

Citizen engagement, is something many UDPs want to do, but few accomplish in practice. Citizens, loosely defined here as the inhabitants of a city, region or country, are hardly ever involved in the design phase of a UDP according to our survey. In the Delphi study, a remarkable difference between the experts from the public and with private sector is the rationale for citizen/user engagement. For the government there is an emphasis on citizens as users of the platform once it is operational, to support them with community building, using their democratic rights, and protecting their privacy and data ownership. The private sector, on the other hand, also sees mutual benefits in engaging citizens already in the design phase of the platform, so that they build something that users actually want. This might explain why to date there is so little involvement of citizens. Most UDPs are being developed by governments, and most of these UPDs are not yet operational. Interestingly, both public and private sector experts agree on helping citizens value or even monetize their personal data, and this seems even more important to governments. Clearly, further research to understand the rationale and mechanisms for citizen engagement on a UDP is needed.

In this report the term **business model** is used to refer to the operating and value creation logic of an organisation, regardless of how this organisation is financed, owned or managed. The use of the term 'business model' should not be equated with profit seeking. Three categories of **business models** are distinguished in the context of UDPs. First, there are 'native' business models, i.e. business models that are born on the platform, either by developing new services using data of the platform, or by simply monetizing data through the platform. Secondly, there are business models of existing Smart City initiatives that connect to the platform, to increase their range or create additional services. Thirdly, there is the business model for the UDP itself. Urban Data Platforms are envisioned to be mechanisms to help scale the business models of smart city initiatives, many of which fail to develop beyond the pilot phase. We have identified three levers for **scaling**: 1) internal optimisation of the business model through additional data, 2) new and

complementary services, possibly developed by complementors on the UDP, and finally 3) access to new customers through the greater reach of the UDP. Further research is needed, once the UDP landscape is more mature, to validate these three levers for scaling Smart City initiatives.

The **capabilities** of the platform manager are an important driver of trust, but they also directly impact the performance of a UDP. Some of these key capabilities e.g. setting the right platform rules and regulations for the UDP are more entrusted to the public sector, whereas others, e.g. nurturing the ecosystem, come more naturally to the private sector. Given that UDPs are a relatively new type of solution run by a new type of organisation, capacity building in platform management is recommended. A UDP **business model canvas** gives a good overview of the tasks that are involved in running a UDP. The canvas is instrumental in the design of the UDP but can also aid the development of a UDP management capacity building curriculum. We propose the design of such a curriculum based on the research findings as a practical follow up action of this study.

One of the big questions surrounding Urban Data Platforms is the question whether they are **vital or critical public infrastructure**. If they are, making a value case for them is important as a matter of disciplined policy making, but investment in them will not depend on a monetary ROI, i.e. a detailed business case. About half of the cities in our research justify UDPs based on 'critical infrastructure' reasoning, which assumes the delivery of public value, with no or a limited monetary business case. The other half indicate the need for a clear business case, of which 75% link the business case with a service line improvement according to the "invest to save" logic. The Delphi-panel experts were unanimous about the vital infrastructure nature of UDPs but are also split on how to finance the UDP. It is a matter for further research to gain a better understanding of the forces driving this dichotomy in thinking. It is imperative for the digital future of Europe that this big question gets answered by authorities, and gets answered soon.

Preface

In this digital age, Urban Data Platforms have emerged from the confluence of three different phenomena. The first one is the movement toward Open Data. The idea behind open data is that in a democracy the data sitting in the public "data coffers" have been financed by the taxpayer and thus belong to the people. Secondly, Smart Cities, which promise that by infusing technology and intelligence into all kinds of city systems, we can cope with growing urbanisation and keep our cities liveable and thriving. The third phenomenon driving UDPs is the success of platform mechanisms in both technology and the economy. Platform businesses e.g. Amazon or Airbnb enable innovation and exchange at an unprecedented scale and speed. So, what can be learned from these platforms, and how do we best conceptualise and realise this emergent idea of a UDP that promises to make our societies democratic, our cities sustainable, and our economies thriving?

This report is the result of research conducted as part of the RUGGEDISED Horizon 2020 project. It is still early days for Urban Data Platforms in Europe. Most Urban Data Platforms are sophisticated Open Data Stores that allow users – citizens, universities, NGO's and companies – to download government published data sets. Based on today's thinking, the vision for an Urban Data Platform is that of an exchange for data between stakeholders in a city ecosystem, so that they can create public and private value. This data can come from organisations – public, private and not-for-profit – and from citizens. In this vision the UDP will help the promise of Smart Cities to become a reality by unlocking siloed data, scaling of smart city projects, and by stimulating (social) innovation.

Many new questions must be answered on both principles and practical implementation to make this vision happen. What exactly is a UDP and how does it work? What problem is the UDP solving, i.e. what is the purpose of the platform? How do we build trust among stakeholders and trust in the platform itself? Who owns the platform and how is it otherwise governed? What measures should be taken for the platform to fulfil its promise of being a game changer? What is the role of citizens in Urban Data Platforms? But perhaps the biggest question of all is whether society sees Urban Data Platforms as part of a societies' vital or critical infrastructure.

If indeed UDPs are conceived as vital infrastructure, private sector companies are ill-advised to embark on developing these urban platforms on their own**.** Our study shows that, these days UDPs are mostly driven and financed by public sector institutions, and some UDPs are public-private partnerships. If UDPs, once they mature, will stay in the public realm remains to be seen. What also remains to be seen is whether UDPs will change how local public services are delivered, with municipalities applying a platform-approach to their ICT landscape, and by doing so allowing the private sector and citizens to deliver   more public services. What the future holds, we do not know. We do know that we need to get UDPs right today. Our research leads us to conclude, that for most UDPs, governments should remain in the lead in the near term but must closely collaborate with the private sector to complement their own capabilities. This report aims to give all parties the insights and tools to do so with confidence and by doing so help secure the digital future of Europe.

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1. Introduction to Urban Data Platforms

Even though platforms have been around for some time now, conceptualisation and approaches to this "animal" in the business ecosystem still vary among scholars. Therefore, we start this report with a brief "primer" on platforms. But first we will characterise the challenges that many smart cities face, specifically the ones that are part of the RUGGEDISED program. One of these challenges is that many Smart City projects fail to scale. Are UDPs the mechanism to scale smart city projects? And should UDPs be considered vital infrastructure? Before outlining the research and the rest of this report, we place UDPs in the context of various trends that explain its emergence and imply possible consequences of UDPs.

1.1 Challenges faced by Smart Cities

Today over 55% of the world's population live in urban areas or cities. Due to rapid urbanisation this number will continue to rise with people moving to cities as places of opportunity, innovation and wealth. Even, when at the time of writing this report, the Covid-19 pandemic forces many people to work from home and use online digital technologies to collaborate, it is widely believed that cities will continue to thrive. Because, cities are places of exchange, most importantly the exchange and multiplication of ideas (Ridley, 2010). And face-to-face interactions are still better at spreading new ideas than digital technologies (Pentland, 2015). However, cities are also facing increasing stress in coping with these numbers which have adverse effects like pollution, crime, and social disconnection. Along these local issues, cities are also challenged by Global phenomena which manifest on the city level. Among these grand challenges, climate change, digitisation and globalisation are commonly addressed as the most impactful. In coping with these challenges, the smart city of the future, is looking to use digital technologies to improve efficiency, inclusion, sustainability, and prosperity.

Current city operating models are under pressure (see Box 1.1) and the digital age offers possibilities for both the public and private sector to innovate with Smart City Business Models. The 2016 consultation paper titled *Towards a Joint investment programme for European Smart Cities* gives several reasons why (local) governments need to rethink the delivery of public services.

"Disruptive technologies and digitisation offer new innovative ways of tackling [societal] challenges. However, the scale of change is greater than the public purse can withstand; so new sources of finance, and new business models must be found" (page 4).
"Several themes disrupt current city business models:

    (i)   the scarcity of public funds to cater for the scale of investment;
    (ii)   the externalisation of services;
    (iii)   the role of society in realising value; and
    (iv)   the increasing involvement of society in financing (e.g. crowdfunding; digital social market).

These present significant opportunities to innovate and design new approaches to the management of investment and return for infrastructure and services. Such change affects all stakeholders. A common prerequisite is the need to evidence value, as the basis to justify commitment of resource, and ensure new business models are viable" (page 15).

Box 1.1 – In need for new business models (EIP-SCC01 2016)

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In smart cities novel digital services such as smart grids, mobility as a service, smart water management, intelligent infrastructure e.g. street lighting lead to the reinvention of public service models and processes. These smart city activities in combination with other new digital media and digital services are increasing the data generated and the data flows in today's cities at an unprecedented rate (Schieferdecker, Tcholtchev, & Lämmel, 2016). Many citizens and organisations are finding it hard to keep up with this high speed of change. Recently the Secretary-General of the UN referred to the dark side of the digital world as one of the "four horsemen" threatening our global future (Guteres, 2020). Simultaneously, this digitisation should be of great value to policy makers, urban planners, businesses and citizens as it offers endless opportunities for improved decision making, processes improvements and innovation of business models. The promise of Smart Cities is to leverage the 'bright side' of the digital world and keep the 'dark side' at bay.

Since the advent of Smart Cities some 10 years ago, there are ample examples of successful projects and successful business models particularly in the energy and transportation domain. While the potential of the digital technologies in cities are endless, cities face significant challenges in the full-blown adoption and operation of these technologies in a way that effectively serves the city. An urban data platforms (UDP) is envisioned as an organisational and technological entity that can help cities to better cope with the challenge of leveraging technology and data. The challenges faced by the RUGGEDISED cities, which the establishment of a UDP aims to resolve, are given in Box 1.2.

Glasgow

The city of Glasgow owned and operated an open data platform and energy app, before RUGGEDISED started. However, the smart city activities in the RUGGEDISED project bring along new data flows. These data flows are combined with the previous data in the open data platform. At the same time, Glasgow acknowledges that for this to be utilised at its best potential, it is necessary to provide users with analytical support. The analytical platform (called the Data Based Decision Platform or DBDP) is subsequently built on top of the data platform resulting in a comprehensive UDP with analytical functionality. This analytical functionality is aimed to improve decision-making across the city council and for businesses and citizens to be better placed to contribute to solutions both specific to their community and to the wider city. As such the DBDP will aid the scaling up of smart city solutions by identifying areas where solutions as implemented in RUGGEDISED can be expanded to or replicated, together with insights on the timing to implement these solutions. The DBDP is aiming to tackle various challenges in the city, such as:

1. Bridging the gap between the increase in data availability and the potential users lacking the expertise and resources to utilise the data. The DBDP enable citizens and organisations in the city, which lack the expensive resources and specific expertise, to benefit from the potential of city data.
2. The need to plan and implement Electric Vehicle (EV) charging infrastructure so EVs increase in share, to accelerate the shift away from fossil powered mobility.
3. The alignment of electricity distribution infrastructure plan with the smart city activities requiring electricity, such as EVs. Effective EV infrastructure requires the power grid to be developed accordingly, this is where data on mobility and energy come together.
4. The DBDP allows to study air quality in relation to the various factors it may be influenced by. Can an increase in EV infrastructure be correlated with improvements

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in the air quality? Are other factors such as road closures, or city events more influential? What should the city actively steer to improve the air quality?

Rotterdam

The UDP strategy in Rotterdam includes the development of a 3D City Twin to enable smart city solutions, including their replication and upscaling. The UDP is based on open data standards, where (near-) real-time physical and operational data of the city are projected in the 3D model of the city. Commonly environmental aspects such as noise and pollution are measured in 2D. However, these aspects also manifest in vertical direction. By measuring, and visualizing, these aspects in 3D, the user gets a richer understanding of these multi-dimensional phenomena. 3D is a universal language that most people understand far better than 2D and thick reports. For these reasons Rotterdam made 3D visualisation an essential part of its UDP, and this UDP is developed to tackle city challenges such as:

1. Bridging the gap between the increase in data availability and the potential users lacking the expertise and resources to utilise the data, via the visualisation in the interactive 3D City Twin.
2. Crowd and public space management in busy places and during city events in a growing city.
3. Energy and resource efficient waste collection and processing in a growing city.
4. Electricity and thermal grid planning and operational optimisation given the diversity in potential sources of sustainable energy, and their challenges regarding intermittency and the spatial impact.
5. Smart mobility as a means to relieve the city of air pollution, noise and congestion.

Umeå

The Umeå UDP is built to support the citizens and planners in short- and long-term decision-making towards a fully sustainable and smart city. This will be achieved by visualising real-time data and historical data to assess the impact of smart city interventions in a shared knowledge repository. Moreover, the UDP is suited to combine data towards new knowledge. To this end the Umeå UDP is committed to share data to various target groups, with the appropriate distinction in data access rights. Challenges in the city targeted by the UDP are:

1. Improved planning and utilisation of car parking facilities in the city by monitoring car parking activities.
2. For the city to make a transition to a smart and sustainable city, for instance via energy management and planning towards a fossil-free energy system, it is crucial to have detailed insights on the lifecycle of the city. Gathering and evaluating data on the activities in the city, provides these insights to the urban planners and other actors, for them to be bettered positioned in planning the city of the future.
3. Improved urban planning also entails monitoring crime and nuisance in the city, so that measures can be designed and implemented to intervene where necessary.
4. The city is plagued by radon gas risks, and these need to be monitored with an important role for citizens which partake in the measurements and then are inclined to share this data for comprehensive city insights by the city council.

Box 1.2 – Challenges faced by the RUGGEDISED Lighthouse cities

The challenges of these three RUGGEDISED lighthouse cities vary from air pollution, EV charging infrastructure design, urban planning to crowd- and public safety management. One thing that all these challenges have in common is that their resolution benefits from the combination of data from different sources. Data that today sits in different organisational units and systems, either within or outside the municipality. Bringing these data flows together and making this data digestible through visualisation and analytics is what a UDP does, among other things. Current value cases for UDPs are predominantly public sector driven. The next phase of the UDP evolution should carry this momentum and potential towards new business models, to be built on top of the UDP, engaging citizens, companies, and knowledge institutions. This report will address the various aspects that are needed to make a UDP work and enable it to foster the evolution towards new business models. Before discussing these aspects, the rest of this chapter aims to provide an understanding of platforms in order to be able to distinguish them from e.g. portals or data repositories.

1.2 The platform phenomenon

Platform business models are very successful, and the number of global platforms is growing exponentially (see Figure 1.1). Some business writers (Choudary, 2020) even predict the end of the linear business model and state that every viable business model in the digital age will need to have a platform component. The most important feature of the platform business models is its capability to scale due to the networks effects that are inherent to digital platforms.
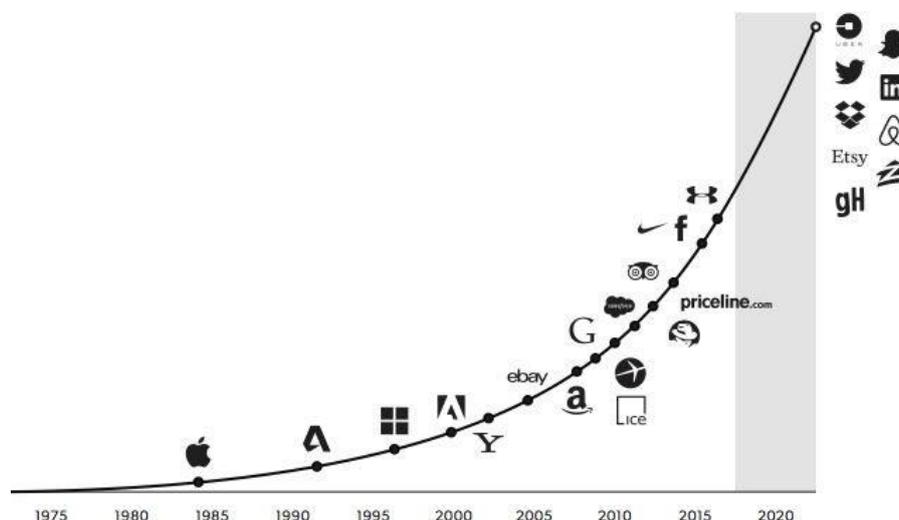
Figure 1.1 – Examples of the growing number of platforms (Moazed 2016)

There are several definitions of platforms (see Box 1.3). Generally defined, multi-sided platforms are organisations that enable the exchanges between producers, consumers, users and developers. Platforms have been around long before the digital age. A bazaar or a shopping mall brings buyers and sellers together in one physical space. To attract buyers, the manager of the shopping mall provides services e.g. parking and bathrooms. By designing the routing in the mall, the ratio between shops, restaurants and recreation, and the rules on how merchandise in front of the shops can be displayed, the shopping mall aims to facilitate the exchange between buyers and sellers. Equivalents of these tasks exist on digital platforms.

> *Varying definitions of the concept Platform*
>
> *PLATFORM BUSINESS MODEL DEFINITION: a business model that creates value by facilitating exchanges between two or more interdependent groups, usually consumers and producers (Moazed, 2016).*
>
> *A platform is the set of components used in common across a product family whose functionality can be extended by third parties (Boudreau 2007) and which is characterized by network effects (Eisenmann, Parker & Van Alstyne 2006, 2011).*
>
> *(…) A platform can be defined as a digital environment characterized by near-zero marginal cost of access, reproduction and distribution (McAfee and Brynjolfsson, 2017)*
>
> *A (software based) platform is the extensible code base of a software-based system that provides the core functionality shared by apps that interoperate with it, and the interfaces through which they operate (Tiwana, 2014)*

Box 1.3 – Definitions of Platforms and Platform Business Models

Digital platforms

Digital Platforms, due to the digital rather than physical nature of the exchange, can provide additional functions and activities that are harder for physical platforms to provide (see Figure 1.2). By capturing data of exchanges and generating profiles of platform participants the digital platform has means to match the different participants. Reputation systems on e.g. Airbnb or Uber are an example of the enablement of matchmaking (or broker function) between resource- (or asset) suppliers and resource-consumers. In the Airbnb case the resource could be an apartment that is refined into the service accommodation, whereas for Uber the resource is a car with a chauffeur which is refined into the service transportation.

Furthermore, digital platforms offer tools and services for participants to develop their own products and services on top off the platform. Amazon enabling sellers to set up their own shop, or the Android platform enabling app developers to develop their own Apps and sell them through the Android App store, are examples of Tools and Services. A UDP is a specific type of digital platform where the resources are data that will be refined into a service or (digital) product. From a functional point of view – the matchmaking or broker function – a UDP is fairly like a commercial platform such as Airbnb and Uber, with the principal difference that data as assets can be reused infinitely.
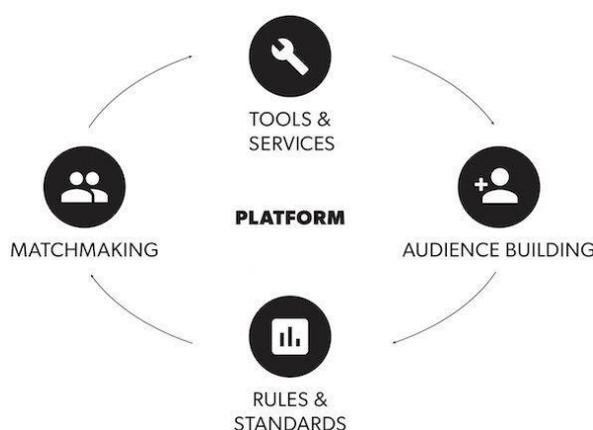
Figure 1.2 – Activities performed by Platforms (Moazed 2016)

Understanding platforms

Gillespie (2010) discusses metaphors for a platform and describes four analogies for the concept of a platform: computational, figurative, architectural and political (see Table 1.1). The examples in this table show the broad use of the term platform and its many connotations and denotations, which were already eluded to by the varying definitions of platforms earlier in this chapter.

Table 1.1 - Platform Metaphors by Gillespie

Metaphor	Description	Example
Computational	A technological platform that allows the development of new systems	Android, Linux
Figurative	A body of knowledge, foundation, position that is a basis of further action and achievement	University degree, Job position in an organisation
Architectural	A physically raised structure from which activities can be better conducted	Oil rig, train platform, speaker podium
Political	A given ideology that a person can use to drive a political agenda	Political party, religion, anarchism / disobedience

Rather than trying to reduce the wide variety of meanings that a platform entails and nail it down to a single definition, the richness of the concept should be appreciated and exploited. Table 1.2 shows what the metaphors look like when applied to urban data platforms. Each metaphor informs us about the various aspects, roles and functions of a platform and explicates the different types of value that platforms can create. The phrase 'platformisation of society' has been coined to describe the widespread use of platforms (van Dijck, 2016 and 2019). This phrase no longer has a mere positive connotation as many platforms have grown so powerful that governments find it hard to provide countervailing power. What if governments were to set up platforms themselves?

Table 1.2 - Types of Value created by Urban Platforms

Metaphor (essence)	UDP Platform Activity inspired by metaphor	Value created
Computational (development new systems)	Allow developers to build innovative solutions on top of the UPD or improve existing solutions	Economic: innovation, internal city hall process efficiency
Figurative (basis for action / achievement)	Set appropriate rules of engagement and by doing so support the legitimacy and quality of further actions of platform participants	Societal: level playing field, compliance to values
Architectural (raised structure)	Create "space" and visibility that empower small businesses (SMEs) and individual voices that otherwise go unheard or unseen	Societal: inclusion Economic: SME growth
Political (driver of a political agenda)	Use the platform to engage citizens and drive institutional and business behaviour change to achieve the platform purpose	Societal: democracy, environment, climate

Researching Urban Data Platforms

What makes an Urban Data Platform (UDP) different from the platforms just described? UDPs aim to exchange data that are generated by all kind of stakeholders, in an urban context, and UPDs

are operating in a public-private sphere. The data can be citizen data, sensor data or data from systems within companies and the government. Compared to the notion of Smart Cities, UDPs are a relatively new concept and most cities have only recently started to explore them. Our research (described in section 1.5) was therefore also of an exploratory nature. We used surveys and an expert panel to understand what it will take for UDPs to flourish just like the platforms we know as consumers. Concepts and theory about existing platforms are used as foundation to explore platforms in an urban context. Furthermore, two pressing and practical questions that have been 'hoovering' above our research from the very onset have also 'steered our hand'. These questions are: (i) can UDPs help to scale smart city projects? And (ii) are UDPs vital public infrastructure? We must reflect on these questions next, before outlining the research and the rest of the report.

1.3 Can UDPs help to scale Smart City initiatives?

The concept of a Smart City (SC) was introduced more than ten years ago, predominantly by technology companies that saw an opportunity to use digital technology to solve some of societies' pressing problems. After an initial one-sided push by these companies, the concept today has traction in both the public and private sector, as evidenced e.g. by the substantial investments in Smart Cities by the EU through their Horizon 2020 research programme. To date, however, many Smart City projects still fail to scale. Why don't they? And what can be done about it? The objective of RUGGEDISED work package 6 "*Enabling upscaled deployment and business model innovation*" is to provide answers to these types of questions.

In Table 1.3 our hypothesis about the possible causes to the scaling problem are listed. In this table we use three (randomly chosen) definitions of Smart Cities as examples to illustrate our hypothesis on why smart city projects don't scale. These hypotheses are all based on the observation that many smart city initiatives have a narrow and limited view of the idea a Smart City. This narrow view inhibits the initiatives to reap their full potential and scale.

Table 1.3 – Hypothesis to explain why Smart City initiatives fail to scale

Our Hypotheses why SC initiatives do not scale	**Example definitions reflect the complexity of the Smart City "idea"**
1. It is not just about technology: it is about designing solutions for and with **people**	**EU:** Cities using technological solutions to improve the management and efficiency of the urban environment
2. It is not just about efficiency but about value: a triple bottom line **challenges business case logic**	**SIEMENS:** Smart city solutions contribute to the effective management of urban areas, improving connectivity, sustainability, and livability. Across all areas of city life, technology and data are used to analyze and optimize, thus enhance outcomes and improve quality of life.
3. It is not just about infrastructure optimization, but more importantly about **behavioural change**	
4. It is not just about creating a space for ideas and people to meet, is also about **managing** that space	**AMSTERDAM** Smart City is the innovation platform of the Amsterdam Metropolitan Area. It challenges companies, citizens, the municipality and knowledge institutions to submit and apply innovative ideas and sustainable solutions to urban challenges.
5. It is not just about one sector doing its thing, but it requires **cross-sectoral collaboration**	

What can be done about this scaling problem? One of the questions that guided this research is whether platforms are a mechanism to accelerate and scale Smart City initiatives, just as they have done for mobility (Uber) and the renting out of private homes (AirBnB). We will refer to the

type of platforms that are used in the context of Smart Cities as Urban Data Platforms (UDPs). Can these UDPs alleviate the "narrow and limited view" of smart city initiatives we mentioned before?

Research conducted by Van der Nat (2018) focused on unravelling why a single organisation, in this case the municipality of Rotterdam, finds it hard to scale smart city projects after the pilot phase. Three causes for not being able to scale initiatives were identified: (i) silos within the organisation, (ii) the mind set favouring a standardised way of working, and (iii) the lack of knowledge on how to implement innovation. All these three causes need to be resolved by interventions in learning and culture. One proposed approach to tackle all these causes are Urban Innovation Platforms (UIPs) which *"are understood as organisational structures that support Collaborative Innovation Networks (CoIN) based on stakeholders with a clear mandate to work together to support urban innovation"* (Johansson, 2019). Another approach, proposed here, is to use data platform mechanisms. The first cause, silos within organisations, can be tackled by having a platform for data that cuts across different departments. Sharing data might be a first step in a process of increasing collaboration across departments.

In chapter five we will describe in more detail how smart city initiatives can use data platforms to scale. One driver is that the platform gives the smart city initiative access to a wider group of users, and another driver is that it can allow developers to come up with services that complement and thus reinforce the original value proposition of the smart city initiative. The more smart city initiatives connect to the platform and share data, the larger the chance to attract relevant developers, and the higher the chance that customers and users will engage. A well-managed UDP can thus bring the key ingredient of platforms, i.e. network effects, to smart city initiatives and help them scale.

For now, we conclude this section with two premises about smart cities. First, a smart city is more than a collection of siloed vertical projects. A truly smart city knows how to leverage data across vertical domains (e.g. mobility, safety, energy), an endeavour that is enabled by UDPs. The second premise therefore is that every smart city project from early conception on needs to be designed with the ability to connect to a UDP at some point in the future in mind. This promise about the importance of UDPs should empower municipalities to withstand the one-sided push for UDPs by technology players and step up to the plate. As our research findings will show, many municipalities are doing this.

1.4 Are Urban Data Platforms critical infrastructure?

So, what are Urban Data Platforms exactly and why are they becoming more important? And perhaps the most important question of all: are UDPs vital or critical infrastructure and what are the consequences if they are? Definite answers to these questions require more research, but we know that these answers ultimately drive the financing, ownership and management of UDPs.

Defining Urban Data Platforms

Our definition of an Urban Data Platform in Box 1.4, based among others on the definition provided by the EIP-SCC (2016), gives both a functional and a technical lens on the platform.

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D6.6 – Governance, trust and smart city business models: the path to maturity for Urban Data Platforms

Public (PU)

An urban data platform (UDP) uses digital technologies to **enable and combine data flows** within and **across city systems and infrastructure** of the public and private sector and make data (re)sources accessible to participants in the cities' ecosystem for innovation.

- The UDP adds public and private value by **nurturing the cities' ecosystem** towards sharing their data (re)sources in a trusted manner
- It also facilitates the development of information tools that make data more accessible for further **use, visualisation and modelling** in a comprehensive, reliable and affordable way
- This can **empower participants in the cities' ecosystems** to **contribute to a city's triple bottom line** – people, planet and profit and contribute towards the UN SDGs by developing new products and services.

Box 1.4 – Definition of an Urban Data Platform

Please note that city systems are not confined to municipal systems but include systems and data of all possible actors in the cities' ecosystem (see Figure 1.4). These actors may supply and sell data to the platform or build new business models on top of the platform. An Urban Data Platform should not be confused with an Open Data Platform which generally provides a unilateral source of open government data.
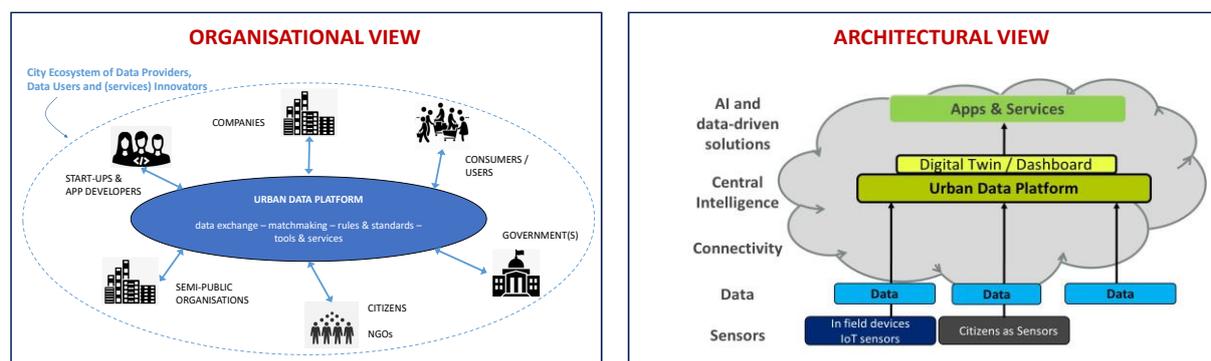
Figure 1.4 – Organisational and a simplified architectural representation of an Urban Data Platform

Functionally a UDP aims to provide the city with a data infrastructure that will attract an ecosystem of users, citizens, government, and companies that together will create both private (e.g. innovation, profit) and public value (e.g. political, social, environmental). Technically the UDP focuses on collecting, aggregating and distributing data from a wide variety of data sources (sensors, citizens, private and public ledgers, etc).

The main trend causing UDPs is the ongoing datafication in cities

The emergence of UDPs as an infrastructure (see Figure 1.5) can to some extent be explained by the Open Data movement: multiple data sources and multiple data consumers require a platform that can aggregate data and make it available. Another source for the need of sharing the abundance of data is the datafication of things, processes and behaviour. This datafication, a consequence of e.g. sensors, automation, and increasing amounts of data generated via social media, creates the opportunity to collect data from various sources and to leverage this data for improved decision making and innovation.
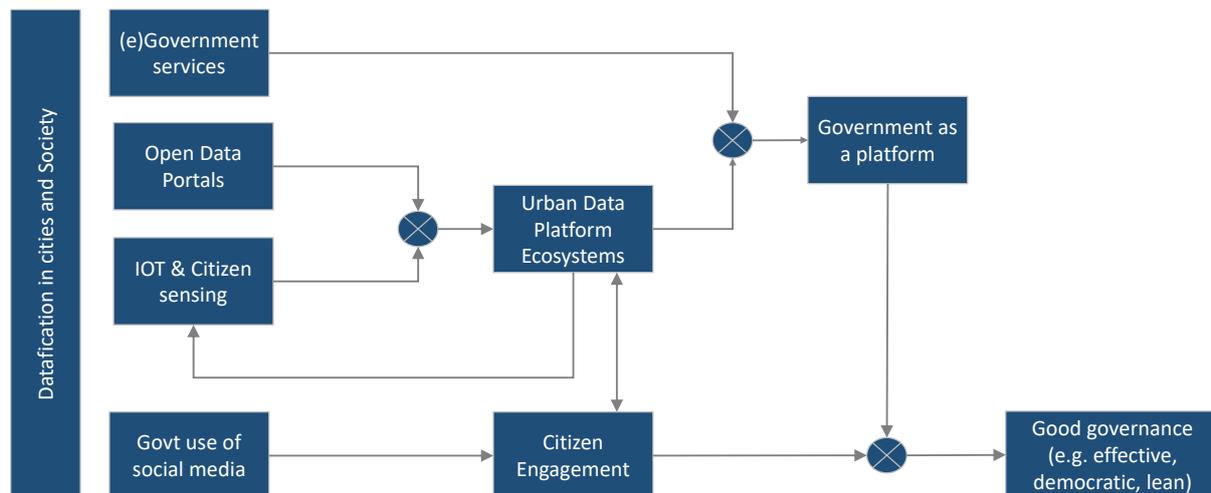
Figure 1.5 – Trends related to the emergence and possible paths to the future for Urban Data Platforms seen from the perspective of the Government

Consequently, services and processes in cities are becoming increasingly data driven. For instance, waste bins can sense when they are full, water levels can be measured remotely, and so on. All these solutions are separate systems that from a data point of view do the same thing: a sensor measures a value, data is collected in a secure way and communicated to a service provider that refines data into a service. In these examples, neither infrastructure, nor data is shared. With a platform, cities expect economies of scale by sharing a data infrastructure. In a second step a city can measure different flows of traffic, waste, water etc and gain new insights, thereby making better decisions and better plans. Moreover, data measured for one purpose may have a value for other purposes, and different data sources combined may lead to completely new insights and services.

Urban Data Platforms are envisioned to ultimately empower citizens to participate in society which is deemed good for society as a whole and specifically for democracy. As our research will show the engagement of citizens in Urban Data Platforms is considered relevant but hard to achieve. As Urban Data Platforms foster city ecosystems, their adoption and use will enable government to co-create and innovate services with their ecosystem and for certain services take on the role of a platform organisation themselves. This idea of Government-as-a-Platform (O'Reilly, 2011), which will become more feasible as UDPs mature, are beyond the scope of our research and this report. The ultimate, and admittedly positive, outlook for UDPs is that the combination of citizen engagement and government-as-a-platform will lead to good governance, i.e. a lean, effective, enabling and legitimized government.

The dual nature of a UDP as critical infrastructure

Envisioning UDPs as vital public infrastructure would mean that we accept that they have characteristics of both platforms and Infrastructure (Plantin et al., 2018). Platforms are associated predominantly with digital private sector initiatives e.g. Uber or Android, whereas infrastructure is associated with railway networks, energy grids and telecommunications networks. This dual nature of UDPs means that their focal interest is both public value creation and the enablement of essential public services, as well the enablement of private profit by users of (data on) the platform. Platforms are nimble and evolve, whereas infrastructures tend to be designed top-down and rigid.

This dual nature of UDPs places extra strain on the capabilities of a platform manager and on the decision making on how to position and regulate them. Feld (2020) argues that digital platforms such as social media platforms and online shopping platforms should be regulated by a special regulator that oversees competition, consumer protection, content moderation as a single agency, rather than distributing this responsibility across multiple agencies. We can imagine that urban data platforms once mature and deemed critical, regardless of who owns and manages them, will require similarly special regulation like other digital platforms that serve the public interest.

	Infrastructure	Platform
Architecture	Heterogeneous systems and networks connected via sociotechnical gateways	Programmable, stable core system; modular, variable complementary components
Relation between components	Interoperability through standards	Programmability within affordances, APIs
Market structure	Administratively regulated in public interest; sometimes private or public monopoly	Private, competitive, sometimes regulated via antitrust and intellectual property
Focal interest	Public value; essential services	Private profit, user benefits
Standardization	Negotiated or de facto	Unilaterally imposed by platforms
Temporality	Long-term sustainability, reliability	Frequent updating for competitive environment
Scale	Large to very large; ubiquitous, widely accessible	Small to very large; may grow to become ubiquitous
Funding	Government, subscription, lifeline services for indigent customers, pay-per-use (e.g. tickets)	Platform purchase (device), subscription (online), pay-per-use (e.g. TV shows), advertising
Agency of users	"Opt out," for example, going off the grid	"Opt in," for example, choosing one platform instead of another; creating mashups

Figure 1.7 – UDPs have characteristics of both infrastructure and platforms (Plantin et al., 2019)

Throughout history we see that development and ownership of infrastructure pendulates between the public and private sector. Railroads e.g. started out as private sector initiatives, were then nationalised, and at the end of the 20th century many were privatised again. Currently the Netherlands are planning to integrate the rail infrastructure part back into government, swinging the pendulum back to the public sector. The point is, even though many UDPs today are publicly owned, like other infrastructures before them, they may end up in the hands of the private sector at some point in the future. In chapter three we will present what our research revealed about the question whether UDPs are critical infrastructure.

1.5 Research questions and activities

With a basic understanding of smart city challenges, platforms, and the trends leading to the emergence of Urban Data Platforms in place, we are ready to introduce our research, the conceptual framework for UDP value creation that underlies our research, and the outline of the rest of the report in the next section.

Research Questions

The main research questions underlying this research are:

1. What are Urban Data Platforms?
2. How can UDPs enable the scaling of smart city initiatives?
3. What is the state of play in Europe?
4. What are drivers, inhibitors, and enablers of Urban Data Platforms?
5. How should UDPs be governed?
6. What do viable business models **for** and **on top of** UDPs look like?
7. What is a good process for developing UDPs?

Research Activities

Two surveys and a Delphi study among global experts were conducted as part of this research (see Appendix 1 for an overview of the participating institutions). The first survey was conducted in the first half of 2018. About 30 cities responded to this broad exploratory sweep covering a wide range of UDP topics. The second more focused survey study was conducted among a representative sample of 80 cities in Europe, with in total 105 respondents. 82% of the respondents were working for the municipality (as project manager, platform lead), 10% worked with a private organisation and 8% in a research institute. The study was executed in the period November 6, 2019 until January 10, 2020. 85 percent of the respondents were partner in one of the EU SCC projects, funded by the European Commission. The participating cities and their stage of UDP development is shown in Figure 1.8.

Exploring & Planning

Alexandroupolis	Évora	Rennes
Alkmaar	Genth	Reykjavik
Amsterdam	Gothenburg	Riga
Bassano del grappa	Graz	Santa Cruz de Tenerife
Berlin	Kerava	Skellefteå
Budapest	Maia	Suceava
Cluj-Napoca	Manchester	Smolyan
Derry	Oostende	The Hague
Eskişehir	Parma	Umeå
Essen	Porto	

Building & Implementing

Alba Iulia	Linköping	Stavanger
Bilbao	Maribor	Stuttgart
Bordeaux	Nottingham	Trento
Bristol	Pamplona	Tampere
Groningen	Rotterdam	Firenze
León	Saint-Quentin	Glasgow
Lublin	Santander	

Operational

Albacete	Lisboa	San Sebastian
Barcelona	London	Sonderborg
Brno	Lyon	Stockholm
Cologne	Matosinhos	Tartu
Copenhagen	Milan	Utrecht
Grenoble	Munich	Valenica
Hamburg	Nantes	Vienna
Helsinki	Oulu	Warsaw

Figure 1.8 – Survey Participants from across Europe

A Delphi study was conducted with a global panel of 30 experts in the first round, of which 20 experts also participated in the second round. In the first round the experts were asked to fill in a questionnaire about the governance of UDPs. The aim was to solicit from experts their beliefs (i.e. position, preference or choice) about the best way to govern UDPs and the rationale, if any, behind their belief. Using the collective intelligence of the panel experts from the first round, a second

focused questionnaire was designed to zoom in on key points that needed more deliberation to either establish consensus or to understand the disagreement among panel members. The panel represented government, companies and other institutions, including academia. The study was executed in the period February till April 2020.

Figure 1.9 – Delphi expert panel participants

TNO has conducted detailed case studies of the three main cities in RUGGEDISED – Glasgow, Rotterdam, Umea – which is reported on in a separate deliverable (Diran et al. 2020). Parts of this research are discussed here to complement the conceptual framework underlying this report and give a more detailed description of the practical UDP development issues of these three cities.

Furthermore 16 master thesis projects (see Appendix 4) over the course of three academic years covered various aspects of Smart Cities and UDPs. These projects were executed under the guidance of the Erasmus University RUGGEDISED research team and in close collaboration with the municipality of Rotterdam.

The survey study and the Delphi study were conducted under the guidance of the EIP Smart Cities marketplace / Integrated infrastructures and urban platforms initiative (led by Graham Colclough, partner Urban DNA) and SCC01 Task group Data management (led by Albert Engels, Programme director RUGGEDISED).

1.6 Outline of the report

From our research activities we have induced the following conceptual framework (Figure 1.10) to understand the drivers of adoption of UDPs and value creation by UDPs. This framework is used to structure this report. A more detailed version can be found in chapter six (Figure 6.3 in section 6.4). Central in this model is this model is the elusive concept of trust. We will describe the drivers of trust, i.e. purpose, governance and (managerial and technical) capabilities, and quadruple helix collaboration.
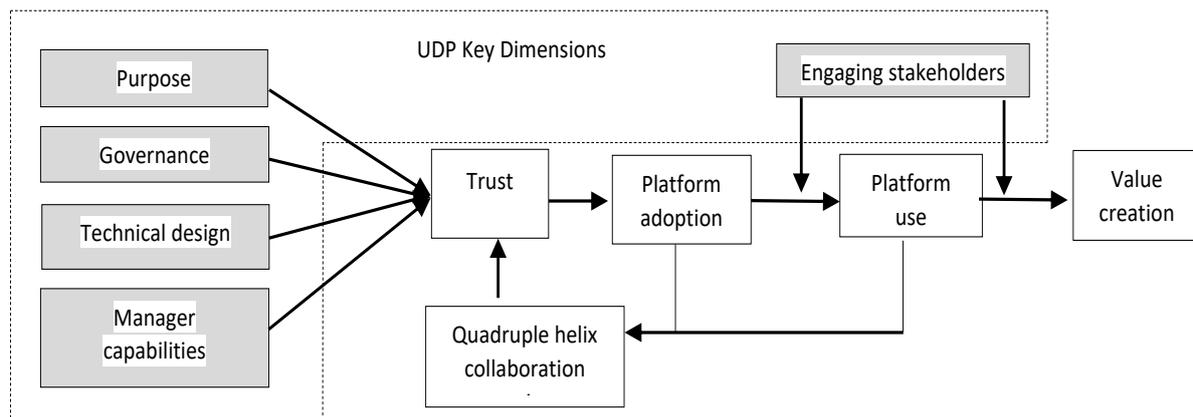
Figure 1.10 – A conceptual framework for value creation in Urban Data Platform Ecosystems

Chapter two will report on where we are with UDPs in Europe. A **maturity profile** will be introduced that can serve as a tool for platform managers on how to grow. Platform **purpose** is an indicator of the breadth and depth of the vision behind a UDP in a city. In this chapter we will also discuss **trust** which has emerged as probably the most important key to unlock the success of UDPs.

Chapter three is dedicated to **platform governance**. A key component of governance is the institutional arrangement, i.e. the ownership, management, and financing of the platform. Other components of governance are data governance and controls & principles. These components are described, and the survey results will give an insight on the performance of European UDPs in terms of governance.

In chapter four we will focus on other key **aspects of designing** an urban data platform. We will introduce a comprehensive business model canvas for UDPs and discuss selected components of this canvas, i.e. citizen engagement, and platform manager capabilities. A high-level view of platform architecture and technical capabilities is given. Designing the right business model for the UDP using the canvas will determine not only the adoption of the platform but also its scalability, i.e. its potential to grow in scope, use and reach.

Chapter five focusses on **business models** that are enabled and / or enriched by a UDP. We will discuss what makes smart city business models specific. With this understanding of the complexity of smart city business models, a typology of business model 'on top of' UDPs is introduced, followed by a description of the business models canvas for these UDP engaging business models. Finally, we reflect on the business model ecosystem that will emerge once a UDP starts to flourish, and how this emergence may affect the roles and positions of government, companies and citizens.

Finally, in chapter six we discuss how to move forward with urban data platforms. We provide recommendations for policy makers in government and for strategists in companies. We introduce a development approach for UDPs that emphasizes the continuous improvement and continuous learning approach which is needed when embarking on the UDP journey. Recommendations for further research are provided, based on a more detailed version of the conceptual framework of Figure 1.8. We hope this encourages academics and knowledge institutions to pursue the many questions that remain unanswered.

2. State of Play of Urban Data Platforms in Europe

Our consecutive surveys paint a picture that UDPs are still in their infancy in Europe, with a few notable exceptions. It is our observation that 'trust' and 'purpose' are key ingredients that we need to get right for UDPs to really take off. The required level of trust in institutions and the technology is to date insufficient. For purpose, which can vary from being down to earth efficiency focused to more aspirational society focused, we find a gap between the aspiration and implementation. We conclude this chapter with a maturity profile for UDPs that can be used to model the growth path for a city in the form of a roadmap.

2.1 It is still early days for UPDs in Europe

Urban Data Platforms are a relatively new phenomenon, gaining more traction about ten years ago, with most platforms initiated in the last five years (see figure 2.1). Therefore, the maturity of platforms in Europe varies, with about 30% of cities saying that their platform is in operation, while a quarter of cities say that they are still exploring the need for a UDP. Others are either planning, building or implementing their platform. Furthermore, only about half of the platforms surveyed qualify as full UDPs in the sense that they comprise both municipal and external data and extend beyond the boundaries of the municipality.

When did you start working on the Urban Data Platform?
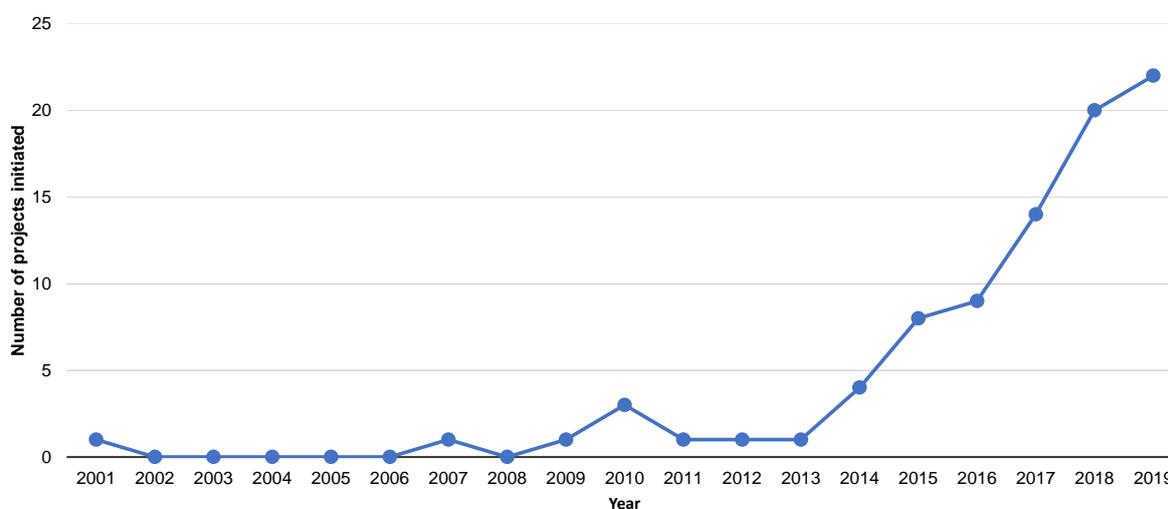
Figure 2.1 – Year of initiation of Urban Data Platform (Survey 2019)

As we will discuss in section 2.5, UDPs do not start out as full-fledged platforms, but in general evolve from either open data portals or internal municipal data platforms. Of the cities surveyed (see Figure 2.2) the majority are today indeed urban data platforms as we define it, cutting across silos within the municipality and including data from the entire city ecosystem, i.e. not only data from the government but also from other organisations. A significant part of the platforms contains only municipal data and those in the exploring and planning phase report that their data is still locked in municipal silos. A small number of UDPs report that their platform does not include data from the municipality.

How would you characterize the predominant data ecosystem in your city?
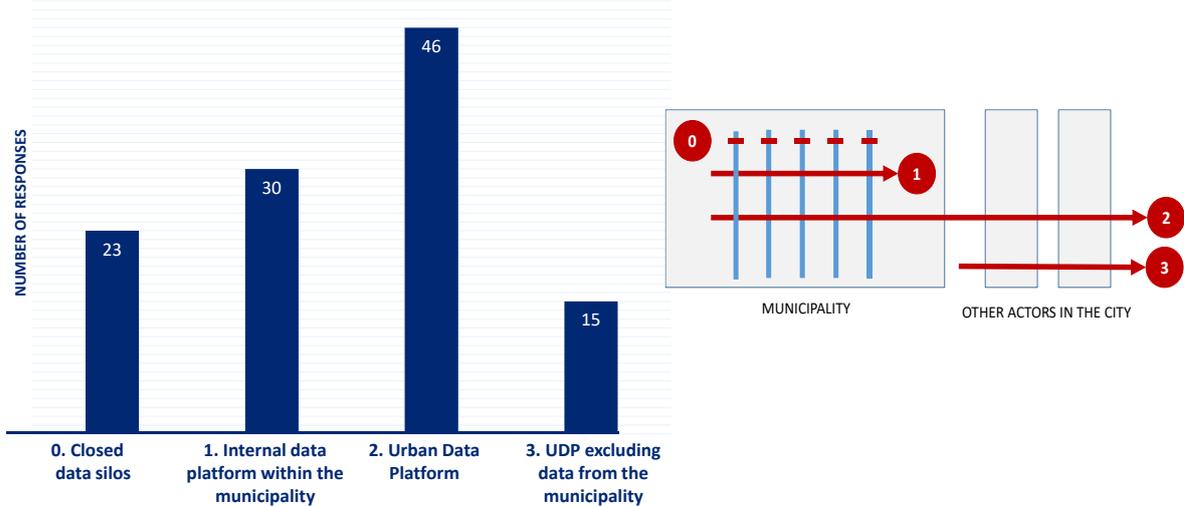
Figure 2.2 – Scope of platform (Survey 2019)

Also, in terms of adoption of the platform by data users and data providers it is early days in Europe. About half of the platforms report that they have a very low or low adoption of the platform by both data users and data providers. Getting people and organisations to adopt the platform really depends on how well the platform is designed and the level of trust people have in the platform, both in terms of technical capabilities of the platform itself and the managerial capabilities of the platform manager. A metaphor often mentioned also in relation to UDPs is that of the cathedral and the bazaar (Raymond, 1999), denoting the difference between centrally designed hierarchical software structures (cathedrals) and the more horizontal and collaborative approach used by open source software development (bazaars). And although the bazaars metaphor not fully fits with the UDP ecosystem, it does clarify the mindset required by the manager of the platform. This bazaar mentality does not come naturally to government but is crucial in both the design and the operational phase of the platform to ensure and drive adoption.

How would you rate the overall adoption of the platform by data users?
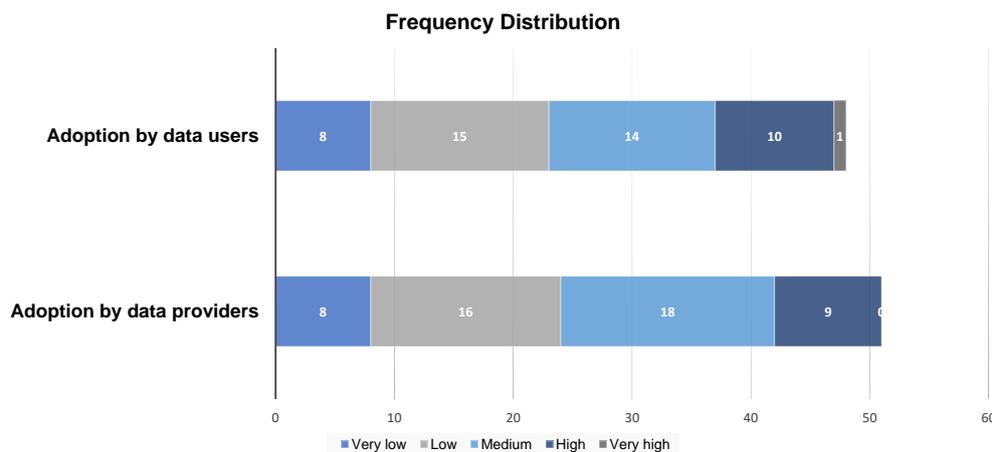
Figure 2.3 – Platform Adoption (Survey 2019)

It is also `early days´ for the lighthouse cities in the RUGGEDISED project. Before turning to the results from the experts and UDPs surveyed, the challenges these cities – Rotterdam, Umea and Glasgow – face today are described.

2.2 Challenges faced by the RUGGEDISED cities

The literature about the state-of-the-art in UDPs still describes significant challenges over various phases of UDP development and operation. First, there are challenges related to the technical architecture and data. (Krylovskiy, Jahn, & Patti, 2015) mention the challenge to develop and operate a UDP which can adapt to the fast-paced development of new technologies, standards and services. Moreover, difficult interoperability between the UDP and other specific systems, is a result of the lack of a common standard and the lack of knowledge on system architecture (Trilles et al., 2017). Regarding system integration, (Cheng, Longo, Cirillo, Bauer, & Kovacs, 2015) mention the challenge of building a UDP on top of current and future platforms for all smart city activities to share and reuse data processing and analytics. (Liu, Heller, & Nielsen, 2017) and (Liu, Heller, & Nielsen, 2017) and (Badidi & Maheswaran, 2018) report re-occurring challenges on data quality, interoperability, integration and exchange, but also security and privacy challenges, e.g. personal data, cost intensive security applications, and the risks of hacking.

A leading question for these data management challenges, related to the data quality and integrity, is whether users can trust insights derived from UDPs. In line with the common saying in data analysis of "Garbage in, garbage out", the quality of insights derived directly from a UDP, or via data provided through a UDP, is difficult to validate if the data is of insufficient quality. The quality of the data can be impacted by the technology used and the human involvement in the generation of the data, but also in the cleaning and processing of data and the choices made for data generalisation, calibration, formatting etc. Finally, unpredictable data generation rates, data heterogeneity, different data access constraints, and technical requirements for real-time processing are challenges regarding social data mining in a smart city (Giatsoglou, Chatzakou, Gkatziaki, Vakali, & Anthopoulos, 2016).

In addition to the technical challenges, literature reports on the organisational and governance challenges of UDPs. (Badidi & Maheswaran, 2018) mention the misalignment between the organisational goals and priorities, and the efforts and investments required for the UDP and its hardware, software and expertise. This withholds further investments in UDPs. Moreover, they mention the lack of supported integration standards. Finally (Badidi & Maheswaran, 2018) report a low willingness to share data or the lack of motivation to follow standards for convenient data integration and interoperability as a major challenge.

With the background on what literature reports regarding the challenges, the following section will investigate the challenges faced by the RUGGEDISED lighthouse cities.

Challenges faced by the lighthouse UDPs

The lighthouse cities made great efforts to engage on the journey to establish UDPs in their city and position themselves as leaders in the field. However, this journey was not one without challenges. These challenges are presented in table 2.1a to 2.1c.

Table 2.1a – UDP Technical architecture and data challenges faced by the lighthouse cities

Challenge	City
It remains a technical challenge to gather and publish real-time data sourced by municipal sensors, due to internal firewalls in the Municipal IT systems.	Umeå
Providing access to data and the means to analyse it by a broad variety of non-experts challenges the interface design.	Glasgow
Data security and privacy is of major importance. Glasgow dealt with the data security challenge by linking the DBDP to the corporate GIS and data systems, to ensure that access to certain datasets is limited to authorized users within the Glasgow City Council. Rotterdam and Umea introduced various levels of data access authorisation for external users to ensure the security and privacy with potentially sensitive data.	Glasgow, Rotterdam and Umeå
It can be a challenge to prioritise the functionality for which a UDP is to be designed due to the variety in stakeholders and unknowns about future users. The Digital twin concept helped Rotterdam to target the use of the UDP and provided a picture of the desired functionality of the UDP and what can be developed in applications and services. Therefor the platform itself contains a minimum of smart functionalities, and from there functionalities can be developed and added by partners.	Rotterdam
Although the use of open data standards is preferred, deciding **on which standards to use** is more complicated then it seems. It is difficult to cope with the many definitions of open standards, the subsequent ambiguity and large number of standards, and the dilemma between open data and privacy.	Rotterdam
Ensuring that the data on the platform is up to date is challenging, especially when there is a large amount of data sources.	Glasgow
There are challenges pertaining to the internal city council **data source owners** and the process of engaging them to share data on the UDP.	Rotterdam and Umeå
Companies generating data for commercial purposes are not accustomed to utilising **open data standards**, and they lack incentive to do so. For Rotterdam it is important to enforce this when companies are building applications on the UDP. In the Rotterdam example of the smart waste collection at least three aspects were found for municipalities to consider: a) Ensure that you have the full and free rights of using the source data, i.e. 'ownership' of the data. b) Ensure agreement upon a pro-active service on the company side to send the data to the municipality automatically. c) Ensure that the data is delivered in an open data standard format that you can read, understand and publish.	Rotterdam

Table 2.1b – UPD Governance & organisational challenges faced by the lighthouse cities

Challenge	City
There is a municipal vision on city data, but without the necessary resources to execute this vision. On the other hand, there is the RUGGEDISED vision with resources. However, this RUGGEDISED vision is different from the municipal vision, and this mismatch is a challenge. Because the UDP is a RUGGEDISED project it is difficult to get commitment from the other departments to participate. Rotterdam tackled this challenge by embedding the RUGGEDISED UDP within the municipal vision and policies on city data.	Umeå
The **IT department** can be a constraining factor, via concerns on the security of public platforms and the link to municipal databases. Subsequently they can impose barriers for in-house development related to the legacy software and hardware in use.	Umeå and Glasgow
Different fields of expertise are still not accustomed to communicate with each other. For example, the geo-field and the IoT-field are not used to work with each other, and this complicated the integration of various technologies in a UDP.	Rotterdam
Various **cultural barriers** within the organisation are in the way of successful pilots. Besides the difficulty of implementing innovation in general, the aim is to do this cross-silo and by a new way of working (co-creation, partnerships, processes instead of smart projects etc.). All together this leads to the famous quote: implementing change is 25% technology and 75% cultural/organisational.	Rotterdam

Table 2.1c – UDP Stakeholder and trust related challenges faced by the lighthouse cities

Challenge	City
Scattered data ownership is a challenge. Stakeholders want to share data, but it is stored by a third party and the stakeholders have no access to the data, e.g. the parking garage operator wanting to share data, but the data is owned by the company operating the signs and displays in the parking garage.	Umeå, Rotterdam
It is a challenge to populate the UDP with enough and relevant data from the various stakeholders in the city.	Umeå
It is a challenge to **convince the citizens and stakeholders** of the value of publishing data as open data on the platform.	Umeå
It is a challenge to **generate the desired amount of traffic**, i.e. data utilisation and application development, on the UDP for its potential to be realised and its investment and efforts to be justified.	Umeå and Rotterdam

Of the three types of challenges identified above, the remainder of the report mainly addresses the latter two, i.e. governance / organisational and stakeholder / trust. A thorough discussion of the first type of technical / architectural challenges is beyond the scope of this research, but we do briefly reflect on some technical aspects in section 4.5.

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2.3 Trust emerges as the most critical success factor

Trust is seen is the crucial factor affecting (the speed of) UDP adoption and implementation (see figure 2.4). This result is consistent across both surveys we have conducted. Respondents indicate this as the most relevant success factor, and that there is a gap between the required level of trust and the actual level of trust. This gap is the largest when compared to the gap for other success factors.

Accelerating and restricting factors in the adoption and use of UDPs

Factor	Value
Trust among the involved partners	0,73
Triple helix collaboration	0,53
Open data standards & Protocols	0,33
Subsidies, Grants	0,30
Citizens' actions and involvement	0,24
Private sector drive	0,14
Business Case	0,00
Political commitment / sponsorship	-0,17
Cultural and social issues	-0,30
Digital literacy of end users	-0,84
Data ethics and societal concerns	-0,86
Privacy legislation	-0,99
Procurement legislation	-1,03
Cyber security risks	-1,05
Legislation	-1,05
Contractual complexities	-1,24

Scale: restricts (-2) — somewhat restricts (-1) — neutral (0) — slightly accelerates (1) — accelerates (2)

Figure 2.4 – Trust is the most important factor accelerating the implementation of a UDP (Survey 2019)

Trust seems an elusive concept, highly complex and dependent on the context. Edelman (Edelman 2020), the global communications firm that over the last 20 years has become an authority on measuring trust across the globe, writes as they publish their 2020 Edelman Trust Barometer in January 2020:

"… despite a strong global economy and near full employment, none of the four societal institutions that the study measures—government, business, NGOs and media—is trusted. The cause of this paradox can be found in people's fears about the future and their role in it, which are a wake-up call for our institutions to embrace a new way of effectively building trust: balancing competence with ethical behaviour".

We all have some intuitive notion of the concept of trust. At the time of writing this report, amid the Covid-19 pandemic, it is no surprise that there are early indicators of lower levels of societal trust, due to increased levels of uncertainty, worry and stress (Brück et.al. 2020). Despite this shared intuitive notion of trust, the academic literature has not settled on a single definition. Nyhan (2000) states that trust "represents the level of confidence that one individual has in another to act in a fair, ethical and predictable manner". Mayer, Davis and Schoorman (1995) define trust as the "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party".

The literature guides us on how trust can be fostered. Mayer et al. (1995) offer a simple, yet elegant, framework of the drivers of trust. Their factors of perceived trustworthiness are benevolence, capability and integrity.

- Benevolence, i.e. do you have my best interest at heart, is related to the **purpose** of a UDP and hence the rationale of stakeholders to engage in a UDP. Having a mere efficiency motive is likely to instil less trust than having a higher purpose such as serving the environment or improving democracy.
- The more capable a person or institution is, the more likely we are to trust them in a certain context or with a certain task. In this research we make a distinction between the **capabilities** of the platform manager and the capabilities or functionalities that have been technically embedded in the platform itself.
- Mayer et al. define integrity as the degree to which a person or institution "adheres to a set of principles that (are) acceptable (moral integrity), encompassing honesty and fair treatment, and the avoidance of hypocrisy". In an organisational setting, clear and transparent **governance** is the way to ensure integrity.

In our study we have identified the following relevant components of trust:
- trust in the platform technology itself, e.g. reliability, robustness
- trust in the main platform institutions, e.g. owner, manager, and financer
- and mutual trust between the public and the private sector.

Mutual trust in our Delphi study was operationalised by asking about the (perceived) trust in the private sector by the public sector and vice versa. Figure 2.5 shows that there is a lot of mutual **dis**trust. The first survey also showed that according to the respondents there is a gap between the required level of trust and the actual level of trust. Mutual trust can be increased by getting experience with collaboration. According to the panel, government should additionally work on their capabilities, whereas for the private sector integrity and self-centredness are the topics to work on.
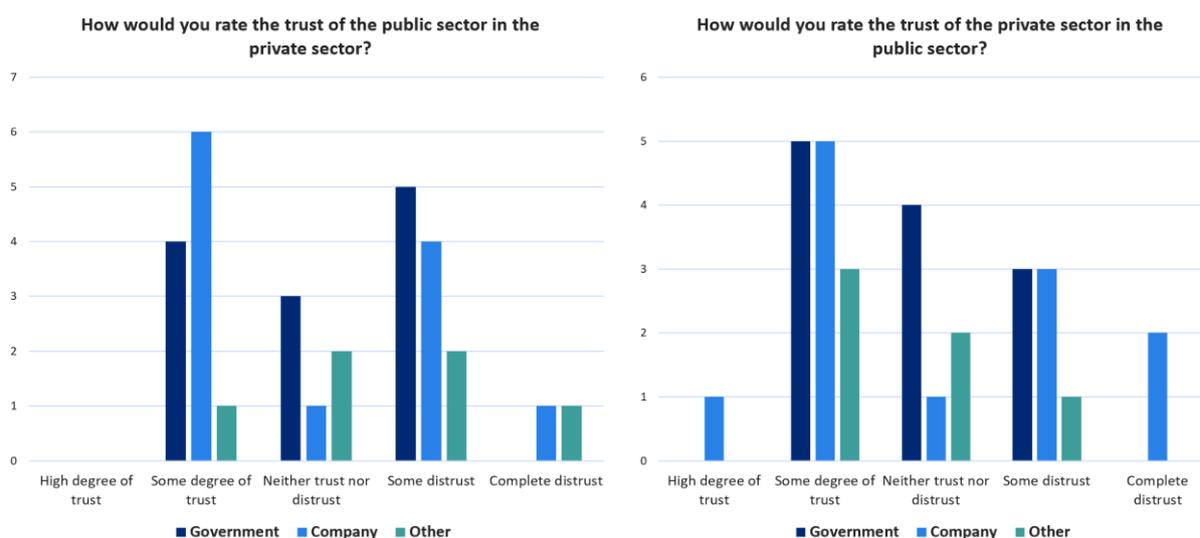
**Figure 2.5 – Mutual Trust (Delphi 2020)**

As our conceptual model shows (Figure 1.8) trust in the platform is driven by the governance (ensures integrity) they choose and the technical and managerial capabilities (ability) they have. We will discuss governance in chapter three and capabilities in chapter four. The next section focuses on the purpose of the UDP, which resembles Mayer's notion of benevolence.

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2.4 Platform Purpose

The Oxford English Dictionary (1991) defines purpose as: *"The object for which anything is done or made, or for which it exists; the result or effect intended or sought; end, aim"*. Intuitively we understand that the purpose of a system is larger than the sum of its objectives, it is really about the "reason of being" of the system or organisation. When envisioning and designing the UDP it is important to understand why you are setting up a UDP, i.e. define the purpose of the UDP. Our survey shows (see Figure 2.6) that many objectives of today's European platforms are about efficiency and economic growth, i.e. "profit" motives in the people-planet-profit frame.

What is the purpose and objectives behind your UDP's strategy?
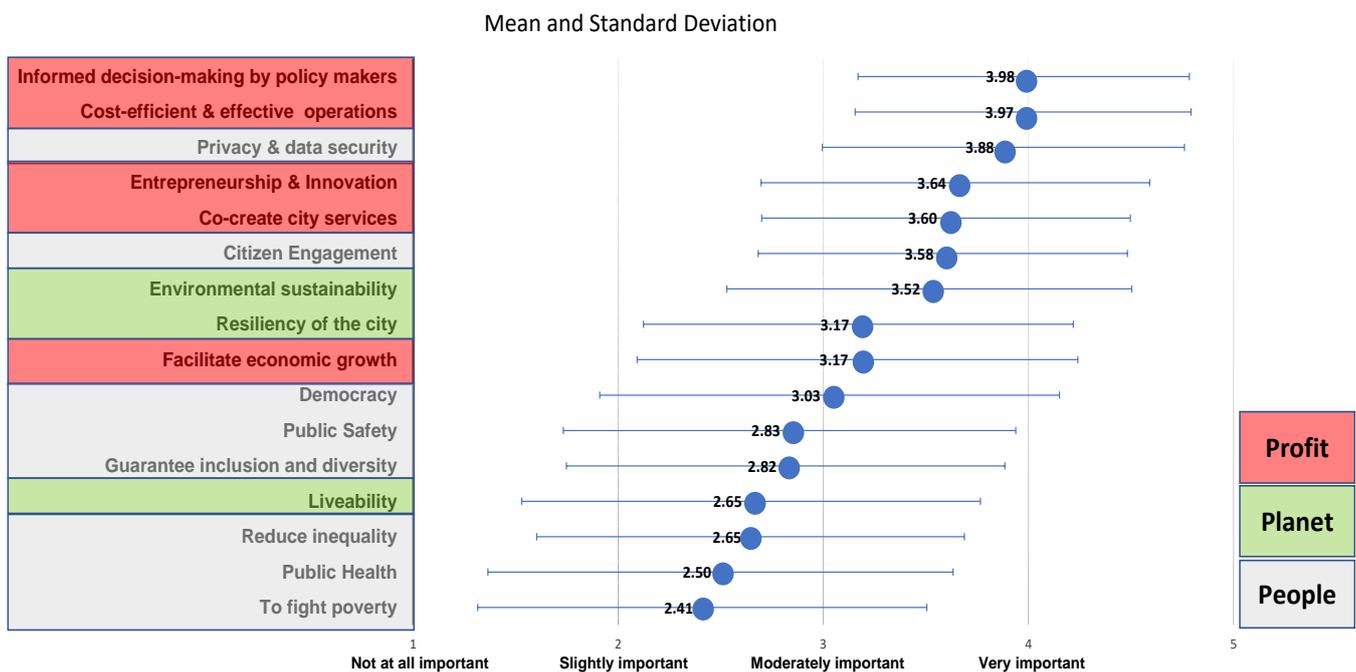
Figure 2.6 – UDP objectives align with a triple bottom line approach (Survey 2019)

From the output of the surveys we were able to cluster the objectives mentioned by respondents into four categories of purpose which we presented to the Delphi expert panel (see Figure 2.7):

- Better City Services, Policies and Decision Making (by the government and others)
- Economic Innovation & Entrepreneurship
- More Resilience and Environmental Sustainability
- Social Innovation and Better Democracy

UDP IMPACT
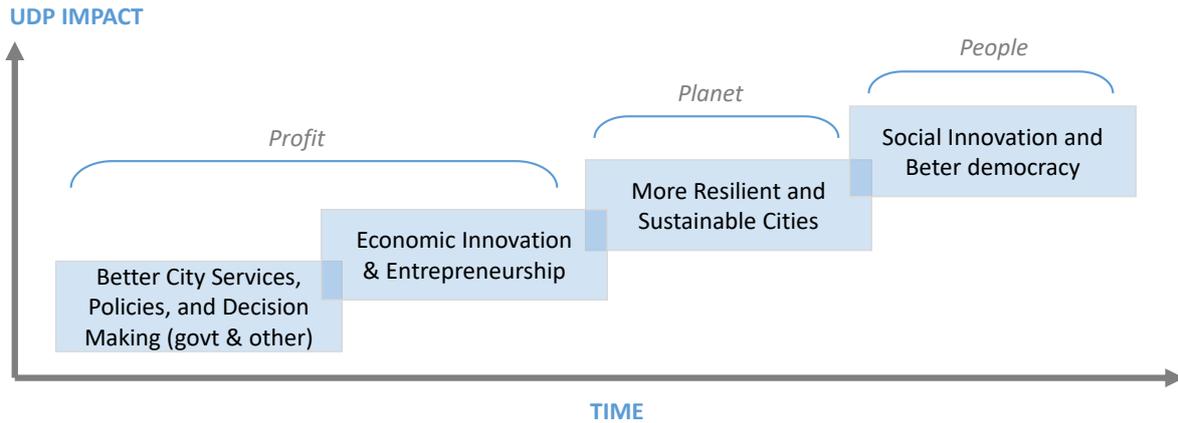
Figure 2.7 – Platform Purpose: the higher the purpose the more impact a UDP has

While all respondents indicate that platforms serve the full scale of purposes (see Figure 2.8), the main platform purpose is to facilitate better services and policies, and economic innovation and growth. The UDP is somewhat envisioned to achieve a sustainable planet, while social innovation and democracy seem less likely as the UDP purpose. It remains to be seen whether UDPs will be able to develop to these "higher purposes", or whether they are just not the right instrument to achieve these. The conclusion from the findings from the survey and the Delphi study is that practitioners and experts mostly accept the triple bottom line nature of UDPs. And although the experts imply that these are almost all important, the practitioners surveyed start with the profit / efficiency focus first. Their challenge will be to evolve to the higher and more difficult to obtain levels of purpose.

In your vision of the future, what should the purpose of a UDP be?
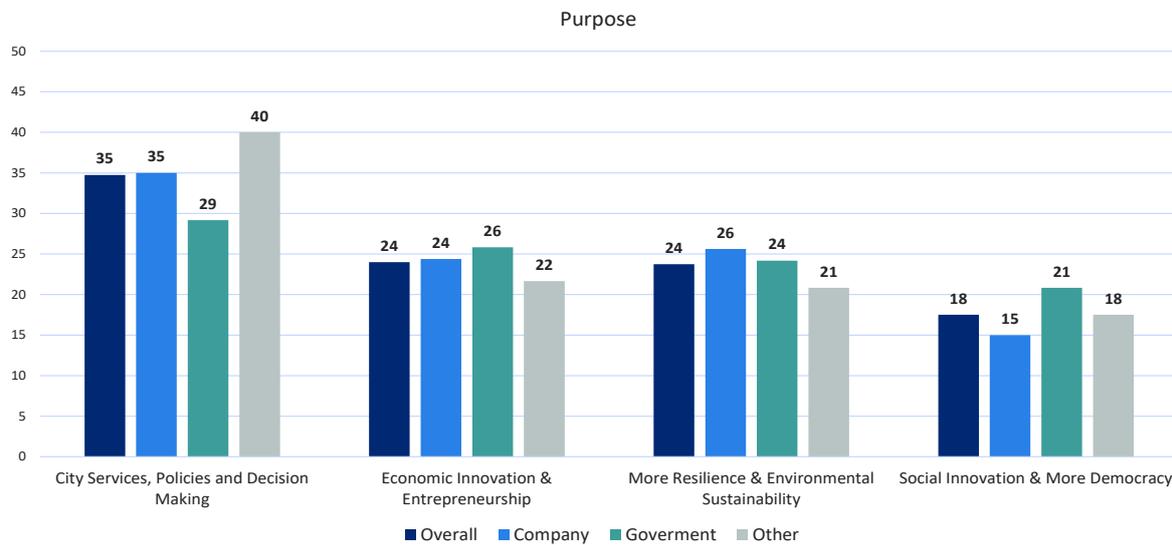
Figure 2.8 – Main platform purposes (Delphi 2020)

It is strongly recommended that all the partners involved in the UDP (manager, owner, investor, builder) all have a clear and joint vision of the UDP purpose. Starting a UDP just for the sake of it is likely to result in failure. Having clarity of purpose upfront will guide the efforts and will give the developers and policy makers confidence and flexibility during development of the UDP and in

managing a UDP. Ideally the purpose is made concrete in objectives, which reflect current and future needs of the city and its stakeholders. Please be aware that these objectives transcend the needs of the platform manager.

2.5 UDPs progress through several levels of maturity

Many of today's UDP started out as open data portals, and by adding functions and features have been repurposed toward UDPs. Barns (2018) typology of UDPs (see Figure 2.9) ranges from data repositories to data marketplaces. Barns' data marketplaces resemble what we have defined as Urban Data Platforms, with an emphasis that the data on a UDP is not restricted to government data and the data in not necessarily stored on the platform itself. The typology shows the evolution of simple repositories, often called Open Data Platforms, to fully featured marketplaces. It is good at his point to mention that the term Open Urban Platforms (used by e.g. the NEN and Dutch municipalities), is used interchangeably with UDPs.

Fig. 2. Urban Data Platforms: Key features.

Figure 2.9 - A typology of data portals and platforms (Barns 2018)

Data showcases and City scorecards are not primarily focused on access to or exchange of data, but much more on making the performance of a city ecosystem transparent. Therefore, in our maturity profile of how platforms mature from data portals to full data platforms we will exclude city dashboards and city scorecards. Our platform maturity model is largely based on the core interaction performed on the platform. "The Core Interaction is a set of actions that you need producers and consumers to engage in repeatedly in order to derive value out of your platform. There might be other actions that users perform, but the actions constituting the Core Interaction are the ones without which the platform would absolutely cease to exist" (Choudary 2020).

Figure 2.10 provides an overview of possible core interaction on a platform and gives the state of play in Europe. 70% of the platforms currently facilitate making data available to users in an open data platform, followed by providing APIs for platform services (49%) and connecting parties. Currently 12% of the platforms visualize data in a 3D digital twin of the city, but this is envisioned to be supported by the platforms by another 56%. More advanced interactions are envisioned to be supported by the platforms, to develop these into a real marketplace. The platforms currently facilitate data analytics to a limited degree.

What Core Interaction is currently facilitated on the platform?

Frequency Distribution

Figure data (bar chart):

Category	Currently supported	Envisioned to be supported
Data available to users in Open Data Platform	41	55
APIs for platform services	29	51
Connect data users, app providers and data sources	27	52
Visualize data in a 3D digital twin of the city	7	39
Software Development Toolkit (SDKs) for App development	7	32
Connect buyers and sellers of data and Apps with catalogue	3	32
Allow trade on the platform through an app store		24
Price setting market mechanisms		22
Selling Apps with revenue share		17

■ Currently supported by the platform   ■ Envisioned to be supported by the platform

Figure 2.10 – UDPs are still evolving and ambitions are higher than implementations (Survey 2018)

The outlook on future core interactions was used to develop a high-level **platform maturity model** (see Figure 2.11)**.** Platform designers and managers can use this maturity model to chart their roadmap during the strategizing phase of their development cycle, whilst keeping the purpose of the UDP firmly in mind. The roadmap captures the evolutionary nature of platforms. The more comprehensive the individual core elements the platform, the higher the overall platform maturity.

Metrics of platform success

The higher the platform maturity, the higher its adoption, use, and ultimately value created. We distinguish platform adoption from platform use. The more data-users and -providers adopting a platform, the more useful a platform becomes. This is the network effect so characteristic for platforms. Adoption can be measured by the number of participants, while platform use can be measured for instance by the number of datasets available, the actual number of data exchanges, the number of developers attracted, and the number of APIs provided. Ultimately the goal of the platform is the value created for the platform users and the additional public value created by the platform ecosystem. According to Parker et al. (2016) platform managers must remain focused on *"… the creation of value for all users of the platform, which strengthens the community, improves its long-term health and vibrancy, and encourages the continual growth of positive network effects"*.

*   *   *

Even though it is still early days for UDPs in Europe, the data gathered from practitioners and experts has clearly pointed to trust as the 'magic ingredient' of UDP performance. One of the drivers of trust in the platform is the purpose of the platform. Platform purpose, once clearly articulated and communicated, will be an indicator of the trust driver 'benevolence' of the UDP organisation(s). Another major driver of trust is the 'integrity' of the UDP organisation(s) which can be best ensured through transparent and comprehensive governance mechanisms. Platform governance, the first of two parts of designing UDPs, is the topic of the next chapter.

	Open Data Portal [+ City Dashboard]	Urban Data Platform		
		Basic	Mature	Advanced
Type of Data	Municipality data only	Ecosystem Data	Ecosystem Data	Ecosystem Data and Platform generated data
Flow of data	1-way	2-way	2-way	3-way i.e. including platform generated data
Objective	Data Services Innovation	Data Services Innovation across Ecosystem	Services Innovation across Ecosystem	Ecosystem Services co-creation, Resiliency, Social Innovation and Citizen Participation
Connectivity	Connect data users to government data	Connect data users, and data providers	Connect data users, data providers and app developers	Connect ecosystem partners to co-create innovative urban services
Transactions	Downloading of data sets (mostly for free, as this is public / govern-ment owned data)	Just exchange of data through the platform. No transaction pay-ments thru platform	Enable transactions between buyers and seller in 'data- and app stores'	Revenue mechanisms to steer transactions in the data- and app store
Pricing Mechanism	None	None	Price catalogue and / or pricing guidelines	Pricing mechanisms in place to mediate buying and selling on the platform
Platform Tools	No SDKs. Limited set of APIs	No SDKs. APIs provided by the data source	Basic SDKs. APIs by data source. Data market places	Business model enable-ment by a portfolio of advanced platform tools, e.g. training, catalogues, collaboration
Ecosystem nurturing	None	Ad hoc management activities to attract users and data providers to the platform	Structural activities to stimulate engagement and participation on the platform	Orchestration by platform manager to encourage new business models contributing to the platform purpose
Data governance & data quality management	Depending on the maturity of the data portal	No data charter Ad hoc data quality mgt	Data charter in place Domain specific data stewards	Overarching CDO role as part of platform mgt capability to assure ecosystem data quality
Collaboration	Limited collaboration silos in the municipality publish 'vertical' data sets	Collaboration between platform owner, manager, financer and platform builder	Collaboration between platfrom manager and ecosystem to build trust in the platform	Incessant collaboration among ecosystem partners / quadruple helix building mutual trust
Societal Relevance	Specific audiences reached to solve specific (business) issues	Some engagement from the 4ple helix. Ad hoc public and private value creation	Considerable engage-ment for the 4ple helix. Systemic pubic and private value creation	Broad societal engagement as the UDP is fulfilling its full potential as vital public infrastructure

Figure 2.11 – Urban Data Platform Maturity Model

3. Designing Urban Data Platforms: Governance

As discussed in the previous chapter clear and transparent governance of the UDP ensures integrity and is as such one of the major drivers of trust. Who should own the Platform? Who should manage it? And who should finance the UDP? These institutional arrangements are a core component of the wider concept of UDP governance. Other components include norms, principles, data governance, and control. We will introduce these concepts and assess their implementation in practice to date in Europe.

3.1 Introduction to Governance

Appropriate governance arrangements that allows urban data sharing, support decision-making, and facilitate interaction among relevant city stakeholders are key to the success of UDPs and their ecosystems. Governance thus plays a particularly important role for platform leaders to make deliberate choices about platform access, ownership, and control to orchestrate communication among the stakeholders (Mukhopadhyay and Bouwman 2019, Schreieck et al. 2018). Therefore, the identification of the dimensions of the governance framework for UDPs matters. In this section, first, some definitions of governance of digital platforms are given. On the base of these definitions, we define UDP governance for this study. Then based on the literature, we identify a set of governance dimensions to be included in a governance framework for UDP.

In a broad sense, governance refers to making decisions and exercising authority to guide the behaviour of individuals and organisations. Governance can be achieved through the development and implementation of norms, principles, control, and institutional arrangements that set standards and create incentives for behaviours (World Economic Forum).

According to Tiwana (2013), digital platform governance refers to who makes what decisions about a platform. Also, digital platform governance should encompass a range of structural, procedural, and relational mechanisms to make decisions related to collective activities concerning the platform. Roles and responsibilities and location of decision-making authority are structural mechanisms. Procedural mechanisms aim to ensure that platform governance executed properly while relational mechanisms aim to facilitate communication, training, and coordination of decision-making among the ecosystem stakeholders (Mukhopadhyay and Bouwman 2019).

Based on the above definitions, in this study, we define UDP governance as a framework for decision making and accountability that produces desirable outcomes within the ecosystem surrounding the platform. The UDP governance framework determines the what, who, and how of platform's decision-making during the lifecycle of the UDP, i.e. from its design, adoption, and use, and scaling and growth. UDP governance can be achieved through the development and implementation of norms, principles, control, and institutional arrangements that set standards and create incentives for the behaviours of stakeholders of the ecosystem surrounding the UDP.

Regarding dimensions of digital platform governance frameworks, various studies have identified different dimensions. Five examples are given here.
- Tiwana (2013) suggests that platform governance should involve three dimensions of decision rights partitioning, control, and ownership.
- Schreieck et al. (2018) propose a governance framework for digital platforms involving the

dimensions of governance structure, boundary resource, control, trust, pricing, and partnership management.

- Mukhopadhyay and Bouwman (2019) suggest five decision domains that should be handled by platform governance as follows: design guidelines for the architecture and the interfaces; guidelines for new partner on-boarding; revenue sharing mechanisms; managing platform vision and integrity; and conflict resolution.
- Otto and Jarke (2019) highlight the importance of decision-making rights and data management activities (data governance, metadata management, and data lifecycle management) as dimensions of data platform ecosystem governance mechanisms.
- World Economic Forum suggests that governance can be achieved through the development and implementation of norms, principles, control, and institutional arrangements that set standards and create incentives for behaviours

Based on the above governance dimensions, our governance framework for UDP encompasses five dimensions as follows:
1. Institutional arrangement (Management, Ownership, Financing)
2. Revenue Model
3. Data Governance
4. Control (Gatekeeping, Process Control, Shared Norms and Values)
5. Principles (Openness, Interoperability, Transparency)

These governance dimensions will be explained in the following sections.

3.2 Platform Ownership and Management

The governance model as defined in our recent studies in Europe is a combination of platform ownership and platform management and was described in the questionnaire as follows. "The Platform Owner has the legal control over the platform technology and the intellectual property of the platform. This excludes ownership of the data provided by participants and the applications developed by app producers on top of the platform, unless agreed otherwise. The Platform Manager maintains, runs and develops the platform within the guidelines (however strict or loose) provided by the Platform Owner. In other words, the Platform Manager executes the platform functions that are necessary to make the platform business model work. Each role can be taken by the local government (municipality), a private partner or via a public-private partnership (PPP).

PLATFORM MANAGEMENT

		(Local) Govt.	Joint PP Set-up	Private
PLATFORM OWNERSHIP	(Local) Govt.			
	Joint PP Set-up			
	Private			

PP = Public - Private

Figure 3.1 – Urban data platform governance: institutional arrangement

There are two compelling reasons why government should be involved in the platform either as the platform manager or platform owner or both. The first reason is that UPDs enable municipalities to deliver public services in co-creation with businesses or citizens and by doing so improve the quality of the public domain without an increase in the municipalities' budget. The second reason is that UDPs can be a very effective mechanism to create public value, just like how their counterparts in the private sector create private (monetary) value. Combining both these reasons one could argue (Sheombar, 2015) that an urban data platform is part of a countries' **vital infrastructure** and therefore should at least be regulated and maybe even governed by the government. This of course requires a

> *"… confident and capable government, which has built up its own capabilities to invest in technological opportunities and, just as important, to negotiate the landscape that they create"* (Mazzucato, 2018, p. 227).

Today more than 60% of UDPs are both owned and managed by the public sector (see Figure 3.2). Only a fraction of UDPs have a joint setup for ownership (18%) and management (17%). The number of UDPs owned and managed by the private sector are even smaller. The Delphi panel of experts takes a more conceptual long-term view. According to them the ownership is equally likely to be in the hands of the government or in the hands of a joint public private arrangement. In terms of management of the platform there is shift in preference away from the government to a public-private setup and companies as managers of the platform.

The ownership and management structures for a platform are part of the governance of the UDP. The actual building of a platform could be outsourced to a third party, the choice of which is not part of our definition of governance. Over half of the platforms surveyed have outsources the actual development of their UDP to a third party. Our research did not research the third option of platform ownership by citizens in terms of cooperatives or commons, which is not to say upfront that this is not a viable option.

**What Governance Model have you adopted and are you outsourcing?**
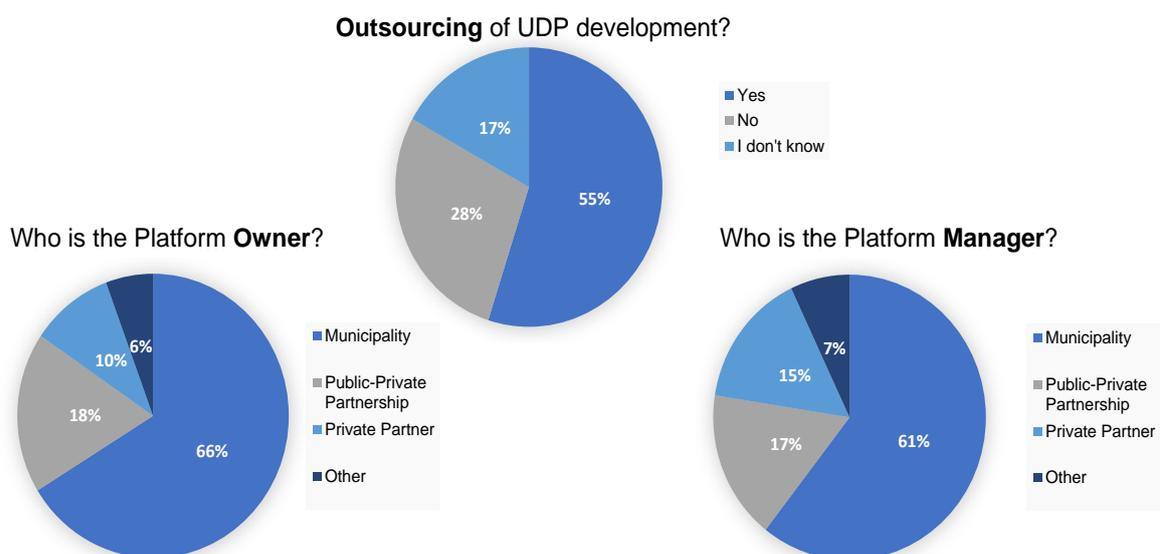
Figure 3.2 – State of play on platform ownership, management and development (Survey 2019)

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3.3 Platform Financing and Infrastructure Criticality

The European Investment Bank has identified investing in Smart City Projects e.g. Urban Data Platforms as a priority (see link) for the following reason:

> *"There is a clear case for investment in many cities in Europe. Medium-income cities did not benefit as much as capitals from agglomeration economies. They have fallen behind in competitiveness and are less able to take advantage of the shift toward higher value-added activities. By upgrading technology, infrastructure, and unlocking public data, these cities can open up new value chains and opportunities."*

However, the returns of smart city projects – in larger and small cities – are not always captured in monetary value. Furthermore, UDPs are a horizontal city infrastructure that can facilitate different (vertical) use cases, by combining different data sources, facilitating the matching of demand and supply for data. Making a proper ROI (business case) for investors in UDPs therefore requires packaging several use cases (that generate concrete financial value i.e. tangible benefits) with use cases that generate social and/or environmental value or intangible benefits. The survey has shown (see Figure 3.3) that the respondents are equally split between taking a business case approach to financing or a vital infrastructure approach using taxpayer money.

What approach is taken to justify investments in the Urban Data Platform?
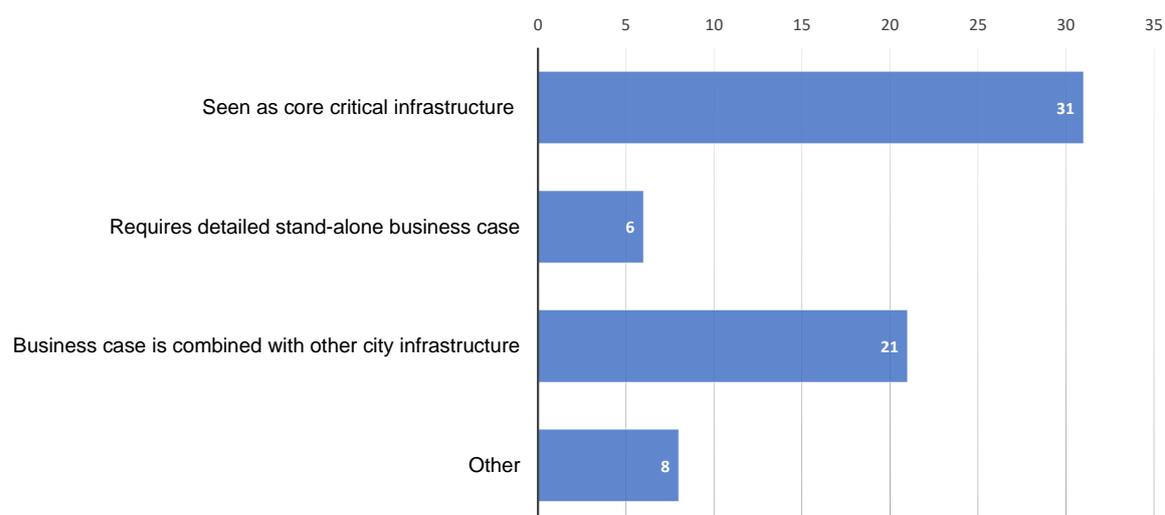
Figure 3.3 – Different approaches to UDP funding (Survey 2019)

Critical Infrastructure

Our panel of experts is unanimous that UDPs are critical Infrastructure: all (somewhat) agree with the statement that "UDPs are vital public infrastructure". Comparisons to other critical infrastructure such as roads, water and the energy grid seem apparent. By connecting and combining data from these physical critical infrastructures, UDPs are instrumental in the cyber-physical integration and therefore become critical themselves. Another reason is that UDPs connect data across silo's and by doing so unleash potential for efficiency, new services and economic growth. They are also envisioned as the gateway that make all city data accessible to potential users and "data is the future". One panellist even contends that UDPs create transparency and will become the

foundation of democracy and will ultimately enable us to save the planet. Section 2.4 on platform purpose revealed that this panellist was not alone in his or her optimism.

Are Urban Data Platforms vital public infrastructure?
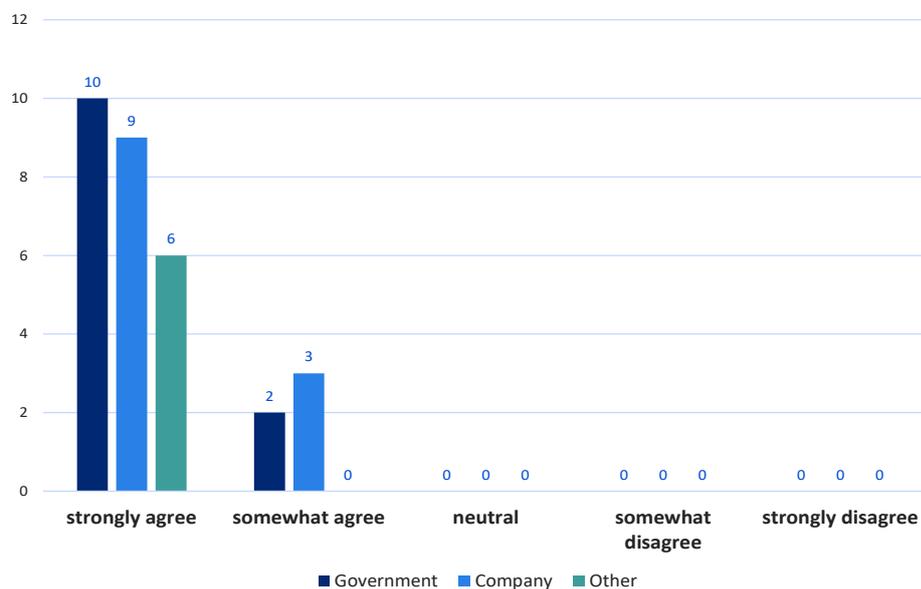
Figure 3.4 – Urban Data Platforms are perceived as vital infrastructure (Delphi 2020)

Among the panel members in the Delphi study there is consensus that a UDP is vital public infrastructure (see Figure 3.4). There is also a majority view that the best way to govern a UDP is a joint public–private set up. However, the panel is spit on how to initially finance the UDP. We asked them to allocate 100 points to their preferred financing option(s) with figure 3.5 as the outcome. The following financing options were presented.

- Policy driven top-down approach at a National or EU level. Critical infrastructure like a UDP should be financed with taxpayer money. National or EU budgets come with incentives to adopt e.g. ethical-, data- and inter-operability standards.

- Policy driven top-down approach at a Local (Municipal or Regional) government level. Critical infrastructure like an UPD should be financed with taxpayer money.

- A more management science approach applied at the Local government level. Even if a UDP is critical infrastructure, it must have a positive business case with the platform paying for its own operation and maintenance.

- Joint public-private investment approach. The (local, regional or national) government co-invests with the private sector. They jointly develop, maintain and deliver the value case.

- Pure market logic approach with private investment. The government pays for the use of the UDP, which operates within certain guidelines set by government (about e.g. privacy, security, standards).

Because UDPs are seen by the expert panel as vital infrastructure, the majority view is that they should be financed top down, policy driven, by the taxpayer, ether at a local/regional or (supra)-

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national level. Still there are panellist that treat the UDP as any other ICT project that requires business case. Interestingly enough, and in contrast with the survey, the experts on our Delphi panel have a strong consensus that the UDP is vital infrastructure (see Figure 3.4).

How should the Urban Data Platform be financed? Allocate 100 points across five options
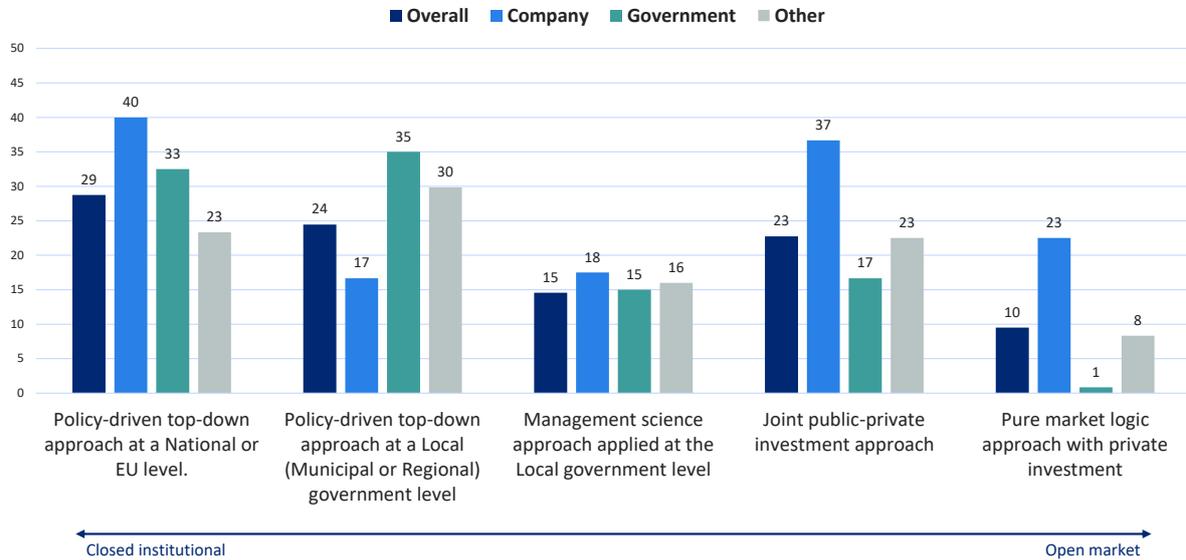
Figure 3.5 – Envisioned Financing of UDPs (Delphi 2020)

Revenue Model

Today UDPs are mainly financed from the capital investment budget, from the operational budget, or by public grants (see Figure 3.6). In case market funding is used, the UDP must at least generate revenue to repay these loans. Even though our research did not explore existing revenue models, given the maturity of current platforms, it is fair to assume that few revenue models are in place.

What are the current sources of funding the development of the UDP?
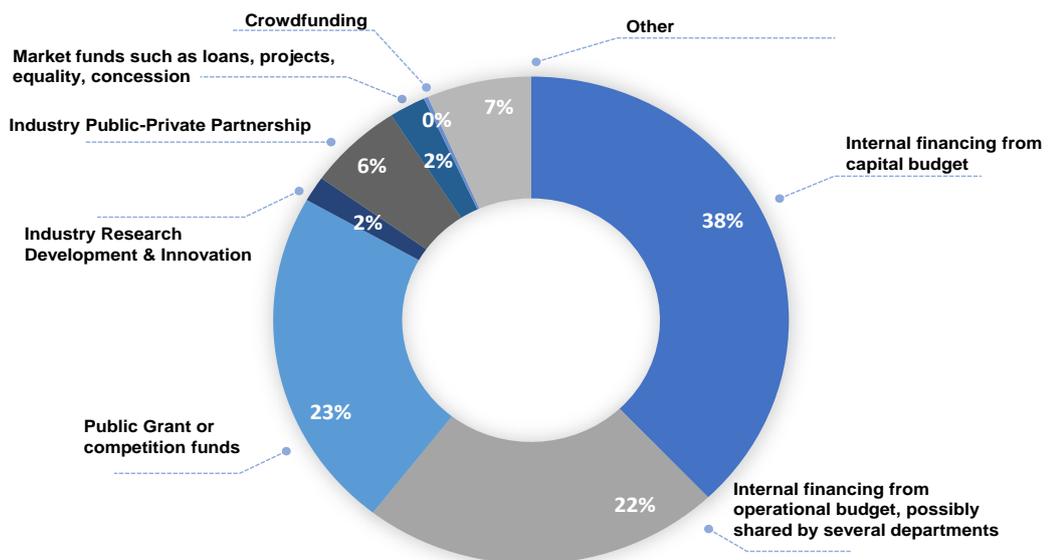
Figure 3.6 – Actual UDP funding to date (Survey 2019)

Existing commercial platforms can use their pricing policy to subsidize a certain side of their platform in order to attract and earn income from another side of the platform (Schreieck 2018). It is expected that the right, fair and transparent pricing policy will not only boost trust in the platform but will impact its performance directly. Please be advised that even if a UDPs is deemed public infrastructure, that does not automatically mean it is free. As UDPs are there to create public value, i.e. have a triple bottom line encompassing financial, social and environmental, getting the revenue model right will be a delicate process.

UDPs and Europe's digital future

When we contrast the point of view of the experts with the findings from the survey about how UDPs need to be financed, we see a split between a "critical infra" approach paid for by the taxpayer and a "just another ICT project" approach in need of a business case, i.e. an invest to save logic. Reaching some consensus among stakeholders about the nature of Urban Data Platforms is imperative for the digital future of European cities and regions. Because the recognition of the importance of a UDP comes with the recognition of the importance of data as a "resource". UDPs are the infrastructures that will deliver the big data for AI, a strategic geo-political imperative for Europe. Harnessing data through UDPs and AI will shape government services, drive economic innovation, and secure the future of our societies and democracies.

3.4 Data Governance

Data governance refers to "*defining, applying and monitoring the patterns of rules and authorities for directing the proper functioning of, and ensuring the accountability for, the entire lifecycle (creating, processing and sharing, using) of data within and across organisations*" (Janssen et al. 2020). Data governance within the platform manager's organisation as well as within the wider ecosystem surrounding the platform lays the foundation for the quality of data exchanged on the platform (Otto and Jarke 2019). The goals of data governance are ensuring the quality and proper use of data and helping utilize data to create public value. For data governance, it should be clearly defined which roles are relevant for the provisioning and processing of data, and how these roles are allocated to the data decision domains such as Data access (Khatri and Brown 2010).

Data Governance domains

There are five decision domains for data governance as suggested by Khatri and Brown (2010): Data principles; Data quality; Metadata; Data access; and Data lifecycle. Also, a range of structural, procedural, and relational practices that describe how data should be managed throughout its life cycle is suggested by Tallon (2013).

- Structural practices identify decision-makers and their respective roles and responsibilities regarding data ownership, and accountabilities.
- Procedural practices (such as data strategy, data retention, access rights) are the means by which organisations execute data governance to ensure that data is recorded accurately, held securely, used effectively, and shared appropriately (Abraham et al. 2019).
- Relational practices (e.g., communication; training) facilitate collaboration between stakeholders.

Furthermore, for data governance within city ecosystems, not only guidelines determining the responsible stakeholders for data management should be developed, but also the existing rules and regulations which define the way to handle urban data should be considered (Cuno et al. 2019).

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Data governance in the Smart City

In his Master thesis Arnaud van den Berg (2020) focused explicitly on data governance in the context of a smart city. He devised a comprehensive framework (Figure 3.7) showing the data governance dimensions along the data life cycle.

Data Governance in a Smart City

• Data Principles • Data Management • Roles and Responsibilities • Metrics	• Data Standards • Interoperability	• Data Ethics • Regulations and Compliance • Privacy

Data Identification	Data Generation	Data Collection Data Sharing	Data Storage	Data (re)use	Data Legacy

• Data Access • Data Types	• Metadata • Data Quality • Modularity	• Shared Data • Open Data	• Technology	• Data Monetization • Data Valuation	• Data Lifecycle

Figure 3.7 – Data governance in a smart city (Van den Berg 2020)

The following data governance dimensions were identified and confirmed by practitioners of seven European cities with UDPs to be most relevant and important in a smart city ecosystem: data quality, privacy, open data, security, roles and responsibilities, and data use. These practitioners added data ethics as in important and overlooked dimension. Also, they emphasised that even more important than writing down how data needs to be governed, is the actual management of the data, which is often problematic. Some of these difficulties are exacerbated by the following specificities of data governance in a smart city ecosystem.

- In a smart city ecosystem, the design of dimensions needs to be focused on enabling collaborations between public and private parties.
- In a smart city ecosystem, it is harder to define who bears responsibility for data-related aspects. While in generic data governance the support of top management is considered crucial, for data governance in an ecosystem, the presence of a committee with data experts is seen as important.
- While in generic data governance it is assumed that data is available, data governance in a smart city must focus on engaging data sources and enabling these sources to share their data, since this data is often stored privately.
- In generic data governance, the privacy and security dimensions are often described as aspects that should be addressed within an organisation. However, in a smart city ecosystem, these aspects are harder to address, since there is unclarity about roles and responsibilities, and different types of organisations need to agree on how to design this.

Some practical recommendations given by van den Berg (2020) based on his research and by investigating the data governance program of the smart city ecosystem of Rotterdam, can be found in Appendix 3.

Data Governance in Practice

A very basic starting point is to **identify the owner of each specific dataset** and this data owner should be able to control access to data. If it is not clear who owns a dataset it should not be shared – not even as open data. The data owner is the one who gives others access to the dataset and determines the rules and conditions for access and usage. To grant someone else access to data, the data owner must do an information classification which includes a risk and consequence assessment. Datasets that have been assessed to be non-sensitive could for instance be made available as open data (with no restrictions in access or usage) while other datasets should never leave the organisation. And between these two extremes, there can be multiple levels of sensitivity related to risks and consequences for data being misused. **Thorough information classification** is necessary if the data owner wants to share data with different types of users in a secure and scalable way.

There are enormous amounts of data in the cities today but normally data is owned by system suppliers (who cannot or does not want to share data with the city unless this has already been required during the procurement) or data is locked into a specific system in some municipal department. Today, the vast majority of collected data in any city is designated for a specific system and is not shared with anyone else. This means that data ownership is not always clear and information classification is less critical or at least easier to perform (again, since data is designated for a specific, well-known system). For the same reasons, the existing information classification tools are today mostly system-oriented whereas they need to be data-oriented in a situation where data is allowed to be shared with someone using systems or applications that the data owner may not even know of – which is the whole essence of IoT.

Another issue that a city must address is the **chain of responsibility** from raw data over perhaps several enrichment processes including combinations with other datasets until data is used in a specific service or application. Example: Who is responsible if data in service is corrupt and leads to someone getting hurt or an organisation suffers an economic loss? If a sensor is faulty one could argue that it eventually is the responsibility of the sensor supplier, but that would require a chain of service level agreements (SLA) from a sensor through different enrichment processes to the service provider. And who is responsible if data is corrupt due to an algorithm making a wrong decision?

For many municipalities (and other organisations) the importance of having full control of its (IoT) data – which includes information classification – is only acknowledged once the one has started to get control of the technical aspects of a UDP and is technically capable of making data available to others. However, the organisational aspects and efforts around making data available over a UDP may be far greater than the technical aspects in terms of new roles, new ways of working, training, etc.

Observe that data governance, data ownership and control discussed here are at very basic levels which will require new processes, new roles, and organisational changes within the municipality. Without dedicated work with data governance including ownership and information classification of all datasets and understanding and identifying responsibilities, the municipality and other ecosystem players will not be able to make data available to others in a controlled way. Good data governance complies with GDPR, which brings a whole new set of challenges and dilemmas as illustrated in the case of Rotterdam below.

Elaboration on the GDPR – UDP tension

The Guide on RUGGEDISED *Implementation and innovation of smart solutions* assessed the Rotterdam UDP from a legal perspective. In this guide, and in the *Guide on UDP development*, one main challenge revolves around the tension between on the one hand supplying sufficient data to the UDP enabling various use-cases, often without knowing in advance what these use-cases are, And on the other hand safeguarding citizen's privacy, i.e. through the GDPR which requires the purpose of data utilization to be specified and assessed on its risks. As a result, the Rotterdam UDP is mainly focusing its current data flows on open non-personal data. Nevertheless, a grey-area remains on what is allowed in a UDP considering the distinction between personal data, protected under GDPR, and open data, supported by the Open Data Directive. Rotterdam is aware of the possible risks that combining non-personal data may yield insights related to individuals. Therefore, coping with the GDPR is a challenge and affects:

(1) The access to data on the UDP, non-discriminatory open data access vs. partially open data.

(2) The organization of the city officials and the measures to put in place to stimulate the efficacy of the UDP, while guaranteeing the public responsibility. For instance, a data protection impact assessment (DPIA), mandatory if processing, including the combination of data, can likely result in high risk to the right and freedoms of natural persons.

(3) The partnerships which the city can establish to develop, operate and own the UDP. Many commercial companies are interested to be involved in the Rotterdam UDP with resources and expertise. However, partnerships and the organization of ownership should be organized in such a way that the commercial interest of profit does not conflict with the protection of the citizens.

Box 3.1 – Data Governance and GDPR in the case of Rotterdam

3.5 Control and Principles

So far, we have discussed the institutional arrangement of a platform (ownership, financing, and management), the revenue model, and the data governance on a platform. The other two components of governance, Control and Principles are discussed in this section.

Control

The control component of the governance framework of UDP refers to how the platform managers monitor the ecosystem and coordinate relationships with stakeholders. Control is implemented by the UDP manager over the city stakeholders involved in provisioning and utilisation of urban data, by using a variety of control mechanisms. In general, control mechanisms are the tools used by platform managers to declare standards of behaviour among ecosystem stakeholders of the platform, reward desirable behaviour, and penalize bad behaviour (Tiwana 2013). For an urban data platform, gatekeeping and process control are the most relevant control mechanisms. The third more generic element of control - i.e. shared values and norms - was not researched. But this by no means implies that this form of control is of lesser importance, especially when it comes to building trust.

Process control

The first form of control is process control which refers to methods, rules, and procedures that are in place to regulate the platform and to observe and monitor desirable behaviour necessary for a

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task (Tiwana 2013). In UDP ecosystems, process control would for instance concern development rules or GDPR compliance of data use.

Gatekeeping

The second form of control is gatekeeping or input control. It refers to the degree to which the platform manager uses selection criteria on which stakeholders can enter into the platform's ecosystem and uses pre-defined criteria to determine which data is allowed on the platform (Tiwana 2013).

How is the platform manager governing and controlling the UPD?

PROCESS CONTROL
is the degree to which the platform manager hands out rewards or penalizes users of the platform (such as app developers) based on the degree to which they follow the development methods, rules, and procedures based on the GDPR regulations.

GATEKEEPING
is the degree to which the platform manager uses predefined criteria for what kind of data is allowed into the urban data platform so that the urban data platform can be GDPR compliant.

Figure 3.8 – State of play of Platform Control in Europe (Survey 2019)

According to Figure 3.8 while gatekeeping has a relatively high occurrence on existing urban data platforms, process control has a relatively low occurrence in current UDPs. This might be an indication of the early maturity or limited scope of these platforms. On a mature platform, the platform managers stimulate the correct use of the platform to fulfil the purpose of the platform.

Principles

The following principles have been researched: interoperability, transparency and openness.

Platform Interoperability

Some to the practical reasons coming from our research for interoperability (see Figure 3.9) are as follows. It is easier for national and global companies to develop applications. It is easier for citizens when they move from one city to another. And finally, interoperability (see Figure 3.10) is important for municipalities that want to learn from each other. There are some concerns about the usefulness of sharing data across different platforms and for most expert panellist this would not be their first priority. For them UDPs are first and foremost there to service the local or regional ecosystem.
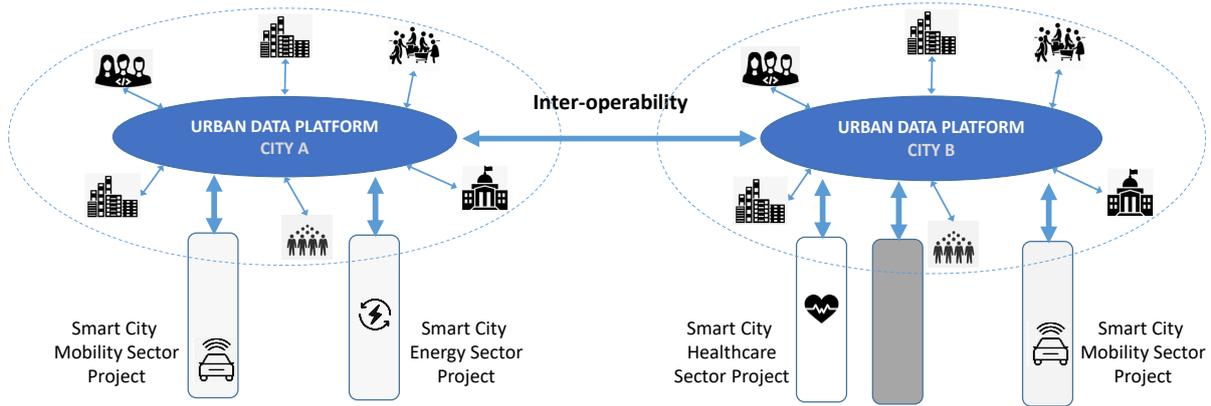
Figure 3.9 – Schematic depiction of Interoperability between UDPs

Interoperability of Urban Data Platforms is especially desirable from the point of view of companies that develop applications using data on the UDP. They have an interest that an application developed in one city will work in all cities in Europe. However, the dominant view on the rationale for interoperability, is the ability to share data between cities. To what end this data will be used is a question for further research.

Interoperability
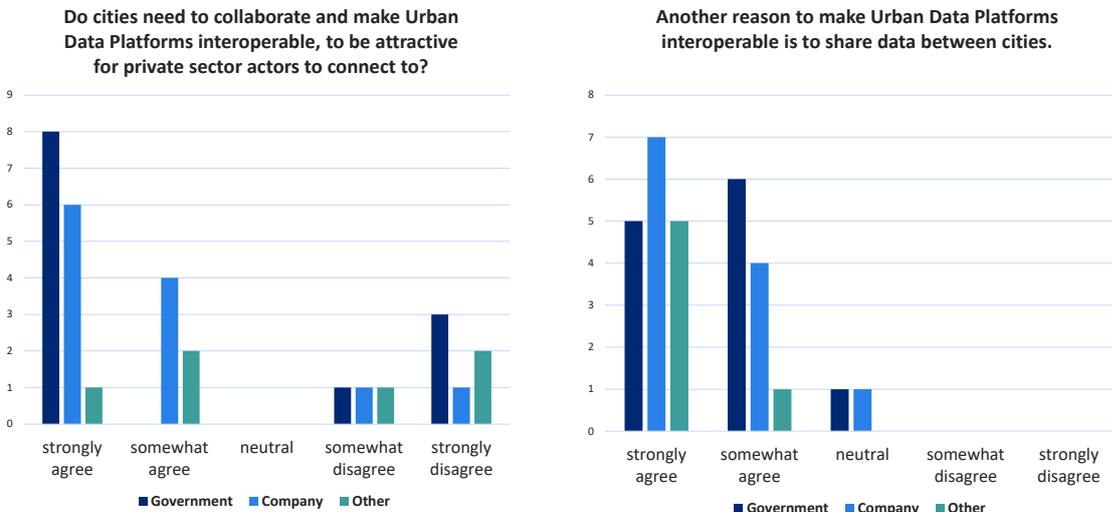
Figure 3.10 – Interoperability between UDPs will facilitate sharing and scaling (Delphi 2020)

Most expert panel members indicate that UDPs are best not developed at the local, i.e. municipal, level, but that at the regional level, with some even recommending the national and EU level (see Figure 3.11). Reasons for this non-local approach include e.g. the size of smaller municipalities, efficiency, the regional nature of certain domains like mobility, and the need for an overall European architecture and standardization. Interoperability will be a logical consequence.

At which level should an Urban Data Platform best be developed?
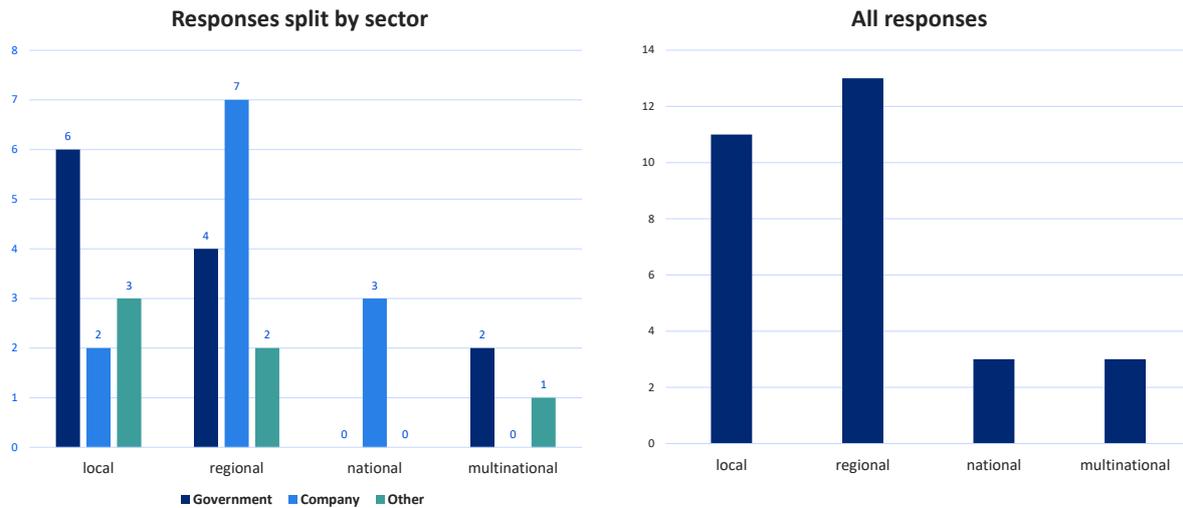
Figure 3.11 – UDPs developed by higher levels of government are more interoperable (Delphi 2020)

Transparency

Transparency emerged from the Delphi study as an important principle, one that we had not defined upfront. This was mentioned as being even more important than openness itself. Transparency about the rules of engagement, the use of data, the analytics and algorithms on the platform is seen as an important driver of trust (see Figure 3.12).

Platform openness and its consequences

Platform openness refers to the extent with which citizens and organisation can join the platform without prior selection by the platform manager. The term open is used in many contexts: open data, open sources, open access etc. A clarification of these terms in the context of smart cities / UPDs will be provided as are the consequences for engagement, innovation, sustainability, etc. Words like open, open source, open data and open platforms are often used in the context of smart cities, however, not seldom in an inaccurate way. But what does "open" mean? There are different definitions and the meaning can vary depending on perspective and type of actor. Box 3.2 provides an explanation of the terms open platform, open source and open data.
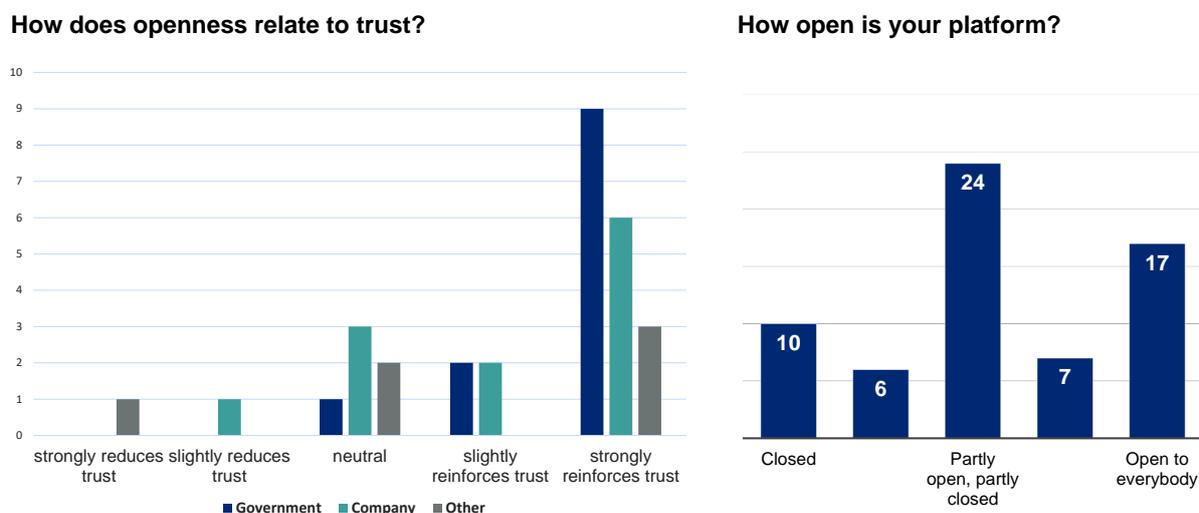
Figure 3.12 – Platform openness builds trust but is not the norm in practice (Delphi '20 and Survey '19)

Restrictions and limitations in data openness

Data that, or in combination with other data, may jeopardise the integrity of a person, an infrastructure or an organisation should never be published as open data. Observe that two "innocent" data sources combined could pose an integrity threat. Also, data that has an economical value from which the data owner wants to profit, will not be published as open data. Nevertheless, these kinds of data can be shared under certain conditions and restrictions.


Open platform

For a technology supplier "open platform" typically means that certain standards are followed. Interoperability is one step further; just because something is standardised doesn't ensure interoperability. For a city administration standards and interoperability are necessary but not sufficient prerequisites. For a city an open platform would be about the possibility to exchange data as well as components or modules related to the platform and to avoid (or at least minimise) lock-in situations towards a supplier. These are broader requirements than following standards and assuring interoperability. A platform supplier may follow standards, e.g., between data layer and platform and between platform and application layer, but if the supplier for some reason does not enable third parties to deliver services on top of the platform, then the platform is not open. Despite following all standards, it is possible to end up in a lock-in situation as part of the supplier's business model. So, openness for the municipality implies a simple way to add or replace equipment or services from third party suppliers. Correspondingly, in an open platform there will be (not only technical) mechanisms to achieve this openness. City administrations needs technical knowledge to prevent a lock-in during procurement. One cannot rely on a platform supplier promising an open platform without understanding exactly what this means.

Open source code

Open source is programming code that can be used and modified by anyone (sometimes under certain license restrictions). There are many advantages with open source code - e.g. an entity that is not the original supplier can modify or reuse the code - but it should not be confused with an open platform. An open platform may contain completely proprietary code; what is important is that all interfaces towards the platform are well defined. Similarly, there is no guarantee that a platform built on open source code will offer openness as defined above.

Open data

Open data denotes digital information that is freely accessible without limitations such as intellectual property rights (IPR). Countries and cities make increasingly more open data available through a web portal. This could be traffic data, office opening hours, geodata, etc. Open data is free to use without restrictions, even for commercial applications. Open data and open platforms are not the same: open data could be part of what is offered by an open platform, but an open platform can also offer data with restrictions in access and usage. The term open data is often misused in cities in the sense that many data sources are not really free to access and free to use for anyone. Shared data is data that does not qualify as open data, but it is accessible under certain restrictions.

Box 3.2 – Demystifying the term "open": open platforms, open source code, and open data

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It may for various reasons not be possible or desirable to procure an open platform. The market for urban data platforms is still very immature, and it may be necessary to allow a certain degree

of lock-in in order to make an agreement sufficiently attractive to the platform supplier. This will likely be less of a problem in a more mature market.

Also, a city administration may not be interested in an open platform because it wants a quick implementation and/or does not have the competencies needed to assure openness in the procurement. Such a solution may even in the short term be cheaper than an open platform, but it is important that the city in such a case understands the potential long-term consequences.

*   *   *

Clear and transparent governance of the UDP will drive trust. This applies to all the aspects of governance discussed in this chapter. In terms of financing we noted that seeing the UPD as vital public infrastructure not automatically means that it is financed by the taxpayer. Another driver of trust is the capability of the platform manager. Is the platform business model designed well? And does the platform manager have the right organisational, collaborative and technical capabilities to implement and run that business model? Platform business model and capabilities, the second part of designing UDPs, are discussed in the next chapter.

4. Designing a UDP Business model and Capabilities

This chapter defines the design areas, other than governance, of a UDP. The business model canvas for a UDP covers all the components that need to be designed in alignment with the purpose of the platform, ranging from e.g. platform partners, assets, activities to the bottom line of the platform. The platform architecture, like architecture in general, ensures that the UDP is robust and functional, with a great user experience, fit for purpose. A platform manager with the right organisational and technical capabilities to build, maintain and innovate the business model and platform architecture drives the trust in the platform.

4.1 Introduction to Business Models

In very narrow terms a business model refers to the logic of how a business plans to make money and sustain itself. Increasingly the term business model is used in a broader sense to denote the operating logic of an organisation, i.e. how an organisation "creates, delivers and captures value" (Ranerup, 2016). Defined this way, the business model concept applies, regardless of how an organisation is financed, owned or managed. This may include public sector organisations and therefore using the term business models does not automatically imply profit seeking. UDPs, like other organisations must sustain themselves in the long run by ensuring that their operational costs are covered by (different sources of) income. Osterwalder (2010) has best succeeded in making the term business model tangible with his widely adopted Business Model Canvas, consisting of nine components that e.g. describe a business' value proposition, its customers and its partners. The business model canvas is really a tool to make the assumptions about the business, or in our case the UDP, explicit. The management thinker Drucker argues that many smart companies fail to keep up with market conditions because they fail to make these assumptions explicit (Ovans, 2015). The idea is that a UDP manager too, must make the UDP assumptions explicit.

In the context of UDPs It is important to make a distinction between two types of smart city business models: the business model of the UDP itself, and the business models of organisations that use the platform. The latter type of business models is discussed in chapter five. For now it suffices to say that these business models can be existing businesses that are enhanced by connecting to the platform, or native business that are a result of the innovation opportunity provided by the UDP, i.e. they are born on the platform.

The distinction between public and private value in times of profound change and the UN Sustainable Development Goals is much debated. Many believe that public value creation is no longer the sole obligation of the public sector. Companies start taking corporate social responsibility seriously and many are defining their purpose beyond profit. On a similar note, economic value creation is not the sole prerogative of the private sector (Mazzucato, 2018), as evidenced e.g. by major investments made by governments into areas such as neuroscience and artificial intelligence. If UDPs are indeed vital infrastructure, these platforms' purpose is to create public value. Much like how governments create public value e.g. by funding fundamental research or creating a level playing field through regulation. The difference being that UDPs do not create public value all by themselves but allow participants in their ecosystem to do so. This public value creation nature of UPDs suggests government to take the lead but invite the private sector to join.

4.2 A Triple Bottom Line UDP Business Model Canvas

Conventional business model descriptions e.g. the beforementioned business model canvas, are insufficient to capture the complexity and the variety of smart city business models. One obvious adaption to the conventional business model is to add a triple bottom line, including not only economic costs and benefits, but also social and environmental ones. Figure 4.1 gives an example of business model canvas with a triple bottom line for district heating (DH) in Glasgow.

| Mission Statement 2: | Connection of Wheatley Group owned Drygate Housing to the Tennents Brewery heating system to provide low carbon and low cost heating to an area of fuel poor residents, demonstrate connection of external customers to a private sector heating network. |

Key Partnerships	Key Activities	Value Proposition	Buy in & Support	Beneficiaries
The key partnership is between the Tennents Caledonian Brewery (TCB) [heat generator] and The Wheatley Group (TWG) [heat consumer]	Installation of connecting heat network. Removal of existing dry heating system, installation of new wet system, creation of back up energy centre, Establishment of contractual relationship	The connection will allow for the provision of low cost, low carbon heat to residents in the city who suffer from extreme fuel poverty.	TWG – Senior management, legal, technical, governance, financial. TCB – Senior management, technical, financial.	TWG will benefit from low carbon, low cost heat, as well as meeting housing and building standards. TCB will benefit from reputational value. City wide benefit from increase to GVA and demonstration of successful connection facilitating further connections, reduction in fuel poverty
	Key Infrastructure & Key Resources Heat network, contractual model, monitoring of heat delivery and consumption, Energy centre, domestic heating system		**Deployment** Connection to power network not viable until 2022. Project cannot progress until grid reinforcement complete.	

Budget Costs	Revenue Stream
Installation of pipe network in roads, removal of dry heating system, installation wet of distribution network in housing, creation of TCB energy centre, creation of TWG back up energy centre.	Without an ESCo, revenue from heat sales would go to TCB. With an ESCo, a surplus on revenue could be generated for future growth of DH.
Environmental cost No notable impacts from project outside of temporary impacts resulting from construction/installation.	**Environmental Benefits** TCB expect to reduce CO_2 emissions as a result of Gas CHP. TWG expect to see improved living conditions for residents and reduced CO_2 emissions.
Social Cost No notable impacts from project outside of temporary impacts resulting from construction/installation.	**Social Benefits** Improved living conditions and life expectancy of residents through alleviation of fuel poverty.

Figure 4.1 - Example of a triple bottom line business model (RUGGEDISED D4.1, Glasgow)

A second adaptation to the Osterwalder canvas is to have three separate canvasses for the economic, social, and environmental aspects of a business model. Such a canvas is proposed by Joyce & Paquin (2016) in what they call the Triple Layered Business Model Canvas (Figure 4.2). This more holistic and integrated view of a business model should inspire companies to innovate toward more sustainability. It also adds two new variables for analysis: horizontal coherence and vertical coherence. Horizontal coherence is known from traditional business models and ensures all components of the business model are aligned.

Vertical coherence is a new notion and denotes the fact that the three different bottom lines and the business model components that sustain them are not in conflict. From practice we know that e.g. economic objectives may conflict with environmental ones. Vertical coherence may capture this conflict and is therefore an interesting evaluation variable for business model design. In an ideal world, humanity would be able to come up with business models where there are no trade-offs between the different bottom lines and vertical coherence is one hundred percent.
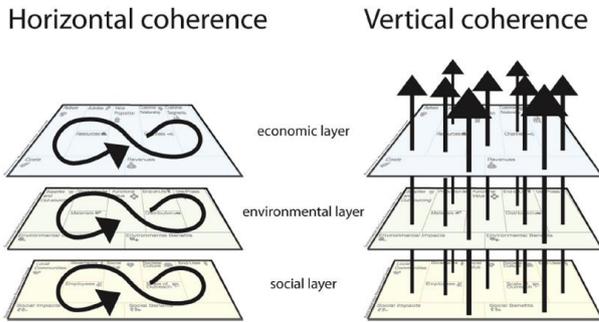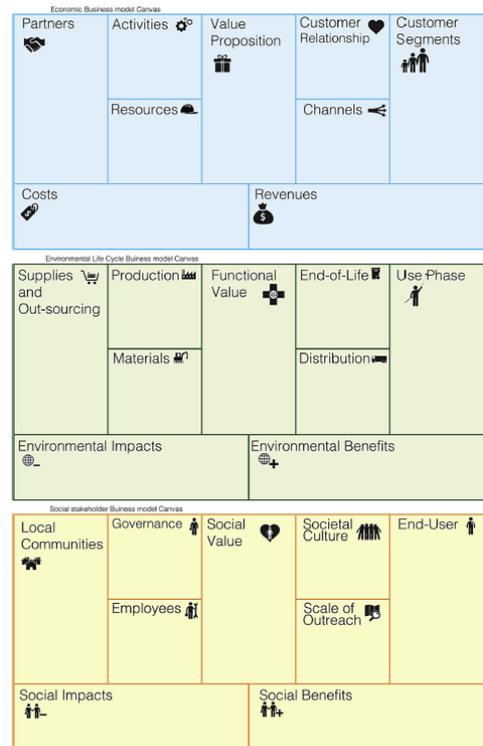
Figure 4.2 –Triple Business Model Canvas (Joyce 2016)

There is no consensus among the expert panel members that a triple bottom line is required for a UDP business model (Figure 4.3). This seems at odds with the Delphi panel's unanimous view that a UDP is vital public infrastructure (see section 3.3). Nevertheless, there is enough empirical support from both the survey and the expert panel to adopt the triple bottom line.

Must the business model of an Urban Data Platform facilitate a triple bottom line?
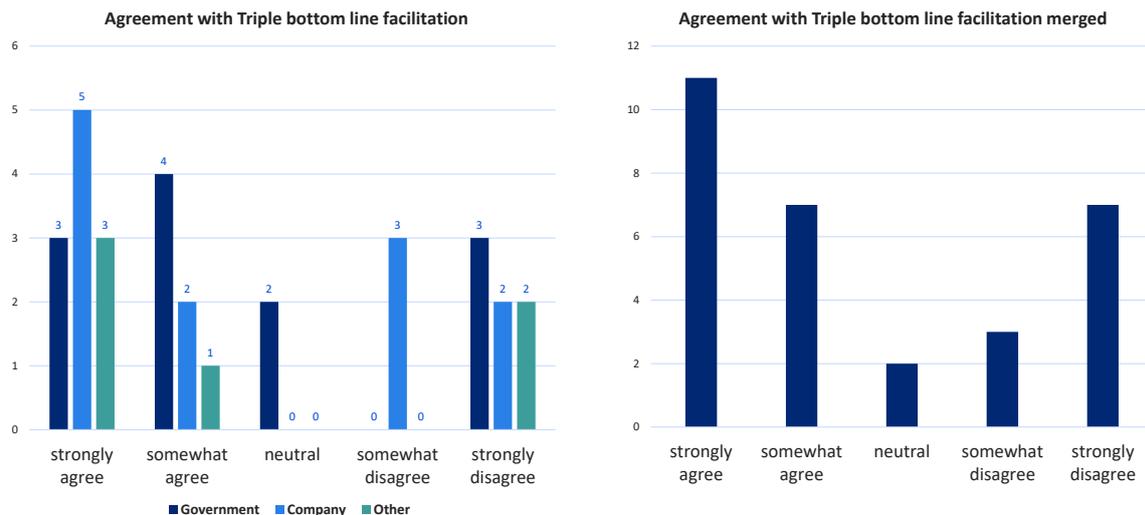
Figure 4.3 – The experts are leaning toward a triple bottom line for UDPs but there is no consensus

In Figure 4.4 we propose a UDP Business Model Canvas with a single canvas that combines the triple bottom line of the Glasgow canvas of Figure 4.1 augmented with some elements that are inspired by Joyce & Paquin's (2016) triple canvas. "Guiding Public Values" (NB plural and singular

"value") is our translation of "Societal Culture" and we have adapted "Scope and Reach" from their "Scale and Reach". Furthermore, to emphasize the importance of data for a UDP, a separate component called "Platform Data Assets" is included.

This Business Model Canvas is specific for Urban Data Platforms and has not been devised to apply generically to Smart City (vertical) initiatives or to business models that are developed on the platform (see chapter five). The UDP business model canvas is specific in the following ways.

-    The "Activities" are specific to platform management.
-    The focus on Data is reflected in a separate component for data assets.
-    The "Guiding Public Values" captures that the UPD has a purpose to serve the public good, and will do so by engaging all stakeholders
-    The triple bottom line breaks the public value down in financial, social and environmental value and allows us the measure the cost and benefit of each type of value created.
-    The multi-sidedness of platforms is reflected by the wide variety of stakeholders in the "Customers, Users & Participants" component.

Mission Statement Urban Data Platform: Create public and private value through ecosystem matchmaking

Partners	Platform Activities	Value Proposition	Guiding Public Values	Customers, Users & Participants
Investor | Owner Manager Technology Partner (Social) Media Partner Subcontractor	**Tools & svcs, Matching, Audience building, Rules and standards**	"Space" for galvanizing innovation, participation, collaboration, co-creation and public and private value creation	Platform purpose that engages all stakeholders	Citizens, Communities Start-ups, Developers, Data providers Companies, Government, NGOs
	Platform Data Assets Data-gathering, data quality assurance, visualisation, AI/analytics		**Scope and Reach** Open-closed, Local-global, Interoperable, Access	
	Key Infrastructure & Resources Digital, Physical, Monetary, People, IP, Brand			

Financial Cost	Financial Benefit
E.g. financial investments, run costs	E.g. ROI, revenue streams, economic growth

Social Cost	Social Benefit
E.g. privacy, security, freedom, personal attention invested	E.g. democratic participation, fairness, liveability, happiness

Environmental Cost	Environmental Benefit
E.g. CO_2 footprint, natural resources used (by ecosystem)	E.g. sustainable innovation, reduced emissions, less waste

Figure 4.4 – A business model canvas for an Urban Data Platform

Public Value and the Triple bottom line

The term "public value" was made popular by Mark Moore in his 1995 book *Creating Public Value: Strategic Management in Government.* At the time of writing - in the 1990s - the predominant view was that government was inefficient, and the smaller government was, the better. By introducing the concept of public value, Moore, aimed to position government as a value-creating institution and offered a framework for managing this value creation. Back then the connotation of "public value" was that it is created by the public sector. Nowadays, as mentioned before, there is a

growing view that public value creation is the responsibility of both the private and public sector. According to Benington and Moore (2010):

"Thinking about public value has since moved well beyond its origins in neoliberal American discourse of the 1990s, and is now at the forefront of cross-national discussion about the changing roles of the public, private, and voluntary sectors in a period of profound political economic, ecological, and social change".

This view resonates with our expert panel who agree that in the future more companies will move toward a triple bottom line business model themselves (Figure 4.5) and by doing so create public value. In this report we have modelled Public Value as the triple bottom line of the business model canvas. Thus, Public value = Economic Value + Social Value + Environmental Value. One could argue that Political Value should be a separate term in this equation, but in the context of UDP this can be captured in the social bottom line.

Within the context of Urban Data Platforms, in the future, …
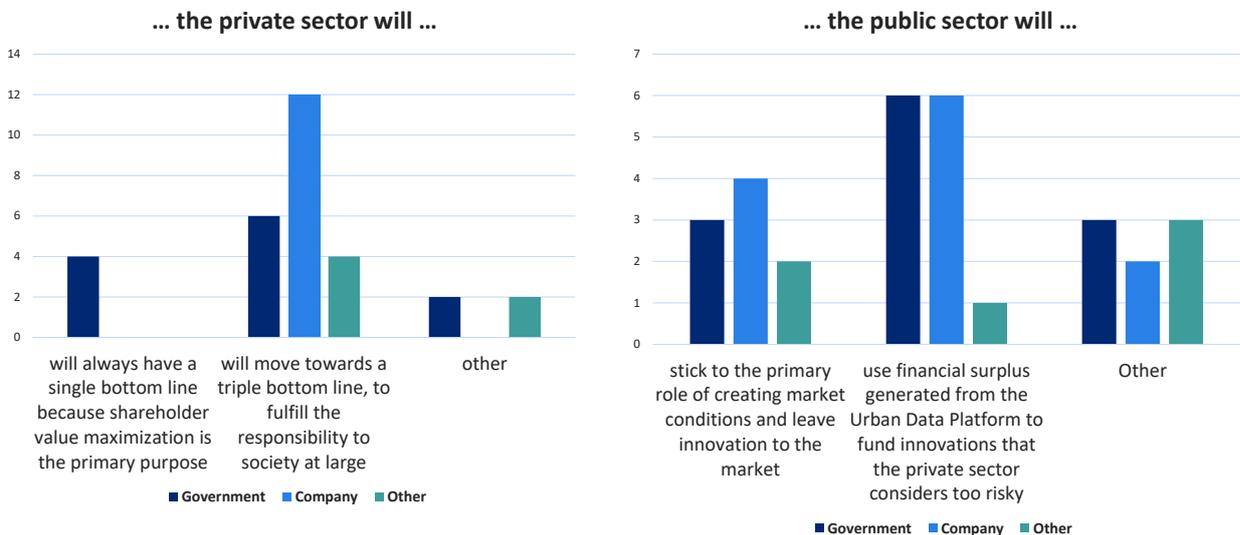
Figure 4.5 – The dividing lines between public and private sector value contribution will blur (Delph 2020)

In the following paragraphs we describe some of the key capabilities – both managerial and technical design – that are needed to make a UDP work. The better these capabilities, the higher the trust in the platform as was suggested by our conceptual model (Figure 1.8). Two other success factors for UDPs are stakeholder engagement and quadruple helix collaboration. Of these we will discuss citizen engagement since this is the activity that many of the UDPs find hardest to do.

4.3 Citizen Engagement

The term citizen is used throughout this report, without a precise definition, to denote the inhabitants of the physical and governed space which we refer to as a city, region or country. As a basic understanding, Citizen Engagement denotes some form of interaction between citizens and their government beyond the electoral process. In the academic literature and in practice there is no consensus about a single definition of citizen engagement. The most established literature and today still used by governments is a seminal article by Sherry Arnstein (1969) entitled "The ladder

of citizen participation". She writes:

> *"Participation of the governed in their government is, in theory, the cornerstone of democracy - a revered idea that is vigorously applauded by virtually everyone. The applause is reduced to polite handclaps, however, when this principle is advocated by the have-nots …. And when the have-nots define participation as redistribution of power, the American consensus on the fundamental principle explodes into many shades of … political opposition".*

Arnstein defined a ladder of participation with eight rungs, with 'manipulation' as the lowest rung, via 'informing' and 'consulting' (rungs 3 and 4) all the way up to 'citizen control'. The perception of participation as a means to redistribute more power (to the have-nots) at the time of writing of Arnstein's article has somewhat faded in the 21st century. Today engagement and participation have the connotation of something that democratic governments and responsible citizens do.

The OECD Recommendation on Open Government (2017) defines stakeholder participation as *"all the ways which stakeholders can be involved in the policy cycle and in service design and delivery"*. Stakeholders can be individuals, institutions or organisations. Like Arnstein's ladder they discern increasing degrees of involvement: informing, consulting, and engagement. Engagement is described as follows*: "when stakeholders are given the opportunity and the necessary resources (e.g. information, data, and digital tools) to collaborate during all phases of the policy-cycle and in the service design and delivery"*. In 2018 mayors and leaders of EUROCITIES, signed a declaration stating (2018): "*We … commit to strengthening citizens engagement by: » involving our citizens in a dialogue about our common future, » inspiring all levels of government to build societies where people come first, » making a positive impact on the way decisions are taken in Europe*".

## To what extent are citizens currently engaged?
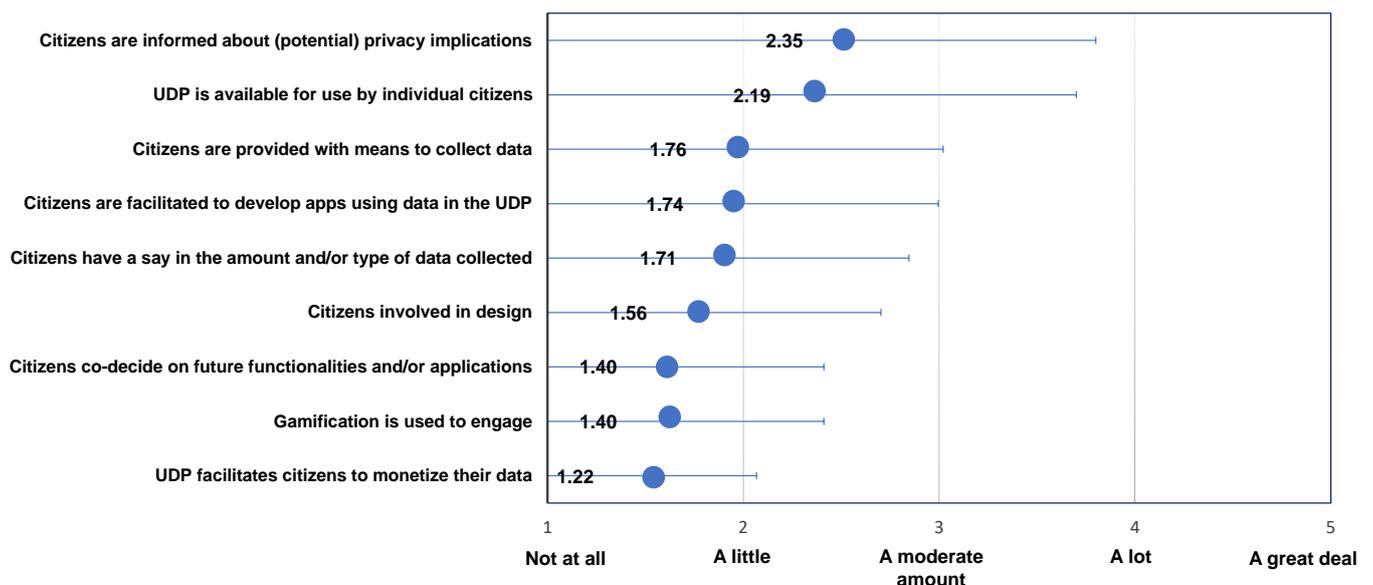
Figure 4.6 - Level of citizen engagement (Survey 2019)

That Citizen engagement is seen as desirable and important is supported by our research, both in the surveys and in the expert panel. Yet few platforms have managed to achieve any substantial level of engagement (see Figure 4.6). Engelbert et al. (2019) make this observation about smart cities in general and suggest that this is caused by a top-down rather than bottom-up approach to citizen engagement: *"… many contemporary imaginations of the smart city, as well-intended as they might be, are still cultivating a top-down version of citizen participation and are excluding the interests and perspectives of citizens".* Why would one engage citizens on the platform? In the Delphi study the government panel members say it is all about attracting citizens to use the platform, once it has been developed. In contrast, companies respond that citizens should be involved already in the design phase of a UDP. These different views (see Figure 4.7) could be explained by the customer centricity, which comes more naturally to companies than to governments. Because most platforms in Europe are initiated by governments and are still in the early stages of development, this could explain why citizen engagement is at a low level.

Rank these categories of citizen engagement from the most to least valuable
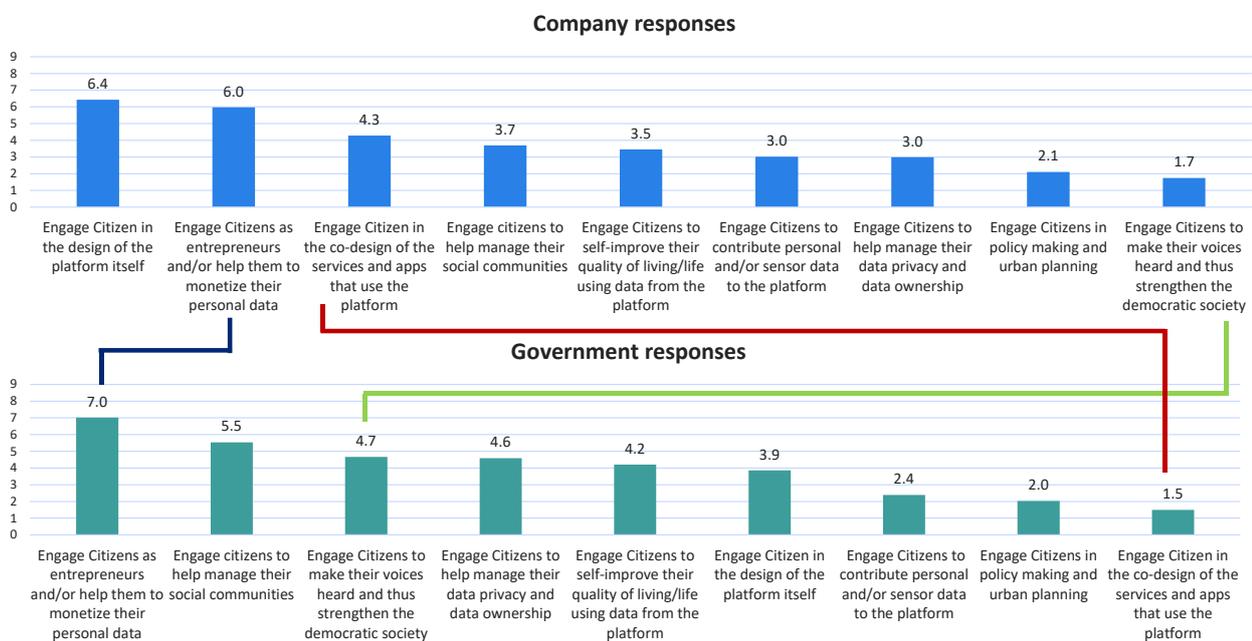
Figure 4.7 – The reasons for companies and governments to engage citizen differ (Delphi 2020)

There is a high consensus among panel experts when it comes to involving citizens to help them value or even monetise their personal data, with the governments being very keen that citizens behave as entrepreneurs where their personal data is concerned. Apparently giving citizens more control in the digital age, means giving them control over their personal data. In a similar vein, governments can benefit from involving citizens in citizen sensing and citizen science projects, assuming they manage to appeal to citizens their own motivations (Weber, 2020).

Although monetizing of data, citizen sensing and citizen science are relevant, the idea behind citizen engagement is much more fundamental. Van Zoonen (2020) argues that it is a matter of principle that citizens are involved from the very start of defining a challenge in the realm of human-centred deployment of data. In the social domain, many municipalities fail to do so. More generally the Centre for BOLD Cities argues that it is imperative in a Smart Cities that the perspective and

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Public (PU)

interests of the citizen are there from the very start of an initiative to prevent unintended outcomes or failure. UDP managers must have a clear idea of what kind of engagement they want on their platform and why, in order to nurture citizens to join. Just building the platform and `hope they will come` is no guarantee that citizens will join in a sustainable and meaningful way.

4.4 Platform Managerial Capabilities

Platform manager organisational capabilities refer to the extent to which a platform manager has abilities and skills required for management and orchestration of a platform ecosystem that creates value for all stakeholders. We make a distinction between the platform owner and platform manager. The platform owner is responsible for the underlying platform technology upon which the ecosystem operates and has the intellectual property and legal control over the platform technology. In contrast, the platform manager maintains, runs and develops the platform within the guidelines provided by the platform owner. The main capabilities of the platform manager are defined in terms of the following four constructs.

1. **Ecosystem nurturing** is the ability of the platform manager in sharing resources to nurture on-going collective innovation and exploring new business models for the growth of the platform ecosystem (Isckia et al., 2020).

2. **Cross-organisation collaboration** is the ability of a platform manager to collaborate with ecosystem stakeholders without having a formal authority over these stakeholders (Mukhopadhyay and Bouwman, 2019).

3. **Leadership** is the ability of the platform manager to support and coordinate collective action in a platform ecosystem, manage conflicts, and create incentives for ecosystem members (Nikayin et al., 2013, Nam and Pardo, 2011).

4. **Data quality management capability** is the ability of a platform manager to communicate and control the data quality strategy, to monitor data quality processes (collection, organisation, storage, processing, and presentation of data), and to operate and maintain the data quality architecture (Wende, 2007). There are two closely interlinked perspectives on data quality management: governance and execution. While data governance defines data quality roles and assigns accountabilities for decision areas of data quality management, during execution the specified functions and tasks are fulfilled (Otto et al., 2007).

How do you assess the importance and current maturity of the following capabilities of your organization?
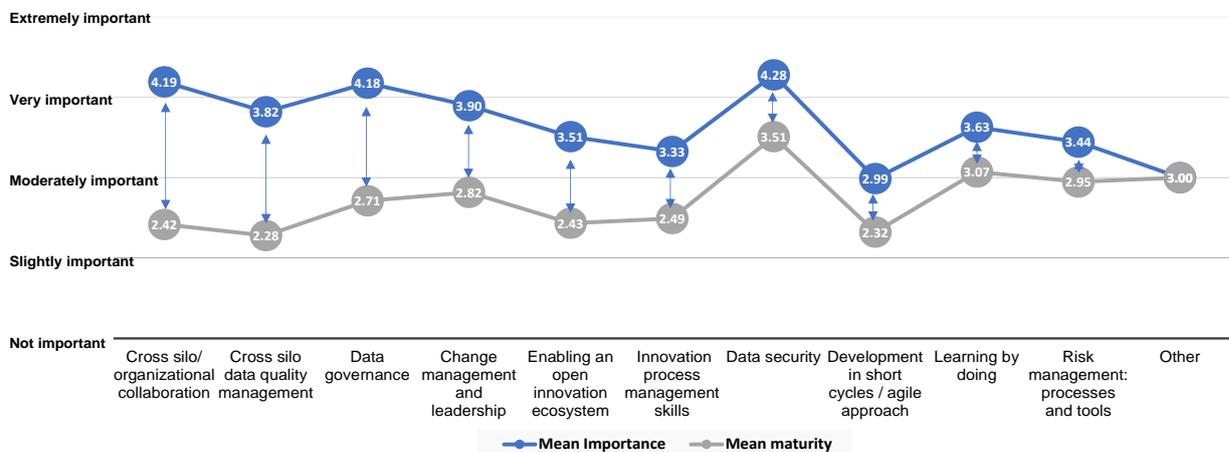
Figure 4.8 – Platform capabilities and maturity (Survey 2019)

The findings of our study reveal that the capabilities of the platform manager are an important driver of trust. They also directly impact the performance of a UDP. The respondents of our survey recognise the importance of certain platform management capabilities but also indicate that currently there is a big gap between importance and maturity of these capabilities (Figure 4.8). This can in understandable given that UDPs are relatively new types of organisations. Therefore, capacity building in platform management is strongly recommended.

Platform management collaboration

Collaboration across organisations is another important enabler of trust. This is confirmed by our research in the surveys and by the expert panel. Another reason for collaboration beyond trust can be derived from Figure 4.9 in which the strengths of existing platform management capabilities of the public and private sector are ranked.

Which participant in a joint public-private setup is most suited to control the following components of governance?
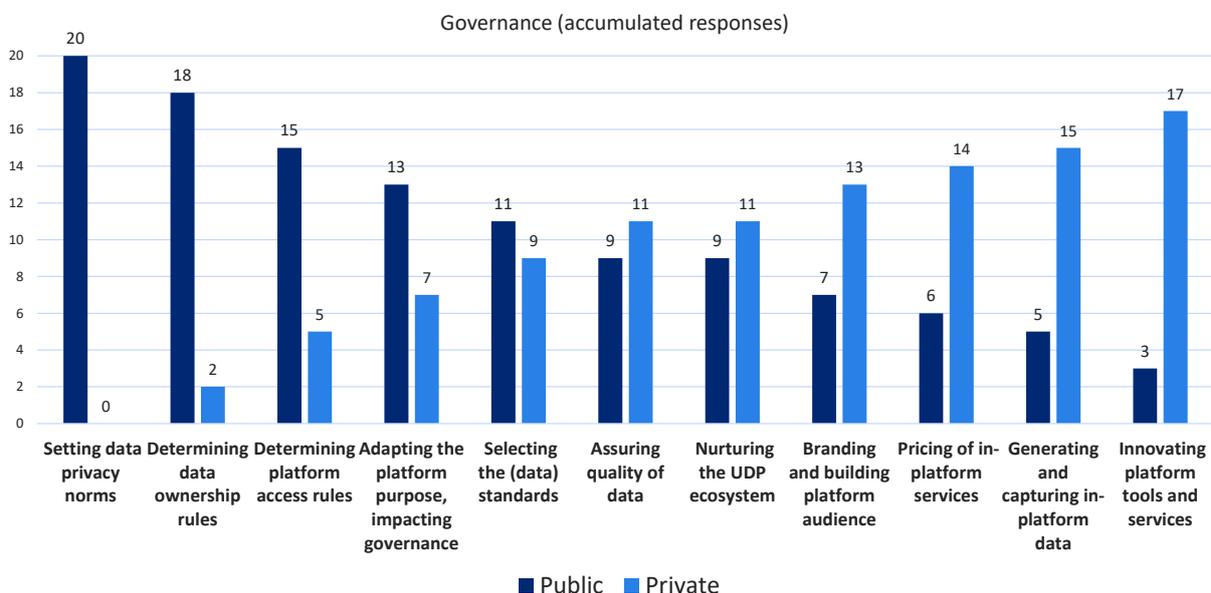
Figure 4.9 – Platform capabilities are distributed across the public and private sector (Delphi 2020)

Some of these key capabilities e.g. setting the right rules and regulations for the UDP are more entrusted to the public sector, whereas others, e.g. nurturing the ecosystem comes more naturally to the private sector. Neither the government, nor the private sectors has the complete set of capabilities required for platform governance. This may explain why our Delphi panel suggest that the management of the UDP should be a joint collaborative effort.

4.5 Platform Architecture and Technical Capabilities

Not only the organisational capabilities of the platform manager are a driver of trust, but also the technical capabilities of the platform itself. A detailed description of these technical capabilities required to run a UDP successfully is beyond the scope of this report. We will suffice here by describing some architectural considerations including the role of (open) standards.

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Technical requirements and key capabilities can be derived from this quote from the *Joint, Boost, Sustain Declaration* (https://www.living-in.eu/) signed by European Mayors.

"Urban platforms are the 'operating systems' of the services provided by smart cities. They are important facilitating infrastructure for handling the growing range of stakeholders and data across various sectors. Interoperable urban data platforms that promote open standards, APIs and shared data models are crucial for removing barriers such as vendor lock-in and non-interoperable proprietary protocols. Interoperable urban platforms are essential for developing and putting in place innovative and cost-effective solutions across the EU, since they create open and interoperable ecosystems and can be extended to serve as spaces for creative experimentation".

The urban data platform is part of a broader ecosystem of digital smart city infrastructure as illustrated in Figure 4.10.
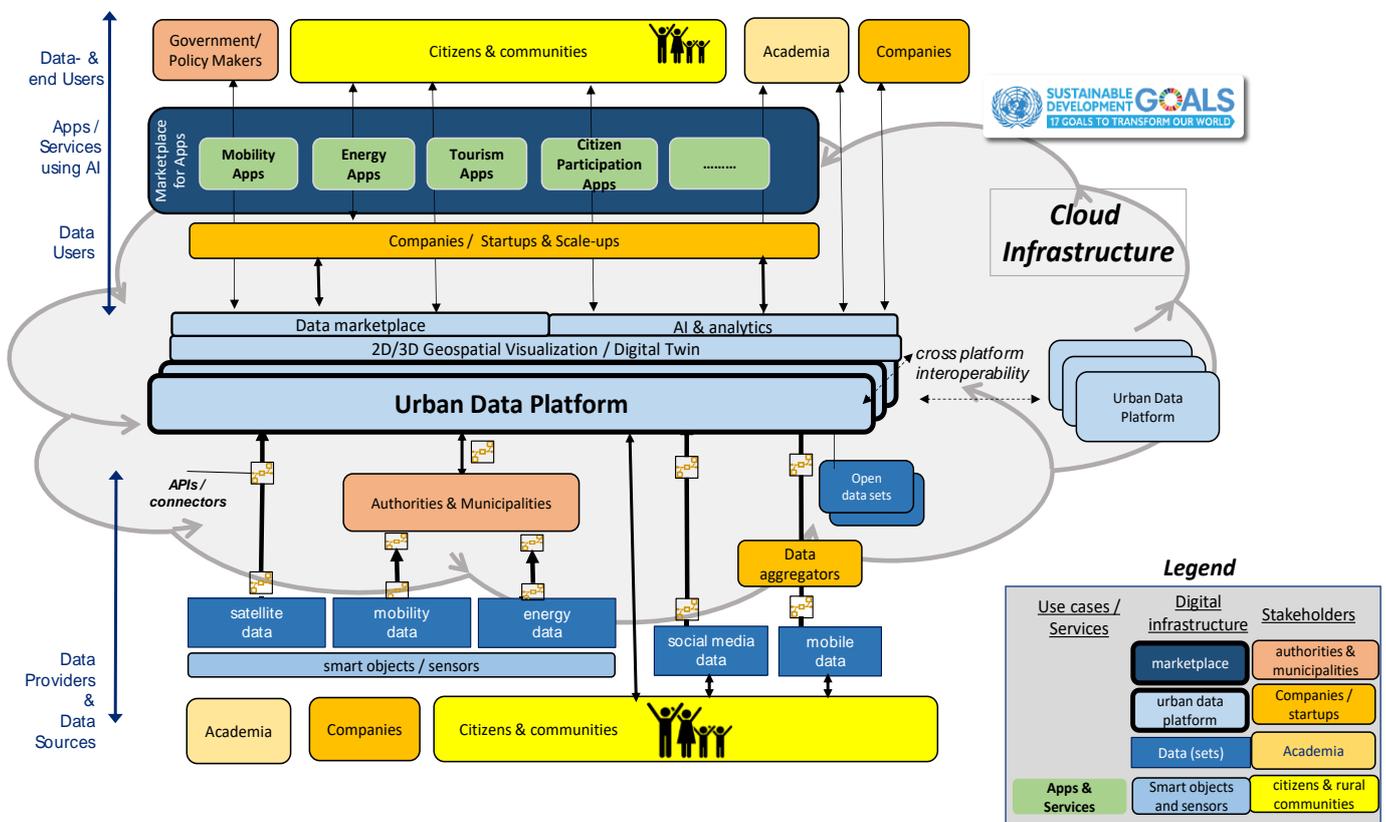
Figure 4.10 – Urban Data Platform ecosystem architecture

The UDP ecosystem architecture provides an overview of the involved stakeholders, the digital infrastructure components (smart objects and sensors, datasets, open interoperable urban data platform, 2D/3D geospatial visualisation, data marketplace, use of artificial intelligence and analytics) and some examples of use cases/services that can run on top of the UDP. These Apps can be bundled and offered to the market via a Marketplace for Apps, which supports replication and upscaling in other cities and regions.

Figure 4.10 also illustrates how the urban data platform connects data providers and data sources from various origins to users and end-users. Besides IoT data from sensors, more and more

citizens are involved as a potential source of data, for instance by providing them with an App to collect local data (citizen sensing). Since there will be several urban data platforms in regions, cross platform interoperability is an important requirement for sharing data across platforms and facilitating Apps and services to work independent of location of their use.

Technical Capabilities

Embedded in Figure 4.10 depicting the platform architecture are some key technical capabilities that will enhance the trust in the UDP. These are security, privacy, analytics and business model support tools. Security and Privacy are a sine-qua-non. Analytics and Business model support tools are a matter of platform maturity. The better the business model support tools, the easier it is for innovators to enhance their existing business models or to create new business models by using the UDP. SDKs, APIs, and data marketplaces are all enablers of new business models. The better these tools, the more likely it is to succeed. Analytics as a technical capability of the platform is not automatically appreciated according to our Delphi experts. Using analytics to become 'big brother' mentioned as a concern and can be explained by today's big-tech-backlash. This point of concern needs to be addressed, since analysing the activity on the UDP can be a source of value in itself. For an overview on the state of play of some of these technical capabilities we repeat the insights from our survey in Figure 4.11 (chart shown before in chapter two).

What Core Interaction is currently facilitated on the platform?
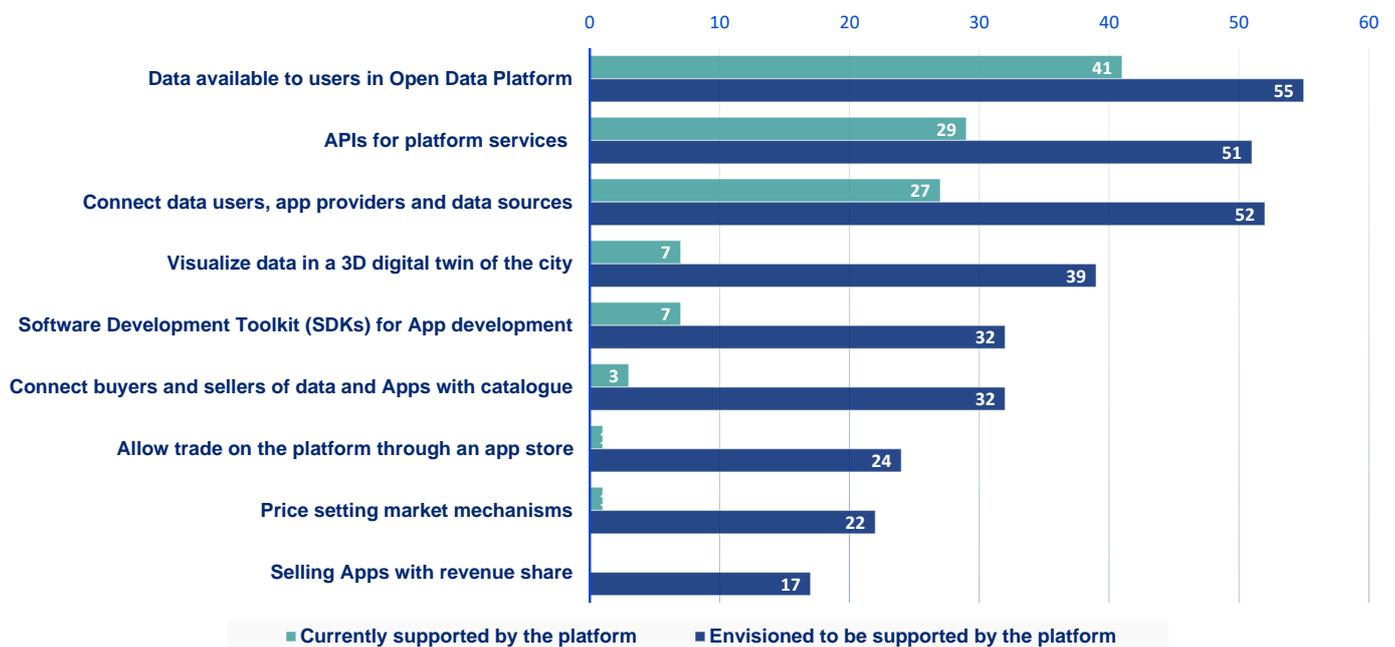
Figure 4.11 – Platform technical capabilities (Survey 2018)

Platform Standards

In order to share data between different users (e.g., for different services at different city departments) there needs to be a minimum level of standardisation in order to achieve a minimum level of interoperability. A simplified architecture of how data as a resource is used to develop services using a platform is depicted in Figure 4.12 which shows a three-layered model. In the

middle the data exchange layer (also called IoT core, middleware, data broker or service broker depending on view and background). Below a data layer where data could come from sensors, databases or other platforms) and on top the application layer where data is refined into a mobile app, a visualisation, a decision system, big data analytics, etc.

This architecture could be seen as a minimum viable framework for interoperability which is rather similar to the concept of "minimum interoperability mechanisms" (MIMs) in Open and Agile Smart Cities (OASC). The minimum level of standardisation needed are thus at the interfaces between the different layers. These are southbound standards in the form of data models and northbound standards in form of application programming interfaces (APIs). If different cities use the *same standards* for data models and APIs, then this will contribute to the interoperability of platforms.
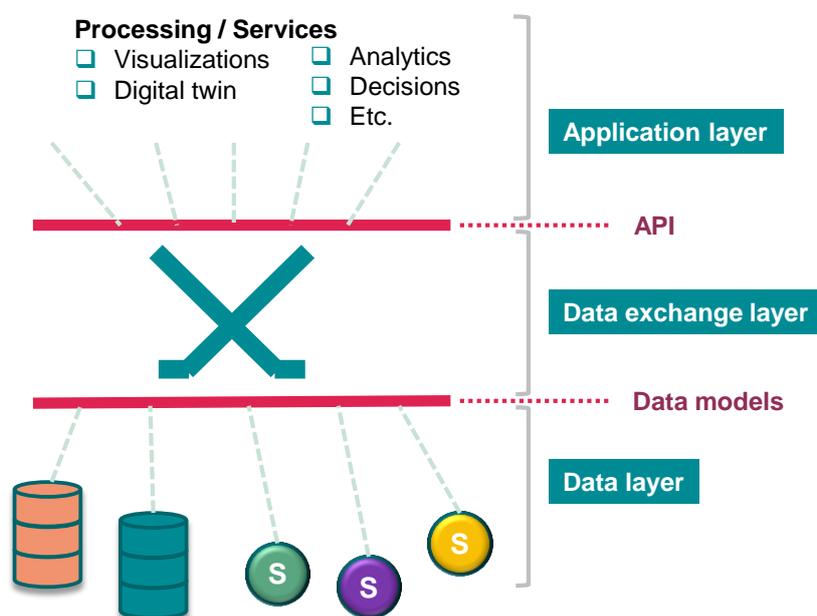
Figure 4.12 – Platform architecture framework of standardized interfaces between layers

Figure 4.12 shows the platform architecture, showing a minimum viable framework with standardised interfaces between data layer and data exchange layer (data models) and between data exchange layer and application layer (APIs). Setting rules and standards on how to interface between the various layers of the platform is a critical success factor. Looking at the architectures adopted by UDPs in Europe (Figure 4.13), about a quarter of UDPs have chosen to adopt a more integrated and controlled approach. A bit more than half of the UDPs have chosen the more loosely coupled approach described here, with interface specifications and flexibility to let third parties develop their own modules for the platform.

Design Principles

Several European stakeholders have developed the key design principles for developing open interoperable urban data platforms. These are summarised in the ***Join, Boost, Sustain Declaration*** on joining forces to boost sustainable digital transformation in cities and communities in the EU.

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How would you characterize your architecture framework?

17%
Other

26%
An **integrated and controlled system** in which modules are documented and developed by a **private party**, guaranteeing the **quality** of these modules when working together.

57%
A set of **interface-related standards** that are already widely in use, allowing other parties to **develop their own products** while accounting for these standards.
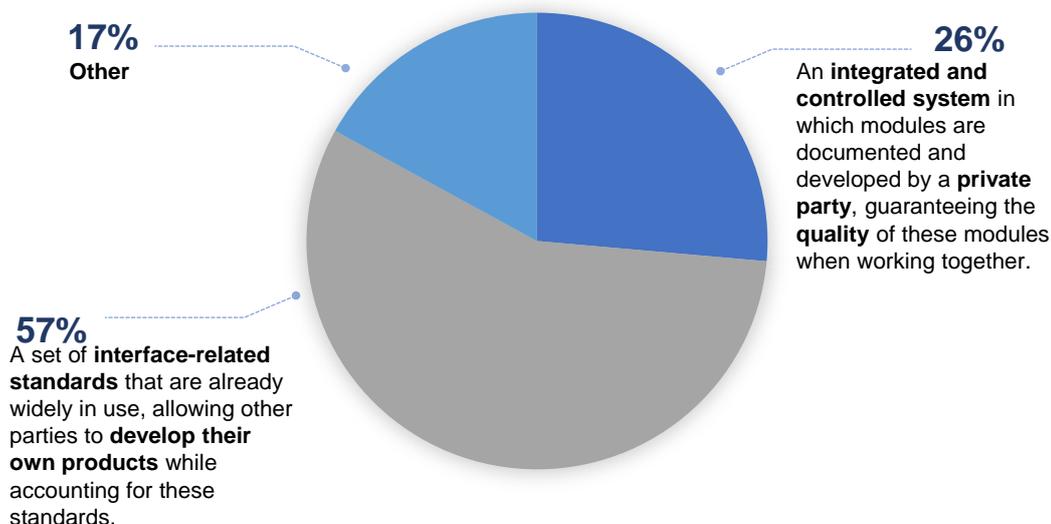
Figure 4.13 – Platform architectures choices for European UDPs (Survey 2018)

Some of the key principles that are promoted are:
1. a citizen-centric approach;
2. a city-led approach at EU level;
3. the city as a citizen-driven and open innovation ecosystem;
4. ethical and socially responsible access, use, sharing and management of data;
5. interoperable digital platforms based on open standards and technical specifications, Application Programming Interfaces (APIs) and shared data models;
6. use of once-only and privacy-by-design principles;
7. the use of unbiased and transparent algorithms to improve quality of life and digital rights in cities and communities.

* * *

The business model of a UDP describes the UDP's strategic choices and activities, and how the UDP plans to sustain itself. Embedded in the description of the business model of the UDP are its purpose, its governance and the required capabilities of the UDP manager. Getting all this right will drive trust in the platform, which will lead to adoption, use and ultimately value creation by the UDP and by the UDP's ecosystem. This new value will be created through new business models enabled by the UDP or through existing business models enriched and scaled by the UDP. Please bare in mind that in our definition, business models have a triple bottom line and thus include initiatives that create value related to people and planet, as well as profit. These smart city business models engaging with the UDP are discussed in the next chapter.

5. Smart City Business Models engaging with UDPs

The UDP is a means to an end, and the 'end' is determined by the platform purpose. In the near term one very practical end is the creation of better and more sustainable urban services through innovation, which is what most existing Smart City initiatives aim to do. Can the UDP be a lever to enrich existing business models and improve their scalability? And can the UDP help generate entirely new business models? Both business model effects of a UDP are discussed in this chapter. But first we contemplate what it is that makes smart city business models specific.

5.1 Introduction to Smart City Business Models

In chapter one we mentioned four root causes why traditional city operating models of are being under pressure: scarcity of public funds, externalisation of public services, the role of society to co-create public value, and the role of society in financing. Using UDPs to cope with the challenges that cities face result in new Smart City Business Models that differ from traditional city operations. Three categories of business models are distinguished in the context of UDPs.

1) First, there are 'non-native' business models of existing Smart City initiatives that connect to the platform and leverage the cross-silo data made accessible through the platform.
2) The second category comprises 'native' business models that are born on the platform, either by developing new innovative services off the data on the platform, or by simply monetizing data through the platform.
3) And finally, there is the business model for the UDP itself which we discussed in chapter 4.

In general, Smart City Business Models warrant a different approach because they differ from more conventional business models because of the confluence of the following four characteristics.

First, they are by nature public-private endeavours that cater to societal objectives e.g. inclusion, public cost reduction, prosperity and sustainability, rather than to mere profit. Private sector companies that participate in Smart City business models 1) are not simply driven by a single bottom line, but by the triple bottom line of people, planet, and profit; 2) need an alliance with the public sector for the business model to work. The latter goes beyond the mere principal-agent relationship when e.g. a city subcontracts maintenance to a private sector company (Holst, 2020). More analysis of this second motive for companies to engage in smart city business models is needed. Much of the EU research (e.g. the EIP-SCC Urban Platform Management Framework) focuses on business models taking the point of view of the City. Why and how a company will participate in a smart city business model is a caveat, which if not addressed well, will hamper the viability of many smart city initiatives.

Secondly, they may involve citizens as active users and not just as customers or consumers. The idea of non-paying users is a common phenomenon in digital business models. The conversion of a fraction of these non-paying users into paying customers is a key managerial activity within the "customer identification" element of a digital business model (Zhang et al, 2015). In a Smart Cities business model, however, having citizens as users is a goal in itself. Engaging with citizen users is a source of legitimacy and sustainability for a smart city initiative in general and particularly for an urban data platform. This engagement can focus on e.g. policy co-creation, citizen participation in urban planning, and citizens providing (personal) data for the good of society.

Thirdly, their value case and consequentially their investment cycle differ from PPPs. The value case is the equivalent to the multi-stakeholder multi-value business case. It answers the question who 'gets' what and who 'gives', in terms of values, both financial and non-financial in short and longer term (Dittrich and Van Dijk, 2015). The value case represents the value of a collective proposition/action for a system as a whole and how it is balanced with the value for the individual stakeholders. Due to their innovative and sustainable nature, smart city business models have uncertain pay-back times. The complexity of the relationship between the parties involved (government, companies, citizens, customers) make allocation of the revenue stream not a straightforward exercise. The triple bottom line nature of smart city business models complicates the valuation of benefits, the monetisation of these benefits and consequently the allocation of benefits to investors. The investment by one party very often benefits the other, further complicating the financing of these business models.

And finally, their value case almost always necessitates behavioural change. The societal challenges that smart city business models aim to tackle, can ultimately only be resolved if people change their behaviours. Be it citizens who must change their consumption pattern or lifestyle, policy makers who must change the way they make decisions, or managers who will have to change the way they coordinate assets and resources. This latter organisational learning theory (Chandler, 1992) can be instructive to understand how company managers are evolving toward also resolving societal challenges. Changing the behaviour of citizens through e.g. nudging (Thaler and Sunstein, 2008) is embedded in the customer engagement component of a smart city business model design.

Summarising, one can say that a Smart City Business Model must combine the risk appetite and agility of start-ups with the solidity of infrastructure companies, whilst catering to societal needs (for behavioural change). This agility is reflected by the fact that the owners of a smart city initiative must continuously seek what works and what does not. They must pursue multiple ways of scaling and experiment with multiple business models to increase the viability of their initiative. Being part of UDP ecosystem does not detract from this need for agility and may even exacerbates it given that UDPs are themselves continuously evolving.

5.2 Typology of UDP engaging Business Models

A reported challenge by the RUGGEDISED smart cities, regarding the UDP upscaling and utilisation, is related to the lack of initiatives being developed on top of the UDP. This complicates the scaling of the UDP itself and its potential to create public value. This section elaborates on business models which can be built around and on top of the UDP for an improved embedding of these UDPs in society. Business models are presented which interact with the UDP and its stakeholders via data supply; data processing, aggregation, and sharing; and finally, data use and analytics. The business models are inspired by the work of (Hartmann, Zaki, Feldmann, & Neely, 2016) which elaborate on business model archetypes for start-ups working with big data, enriched with knowledge and experiences coming from the RUGGEDISES lighthouse cities. The four categories of business models are presented in relation to the layered UDP architecture as presented earlier in section 4.5 of this report.
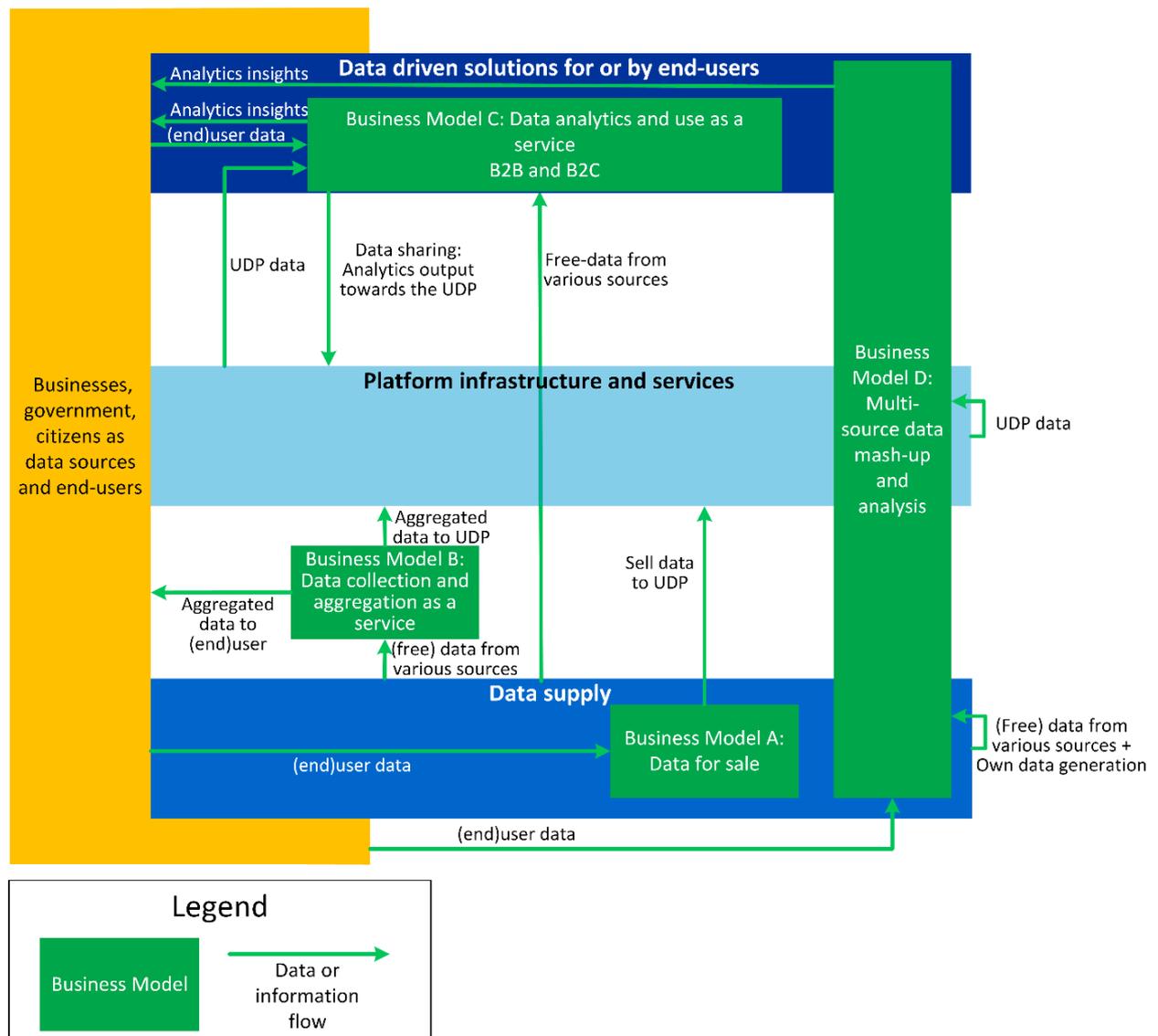
Figure 5.1 – Typology of Business Models on the UDP

Business Model A: Data for sale

Companies or authorities generate data for their internal processes, e.g. through crowdsourcing, web analytics, mobile phones or other sensors, and may look to generate additional revenue with this data by offering the data to other parties. This exchange can be organized via a UDP, in the role of a data marketplace. Aggregated data may be offered for free, while more detailed data may be offered for a premium.

Example 1 – Crowdsourcing data for sale

Crowdsourcing data rely on citizens to generate data on various issues or challenges. This can be done for instance via the sensors in their phones or other connected devices, or via reporting on the observations of citizens, e.g. observed empty parks or garbage on the streets. This data can be monetarized, e.g. to pay back the participating citizens. The monetarised data can be acquired by governments, and subsequently published on a UDP.

Example 2 – Data for a new purpose

The department responsible for waste management in Rotterdam equipped waste containers with sensors to measure the available capacity of the waste containers. An initial use case is to use this data for smart routing of waste collection in the city. This data is shared via the UDP in Rotterdam, as open data, as it is collected by a public authority. In case a private party generated this data, they may choose to sell this data to the UDP for it to be shared. Additional value van be created with this data towards parties interested in the insights on the available capacity of waste containers. For example, home care providers have a packed schedule of patients to visit and provide with care. To save time while discarding the waste, they could benefit from insights on the nearest waste containers with capacity to discard the waste, and the quickest route to that waste container, taking into account the current location, the next location on the list of patients, and possibly the traffic.

Business Model B: Data collection and aggregation as a service

In this business model data is collected from a vast selection of sources, with the emphasis on free and open data sources. The offered services subsequently extent to the cleaning, filtering, processing and aggregation of the data for it to be useful and compatible for end-users directly or via a UDP. Thus, this data can be provided to a UDP, or other interested parties. Revenue can be generated by charging the UDP manager for the effort put in collecting, processing and aggregating the data, but possibly also for identifying new and potentially relevant data sources.

Example – UDP Data feed

For a UDP still in its infancy phase, the UDP may proactively identify and promote use cases on the UDP. For these identified use-cases the UDP manager can assign a party with this business model to collect and prepare data for the UDP. The collection of data from local, regional, national and international sources, and the filtering and preparation of the data to fit on the UDP and be suitable for the local context is the provided service.

Moreover, the company with this business model may identify data needs among society and the current and potential free or open data sources, for clients such as a UDP manager. Subsequently this company selects data sources which align with the data needs from society, collects this data and offers this data to be published on the UDP. The UDP manager can pay this company for the efforts in deriving the data needs and the relevant data sources and collecting and processing this data ready to be published on the UDP.

Business Model C: Data use and Analytics as a Service

Actors adopting this business model may conduct data analytics for questions posed by clients in a B2B setting, or for a broader population of end-users, e.g. citizens. Variations can take the shape of P2P solutions where base facilities are provided for peers to build and improve solutions with each other in an open source manner. The analytics and use of data can be conducted on data provided by or collected from their clients, possibly combined with free data coming from various sources or a UDP. Moreover, their offer may include data sharing, via API's, a UDP or apps providing access to analytics output. The parties providing these services carry expertise in for instance AI for data analysis, expertise regarding the processing of data for it to be analysis ready, and expertise to effectively communicate analytics output towards the clients in actionable information.

This business model starts with a base proposition for added value coming from a certain acquired or client dataset, or some sets of basic open data. As it evolves, the value added is improved via

the addition of a more diverse set of data, hence, deriving richer and tailored insights from the horizontal combination of data.

As previously mentioned, this business model may entail B2B as well as B2C and P2P. The line of B2B can provide insights from data analytics in the form of reports or digital dashboard towards businesses and governments, or in the form of recommendations or courses of action e.g. to improve business processes or support decision making. In addition, towards citizens, the data analytics services can be provided via apps, which customize the analytics based on the specific needs of the citizen via the app. Remuneration for the analytics services can be arranged via subscriptions. The app may offer a standard free version with standard data visualisation, and premium options for data analytics.

Example 1 – Data analytics for convenient urban movement
An example is a wayfinding app for citizens to move in the city efficiently, towards the store or location of their interest, based on data pertaining, among others, store, restaurant, government building occupancy or car park occupancy.

Figure 5.2 – Example of a wayfinding App[1]

These wayfinding apps combine various data sources to provide a richer picture of the real world, compared to what a citizen can see when stepping in a car or starting a walk. A standard version of the app may provide the quickest route given open data available, for instance towards the closest car park with capacity. A premium may be asked for a tailored service, for instance if the customer wants to derive a route along stores which matches their specific shopping list, considering the occupancy of the shops.

Example 2 – Energy transition decision making
In the energy transition, consultancy and engineering firms use open data provided over various platforms, to conduct neighbourhood scans on the potential of that neighbourhood, for instance, to make the transition to net positive energy dwellings. The open data relates to the age, function, energy label and area of the dwelling, to assess the energy demand. And on the other hand, the potential sustainable energy sources in the neighbourhood, for instance the potential for solar PV based on the surface area of the roof and radiation data for that neighbourhood. The insights

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[1] Source: https://geoawesomeness.com/indoor-mapping-changing-lives-jibestream-2019/

generated through this approach are of added value for the citizen looking into investments to improve the sustainability of the dwelling, for the utility company looking into expanding a district heating network into a new area, or the municipality establishing neighbourhood transition plans and looking for area's where citizens need assistance to improve their ability and willingness to invest in their dwelling. The business model can thus generate revenue over various channels. The District Scan by Hoom in the Netherlands is an example. Here, a municipality or local energy initiative pays for this scan, according to a pay-per-use remuneration model, to support decision making for a neighbourhood energy transition plan. https://hoom.nl/energiediensten/

Business Model D: Multi source Data Mash-up and Analysis

This model is the most integrated business model as it touches upon all three layers of the UDP architecture. It entails the enrichment of data provided by clients, with data from other (free) sources, or data generated by the party itself, in other words the vertical integration of the data generation, acquisition, processing and analysis phase. Like the previous business model, and in addition to the vertical integration of the process, the horizontal combination of various user and open data, improves the proposition of added value for users. Subsequently analytics is performed on the data for services or products towards businesses, governments or citizens. Potential revenue flows are created by the data analytics and the provided services, but also through the monetarisation of the generated data.

Example - A data-driven cycling app

A company developed a wayfinding app for cycling trips and this app is provided nationwide. However, based on the preferences of local users and the local attractions, the app tailors the trips to this local context. First, the company works with a standard national database containing open data on cycling infrastructure and its use. Then, on the local level it derives the cycling behaviour and attraction visits from the local UDP. In addition, the company generates data from users via deployable sensors on the bike, and via sensors in connected equipment such as the smart phone or a FitBit. This data is visualized for the user through the mobile app as interface and stored in the cloud on the account profile of the user. Moreover, the company derives data through online polls via its apps and social media channels on preferences and needs of the users. The combination of this data results in the tailored cycling route for users in a specific area. A service for which users may pay via a subscription, with additional options such as the lease of a cycling sensor. The rich data on local cycling behaviour and infrastructure use can be used for product development, but it can also be shared with governments for policymaking on the cycling infrastructure in the city, and with other parties via the UDP.

5.3 UDP enabled Business Model generation

Just as the specific nature of a UDP calls for a specific description of UDP business models, as captured in the UDP business model canvas (section 4.2), so does the specific nature of business models that are connected to a UDP require as special business model framework. Ramm (2019) has generated such a framework through exploratory research among stakeholders and practitioners working in the field of smart cities and UDPs. The resulting framework is presented in Figure 5.3. Note the distinction between platform dimensions and operational dimensions. The operational dimensions are familiar dimensions as they can be found in e.g. the Osterwalder business model canvas, but the details are more UDP specific. The platform dimensions describe the engagement of an organisation to the UDP. Appendix 2 shows a similar business model framework that details some of the dimensions mentioned in the canvas shown below.

Of particular interest is the platform dimension 'Native to UDP', denoting that the higher the degree of "native-ness", the more the business model relies on data being sourced from or shared to the UDP (Ramm, 2019). These native business models fit with the purpose of a UDP of "economic innovation and entrepreneurship". UDPs with this purpose will enable these native business models by ensuring that they "adjust their offering accordingly to provide high data continuity and quality on these data types and to these organisations" (Magalhaes et al., 2014).

Smart city UDP Engaging Business Model: Leveraging technology for sustainable and liveable cities

OPERATIONAL DIMENSIONS				
Partner Ecosystem Key Partners required	**Key Activities** Analyse Enrich Application Development Aggregation Data collection	**Offering** Data Information / knowledge	**Revenue Model** Licensing Subscription Sale Pay per use Internal efficiency	**Target Customer** Government Business Citizens Non-profits

PLATFORM DIMENSIONS				
Native to UDP Continuum from: Optimisation Pure players	**Degree of interoperability** Number of platforms connected to	**Type of Access** API 　　REST API 　　Streaming API Download	**Type of data exchanged** Velocity Variability Type Domain Nature	**Type of Engagement** Data user Data supplier Both

Financial Cost E.g. financial investments, run costs	**Financial Benefit** E.g. ROI, revenue streams, economic growth
Social Cost E.g. privacy, security, freedom, personal attention invested	**Social Benefit** E.g. democratic participation, fairness, liveability, happiness
Environmental Cost E.g. CO_2 footprint, natural resources used (by ecosystem)	**Environmental Benefit** E.g. sustainable innovation, reduced emissions, less waste

Figure 5.3 – A UDP engaging Business Model Framework (based on Ramm, 2019)

According to Ramm non-native businesses i.e. existing (smart city) business models benefit from the UDP and adapt their business model in two ways. First, they can improve their internal efficiency by leveraging data from the UDP to optimise processes. Secondly, they can develop new services based on the data available on the platform. We would like to add a third lever for a non-native business model connecting to a UDP and that is extending their reach to customer types not accessible without the UDP. Or by finding not only data, but also complementors and new partners on the UDP. The next section will elaborate in the mechanisms of scaling.

5.4 Scaling Smart City Business Models with UDPs

Are UDPs a mechanism to help scale smart city initiatives? As mentioned in chapter one, this is one of the guiding questions for this research. As Figure 5.4 shows our expert panel strongly believes that the answer to this question is affirmative. By increasing their scope and reach smart cities can grow to the scale and size they need to flourish.

Smart City initiatives will best flourish if they...
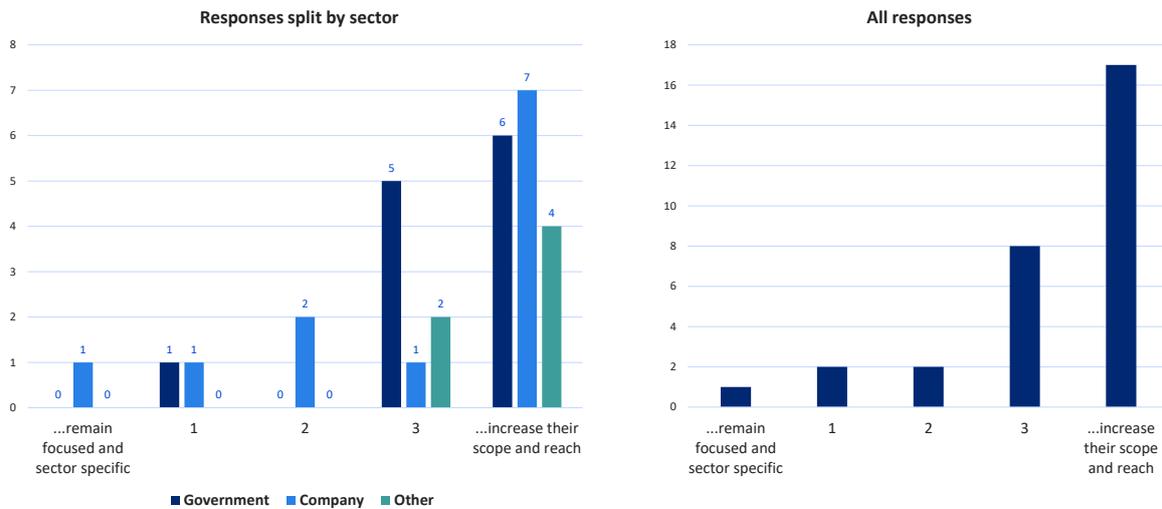
Figure 5.4 – Increasing their scope and reach will help smart city projects scale (Delphi 2020)

Types of scaling

Van Winden and van den Buuse (2017) have identified three ways that Smart City projects scale, based on empirical data gathered from smart city projects in the city of Amsterdam. The three different forms of scaling identified are roll out, expansion and replication (see Figure 5.5).
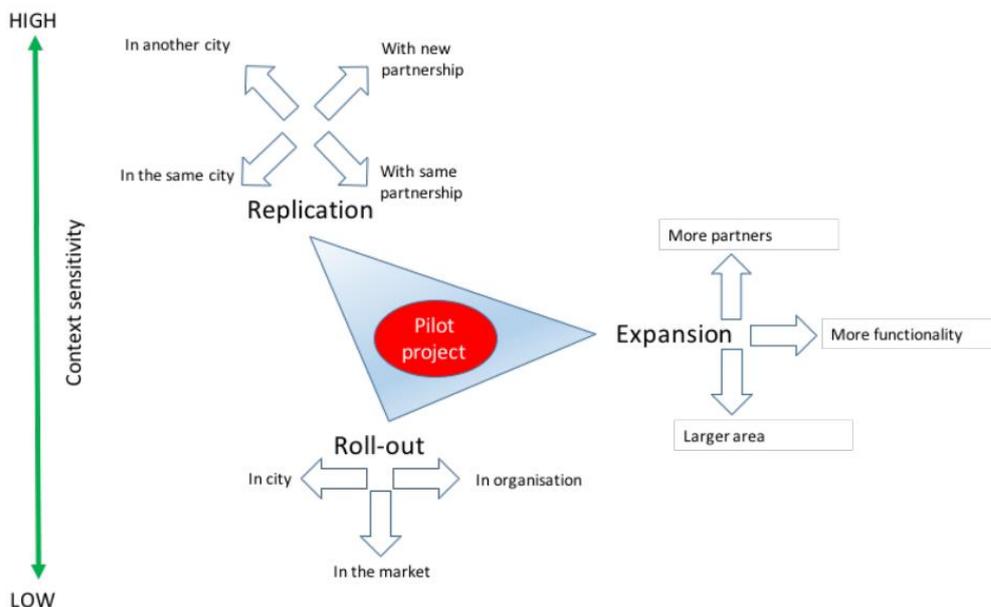
Figure 5.5 - Three types of upscaling (van Winden, 2016, 2017)

Roll-out upscaling can be defined as a further expansion of a solution tested in a pilot – in the organization, in a city or in the market. Specifically, this is the case with solutions by one organization with a sound business model, after a successful pilot. The context sensitivity in this case is relatively low. UPDs can help a smart city project that connects to the platform with market roll out. More users or customers for the project can be reached through the platform by tapping into the audience that is already on the platform.

Expansion upscaling can be defined as expansion to a larger geographical area, to add more functionalities to a solution or to engage more partners. This type of upscaling applies typically to platform solutions, where the value of the solution grows with the number of partner organizations. Specifically, UDPs can facilitate shared data projects, where the solution becomes more interesting and useful when more parties add their data via the UDP. Complementing solutions or datasets from the platform ecosystem may boost the value and, hence, demand of the initial smart city proposition.

Example: City trip apps that share and use user context data on a UDP. The UPD retrieves data from different sources such as websites (e.g. hotels, restaurants, events), and social media, and offers data services to app developers. The UDP also provides a data repository about a city. Using data services on the UDP and a data repository about a city, enable app developers to offer more functionalities and coherent travel advice services for city visitors.

Replication upscaling can be defined as doing the same in another part of the same city, with the same partnership, with a new partnership or in other cities. It can be done by the original partners, or by others. The replicability of a solution, which is a factor predominantly relevant for private sector companies, sets requirements for platforms in terms of standardization and interoperability. For this type of upscaling the context is highly important.

Example: smart charging App that works the same in different cities. It connects to local data sources (parking sensor data, energy data, traffic data) via the local UDP, but offers the same service to the user (independent of the city where the App is used).

Leveraging platform mechanisms to scale

Scaling a smart city initiative by connecting to a UDP (strategy 1 in Figure 5.6) can employ one of the following three tactics discussed before. First, the smart city initiative can use the data on the platform to optimize its internal processes. A second tactic is to develop new services, e.g. by monetizing own data or by levering new external data from the UDP. Thirdly the UDP can help the smart city initiative to extend the scope and reach of the initiative by finding complementors and new customers on the UDP. Due to our focus on UDPs which are by nature more in the public realm, the other two platform strategies for scaling smart city initiatives, Vertical Innovation Platform and Closed Community Platform, are beyond the scope of our research.
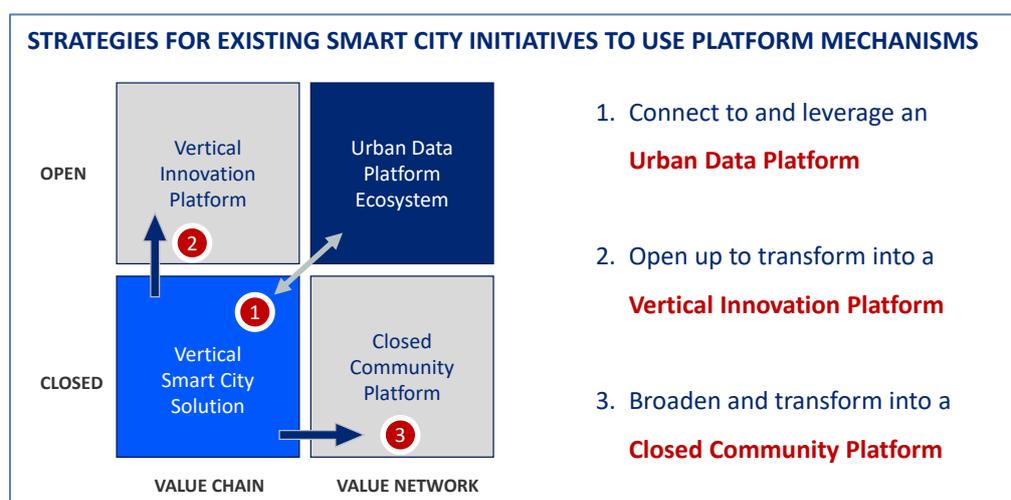

Figure 5.6 – Strategies for existing Smart City initiatives to use platform mechanisms

Overall, UDPs provide smart city initiatives access to a wider group of users, it can enable developers to come up with services that complement and thus reinforce the original value proposition of the smart city initiative. The more smart city initiatives connect to the platform and share data, the larger the chance to attract relevant developers, and the higher the chance that customer and users will engage. A well-managed UDP can thus bring the key ingredient of platforms, i.e. network effects, to smart city initiatives and help them scale.

Van Winden (2016) makes an important point about the balance of learning from SC initiatives and scalability of smart city projects. He observes that *"a single-sided focus on scalability could reduce or impede more fundamental experiments that may not scale immediately but function as small building blocks in a process of systemic and more fundamental changes and entail important learning processes"*. Therefore, smart city projects should not only be evaluated on their ability to scale, but also their contribution to a learning process for developing a smart city.

5.5 Reflecting on an ecosystem of business models

When we speak of a platform ecosystem, we can also frame this as an ecosystem of business models. The ecosystem metaphor is interesting because it connotates mutual interdependencies between stakeholders, balance, resilience, and the fact that the business models are embedded in the same urban environment. Particularly the latter part of the ecosystem metaphor is interesting: the business models do not operate in a vacuum but collectively "live" in the same urban environment. Business models – large and small – are more likely to be complementary if they serve the same local context. With the right ecosystem nurturing by the platform manager, positive feedback loops may emerge that will help the platform achieve its purpose. Be that better services and policies, economic innovation and entrepreneurship, resilience and sustainability, or social innovation and democracy.

When it comes to nurturing it is imperative that the platform manager understands that the UDP is more a tool for emergence than for planning. The UDP will aim to create the right conditions to attract, engage and stimulate collaboration, but it is not a means to direct, plan or control innovation. As mentioned before, is it is more a Bazaar than a Cathedral (Raymond, 1999). For UDPs that are (co-) managed by governments, the question is how to get Cathedral builders to become Bazaar facilitators?

If the main purpose of a UDP is better services, a well-functioning ecosystem may result in the co-creation of city services and thus enabling the municipality itself to become more like a government-as-a-platform (O'Reilly, 2011). This concept is not to be confused with an Urban Data Platform that, even though it might be owned and / or managed by the municipality, is an entity that in our definition stands apart from the municipality. By letting other stakeholders provide public services using the UDP, the municipality can improve their effectiveness and efficiency. If the municipality is the manager of the platform and as such defines and enforces the platform rules and regulations, it must ensure a level playing field for these co-creators and avoid unfair competition for instance from the municipality itself.

For a UDP with the higher purpose of social innovation and democracy we may conceptualise citizens as actors having a "business model" in a platform ecosystem. We are increasingly seeing households operating as 'businesses' in renewable energy- generation and storage. Our expert panel sees the monetisation of personal data as one of the key reasons for engaging citizens on

a UDP. If we stretch the term 'business model' to the more encompassing 'value model', we can conceptualise citizens as actors exchanging their vote once every four or five years to get a government that will pursue their values and best interest.

What if a UDP can foster citizen engagement, not only in the production of (digital) goods and services, but also in governance of the region or municipality between elections? An example of such an improvement to participation and democracy is the allocation of budget and decision freedom to local communities e.g. in design and management of the public space. Another example would be to continuously and transparently monitor citizen sentiment toward policies and policy execution. By being able to engage citizens in governance, the UDP may ultimately emerge as a catalyst for good governance (see Figure 1.5).
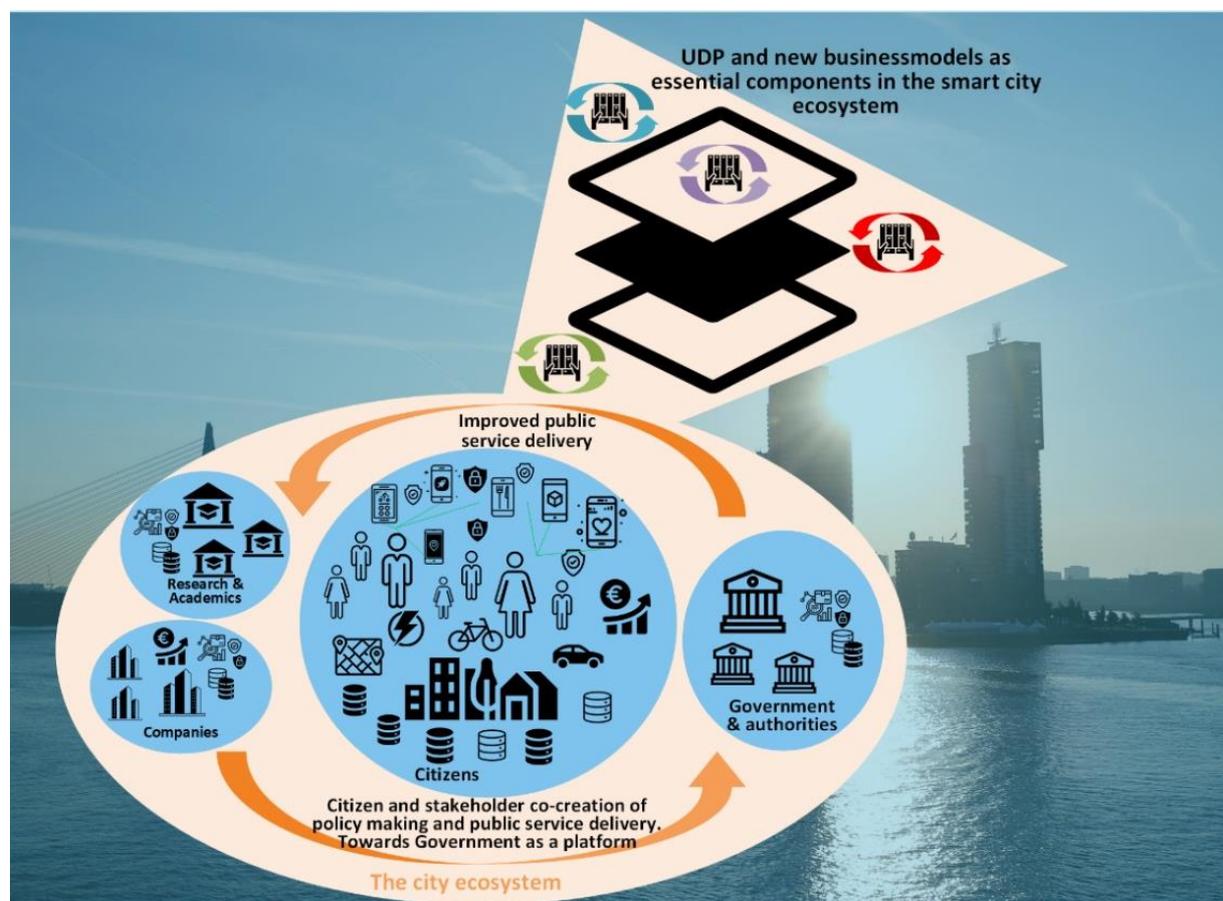
Figure 5.7 – The city as an ecosystem of citizens, government, companies, activities, objects, sensors and business models continuously shaping "life" and "living" in the city

Companies with vertical business models that do not connect to the UDP may see their business model disrupted by new entrants. A more likely scenario, however, is that these companies will connect to local UDPs to strengthen or adapt their business model and find complementors and new customers. Learning how to leverage the platform to use and share data, build new partnerships, and play the digital urban ecosystem game will not be easy.

Today many companies fail to see the path from their current vertical offline business model to a platform enabled digitally augmented business model. This 'failure of imagination' is the most

serious of six reasons for platform failure identified by Alstyne et. al. (2016). Simply not seeing the platform play. In the next chapter on moving forward with UDPs, we aim to provide some suggestions for action by both government and companies to get this thinking process started.

* * *

New and improved smart city business models, either native to the platform or enriched by the platform, are the way a UDP creates value and fulfils its purpose of better services, economic growth and (sustainable) innovation. In this report we started the path to maturity for UDPs with the essential need to understand the platform phenomena. We described the importance of trust in a UDP and explained how clarity of purpose, well designed governance, and strong (managerial and technical) capabilities drive trust. As mentioned before, it is still early days for UDPs in Europe. Many more steps need to be taken to move forward on this path to maturity. A first outline of these next steps is given in the next and final chapter.

6. Moving forward with Urban Data Platforms

This report has provided arguments that UPDs are important mechanisms to scale smart city initiatives and, more generally, mechanisms to leverage city data as a resource. As such UDPs have the capability to create tremendous public value. Our main recommendations are therefore that the government must have an essential role in the governance of UDPs, and that a Triple bottom line business model should be adopted to favour the viability of these platforms. However, more experience and research are needed in both the area of UDP governance and business models. In this chapter we conclude the report with recommendations for government policy makers, company strategists, UDP developers, and researchers.

6.1 Recommendations for Governments

The following set of recommendations for the government is not exhaustive and focusses on the required attitudes and behaviours of policy makers, especially if the public sector is going to take the lead in the governance of Urban Data Platforms. We refer to government in general, encompassing all levels of government – local, regional, and (supra)national. However, as most of our data has been collected at the local level, the recommendations are mostly directed toward municipalities' decision makers.

(1) Think beyond 'open data' and envision how to best manage shared data
Many governments have some form of open data portal that allows them to share public data with citizens and organisations. This is a matter of making the right data available in the right machine-readable format. As we have seen in chapter 2, the manager of a UPD needs to fulfil several additional roles, e.g. setting the rules for the platform, and nurturing the ecosystem. The viability of the platform depends on the fulfilment of these roles and the platform owner must therefore not confuse an open data portal with a UDP. A UDP handles open *and* shared data (with access restrictions) that drive business process of stakeholders in the UDP ecosystem, making it more complex than an open data portal. This requires security solutions and technical and organisational capabilities far beyond those related to platforms for open data. These different kinds of capabilities will most likely require a different kind of staffing.

(2) Build digitalisation capabilities next to your ICT capabilities
One should be mindful that digitalisation is something different than ICT. Many governments do not have a great track record with implementing their IT systems. Whatever the reason for so many failures of governement IT projects, it would be fair to say that this has shaken the confidence of most CIOs and CTOs in government. This could explain why some governments are hesitant to take the lead in UDP governance and lean towards the market. One should understand though, that the digitalisation of processes, markets and society at large is a different game requiring a different approach. Not being very good at implementing ICT systems, does not mean that one cannot be great in mastering digitalisation, like governing urban data platforms.

(3) Adopt an agile mind set
Platforms, also UDPs, have business models that evolve and grow continuously. Most existing UDPs and ecosystems are still immature, as are the initial corresponding business models. It is fair to assume that business models will evolve over time. This evolution must be orchestrated deliberately (Tiwana, 2013) by the platform owner. As platforms are never finished and will

continue to develop and expand, an 'agile mind set' is required. This is difficult for both business and city managers. Both the governance and the architecture of the UDP will change over time as one learns what works on the platform and what fails. This will also affect the business models on top of the UDP. The key is to take a long-term view and understand that co-creation with other stakeholders requires learning and remains subject to change. The use of agile development in short cycles and Proofs of concepts is favoured above long-term development cycles. Accept the right to fail (and learn from it). The metaphor of the Bazaar (horizontal adaptive) and Cathedrals (vertical and controlled) is instructive to illustrate the mindset required (Raymond 1999).

(4) Decide if the UDP is vital Infrastructure and be clear about the platform purpose
Platform stakeholders (owners, managers, and financers) must decide whether their platform is vital infrastructure, for this will drive all decision making about the design, business model and funding, development, and management of the platform – now and in the future. Furthermore, the platform partners - manager, owner, investor, builders, and ultimately also participants - all must have a clear and joint vision of the UDP purpose. As mentioned earlier, clarity of purpose, will enable the necessary agility that is needed to develop the platform and let it evolve.

(5) Ensure the right mix and level of capabilities
Our study has shown that the full set of capabilities required to manage a platform, do not come naturally to either the public or the private sector. When designing the governance of the UDP it is recommended that the capabilities of proposed platform managers or platform management partners are assessed on each of the required capabilities. This may help to design the right mix of public and private collaboration, i.e. in a public-private partnership decide who does what. And even with a public-private mix of skills, it is very likely that additional training of people will be required. The business model canvas can be used to develop a curriculum for platform management capabilities.

(6) Gain trust through 'social innovation'
Our research shows that trust is the "lubricant" that makes a UDP work and fulfil its purpose. Platform stakeholders should measure the levels of trust, e.g. by developing a questionnaire based on the literature and existing practices of trust measurement. These measurements will help track whether the continuous work on improving trust through e.g. collaboration, transparency, and enhancing capabilities, eventually pays off. There is no single recipe for improving trust. Clarity of purpose and values are softer levers of trust. Being competent and collaborative are more tangible drivers of trust. Designing UDPs to serve public values will also improve trust in the UPD and its ecosystem. So, even though technology innovation and business (model) innovation are important drivers for realizing smart cities and UDPs, substantial effort needs to go to social innovation as well. This type of innovation comprises finding new ways to develop and nurture trust, to create and pursue a shared ambition, to engage with stakeholders, and to innovative capacity building.

(7) Consider Citizen Engagement from the start
Platform managers are advised to make the way(s) they want to engage citizens explicit from the start and make the rationale for citizen engagement explicit. Our research is not conclusive about when in the life cycle of a UDP to actually involve citizens, but it does show considerable consensus that at some point in time citizens are to be engaged. Therefore citizen engagement activities need to be part of UDP planning cycle, including the appropriate budgets if these are needed.

(8) Regional governments can support smaller municipalities with UDPs

Regional governments are encouraged to develop a strategy and approach for Urban Data Platforms, for instance to foster interoperability (see section 3.5). More importantly, though, so that smaller municipalities and their citizens are not left behind in the Digital Age. Create regional clusters where several cities collaborate to share experiences and learn from each other. With collaboration between cities it will be easier to front technology providers and other partners. Smaller municipalities with lack of enough competence or resources can act as followers, but still keep up for the sake of their citizens.

(9) Consider data to be a strategic resource

That data is regarded a strategic resource implies that the top municipal decision makers (officials and politicians) understand and pursue this through strategies and action plans. Observe that this is a top-down approach that will only fully work once it penetrates the whole organisation. It will require great change management skills to become accepted and effective and it will require bottom-up approaches simultaneously so that all parts of the organisation themselves can understand the importance of data.

(10) Ponder the vitality of UDPs and what they mean for government in the digital age

Overall, our research is not conclusive on the fact that UDPs are vital public infrastructure even though the members of the expert panel unanimously think so. Governments therefore need to carefully consider how they envision their UDP. Adoption of the vital infrastructure point of view may ultimately create far reaching consequences and opportunities e.g. government as a platform for the joint creation of public service, or more participatory forms of democracy if citizens are engaged in policy making through more advanced and higher purpose UDPs. UDPs, once seen as critical infrastructure may also provide countervailing power to private sector platforms. These considerations are important for individual local governments, but also for policy makers at EU level. Table 6.1 gives specific recommendations for EU policy makers based on our research.

Table 6.1 – Findings and Recommendations to EU Smart City Bodies (based on Survey 2019)

Topic	Key Findings	Recommendations
Market Uptake	(1) Adoption of UDPs – considerable recent take-up; however, a significant gap to fill (2) 75% of cities have 10 or less applications on their platform. And usage of the currently available platforms is very low – by society, start-ups, & businesses	(1) Stimulate take up through Digital EU programme vouchers and grants. (2) improve pragmatic monitoring mechanisms.
Purpose & Scope of UDPs	(1) Do we really know what a UDP is, at all levels of the city such that we can see its current and future value, and can justify action? (2) Motives and ambitions for UDPs are clear – and presently more internally focused (3) 50% of Cities have clear ambitions to establish an open interoperable	(1) Improve the communication of UDPs (2) Strengthen the quality and visibility of the 'packaging' materials from the EIP-SCC & SCC01s (3) Capture evidence-based high impact use cases (4) Develop practical roadmaps

Topic	Key Findings	Recommendations
	city-wide enabling platform that supports multiple services	
Stakeholder Participation	(1) Society is not engaged (2) We see a "Mexican Stand-Off" with Industry (3) Trust is THE No.1 Challenge to accelerate action (4) Legislation and procurement are the big blockers	(1) Unpick 'trust'; analyse, and set in place clear useful actions (2) Bring the parties together to openly address these concerns and put steps in place to resolve them (3) Identify the lighthouse cities leading on societal engagement (4) Establish a clear legal charter and measurable goal for use of data by industry
Capacity Building	(1) Capacity Building – 42% of Cities state they have a Chief Data Officer (CDO); good enough? (2) Cross-Silo collaboration is a vital capacity to develop (3) 70% of Cities use open standards (4) Much more to do in terms of exploiting Modern Data Techniques and sharing data	(1) strengthen and stimulate use of EIP-SCC / SCC01 packaged materials via criteria / voucher schemes (2) Pilot a CDO network, and adopt/adapt the CDO role definition (3) Develop very practical use cases and capture structured evidence-based case studies (4) Strengthen procurement materials
Financial Matters	(1) We are schizophrenic about how we justify UDPs (2) >80% finance UDPs with public budgets; 60% finance internally;	(1) Deepen the understanding of these two apparently opposed approached (2) Capture/pilot joint business case; develop method and tools that will help multiple cities adopt

6.2 Recommendations for Companies

When the term Smart City was coined more than ten years ago, the phenomenon was predominantly driven by technology companies e.g. Cisco and IBM that saw the opportunity to use digital technology to solve some of societies' pressing problems, e.g. climate change and rising inequality. Having in mind that by 2050 the world's population will reach 10 billion, of which 70% are expected to live in cities, these cities seemed like a good place to start working on solutions. See here the emergence of the concept of Smart Cities. After an initial one-sided push by big tech, the Smart City idea today finds traction in both the public and private sector. Here are some recommendations for companies based on the findings of our research.

(1) Mind the triple bottom line

Companies are increasingly being called to action to contribute to solving societal challenges and to abandon their single-minded pursuit of profit to follow a "dual purpose playbook" (Battilana et al., 2019). Companies that genuinely take this stakeholder- rather than mere shareholder approach will gain the trust required to make UDPs and the UDP ecosystems work. These companies will

profoundly understand that the four types of platform purposes we discussed in section 2.4 are not the sole duty of the public sector to pursue but are theirs as well as responsible corporate citizens.

(2) Steer away from the 'dark side' of smart

Transparency and openness are important principles in the governance of UDPs, and by extrapolation of smart city initiatives in general. Failing to adhere to these principles can have serious adverse effects. Just recently Google's Sidewalk Labs abandoned their ambitious smart city project in Toronto (The Guardian, 2020), predominantly because of resistance by citizens that worried about their data ending up in the hands of Google. Citizens also had concerns of Google algorithms controlling city planning and hampering digital rights and ultimately democracy. In the eyes of its opponents, this project crossed a line and ended up on the dark side of smart cities, called "surveillance capitalism" (Zuboff, 2019). So, the challenge for companies really is to walk the fine line between "smart" and "surveillance".

(3) Leverage the UDP to scale smart city initiatives

As mentioned before, many Smart City projects still fail to scale, and the concept is still not delivering on its promise. Our recommendation is that companies use urban data platforms to scale their smart city projects, initiatives, and business models as discussed in section 5.4. This implies that at the very conception of a smart city project, the designers should consider how their project can leverage the platform mechanisms of a UDP. This is true for all smart city projects, whether they are initiated by the public or private sector.

6.3 Recommended Development Approach for UDPs

Within RUGGEDISED the three lighthouse cities each developed their own instance of a UDP, given the local conditions and challenges, and the city vision for data and digitalisation. These UDPs were introduced in section 2.2, where we addressed the city challenges these UDPs target, but also the challenges faced by these UDP in the development and operation. These vast differences in the cities is also reflected in the design and governance of the UPD and the process embarked to realize these UDP's. Among others different choices were made regarding:

1) the procurement of the UDP (in-house development in Glasgow versus outsourcing to the market in Umea),
2) the addition of built-in UDP functionality relating to, but not limited to, data sharing (Umea), data visualisation (the 3D city twin in Rotterdam), and data analytics (the data-based decision platform in Glasgow),
3) the embedding of the UDP in the city council, taking it further than a RUGGEDISED project
4) the organisation of ownership in the UDP ecosystem, including UDP ownership, data ownership, and ownership of the services and products developed on top of the UDP.

Consequently, a one-size-fits-all UDP does not exist, neither does a uniform process to develop a UDP. Nevertheless, based on the lessons learned in Rotterdam, Glasgow and Umea, "Deliverable 1.6: a Guide on UDP development" distilled a step-wise approach which can be followed towards a UDP which is innovative, supported, and creates value for policy makers, citizens and stakeholders by matching the demand for city data with the supply.

This UDP development process consisting of 5 main phases, is depicted in Figure 6.2. From starting with the definition and assessment of the context, or ecosystem on city data, the establishment of a strategy on city data, all the way to the operation and utilisation of the UDP, this process provides means to start. When engaging on the establishment of a UDP in your city, this

RUGGEDISED – 731198
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Public (PU)

guide provides an overview of the aspects to consider, and what possible perspectives of action might be when addressing these aspects. As can be noticed it is a circular process, implying that UDP development and operation is a continuous process. This is necessary to cope with an ecosystem which continuously changes with new technologies, actors (and interactions between them), questions and challenges, data and business model arising. For a UDP to be effective in this highly dynamic ecosystem, it is essential to proceed iteratively and maintain a UDP proactively. Each phase will briefly be addressed, in terms of the necessary activities and deliverables per phase, along with the challenges experienced by the RUGGEDISED lighthouse cities per phase.
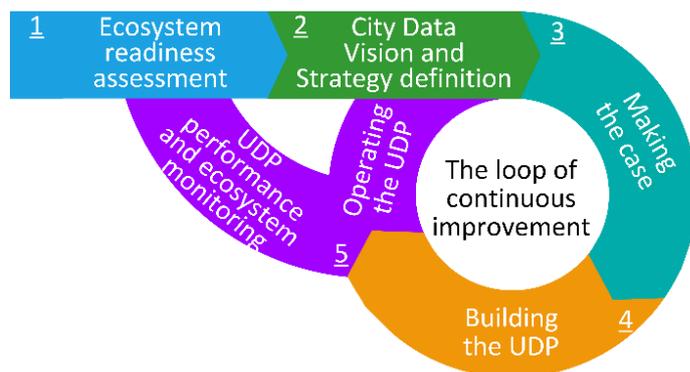
Figure 6.2 – A guide of continuous improvement to develop a UDP in your city

1. Ecosystem readiness assessment

The process starts by assessing and agreeing upon the city's readiness for smart initiatives and its city data ecosystem. This phase results in insights on the city data ecosystem in terms of its services and applications; stakeholders on the supply and demand side; technologies and standards in place; and the existing vision, strategy and policies on city data. By having a good overview of the existing strategies and plans for city data, the proceeding steps can ensure to draft a vision and strategy on city data which complements and links the current initiatives. Or that alternatively a strategy on city data is developed when such is lacking. In this phase it is important to start involving and engaging the relevant stakeholders to determine what their ideas and interests are, for an inclusive and supported strategy.

Challenges to cope with:
- An ecosystem can be highly dynamic and heterogenous, the assessment phase should be regularly repeated for up to date insights.
- Ensure that the ecosystem assessment derives the insights to smoothly plan and implement the proceeding phases in the city data strategy and UDP development.

2. City data vision and strategy definition

The Ecosystem readiness assessment is proceeded by the phase of *City Data Vision and Strategy definition*, where a clear and supported vision and strategy on city data and the role of the UDP are established. This is operationalised in policies and plans and linked with resources to implement projects. In the case that the city already has a vision and strategy, this phase is dedicated to aligning and updating these with the latest innovations and challenges in the city. A clear connection between needs and the policies should be established, and citizen and stakeholder engagement support this.

Challenges to cope with:

- This is where it can be ensured that the UDP is not just a loosely hanging project in the city, but well embedded within a supported and resourceful strategy of city data. Make sure the vision and strategy can be implemented, by including the necessary resources.
- Embed: on the one hand, robustness in the vision and strategy to cope with the heterogenous ecosystem and with the technology and social uncertainty; and on the other hand, adaptiveness to cope with the ever-changing ecosystem of stakeholders and technology.
- Smart city development brings the various departments within the city council together, this should also be the case for the city data vision and strategy. By doing so, commitment to the UDP project is created early on, and challenges, for instance, pertaining to data exchange between the departments and towards the UDP can be overcome.

3. Making the value case

The third phase is called *Making the value case* and entails the development of the UDP definition and value case. This consists of the UDP purpose in the city, and that purpose translated into the necessary UDP functionality to effectively and efficiently achieve the smart city goals, and the desired business models to be developed within, or around the UDP, and contribute in the UDP purpose. The UDP value, functional, and technical definition are translated into the development and operational requirements of the UDP.

Moreover, this phase encompasses the governance design to ensure that the UDP design fits within requirements pertaining to data and UDP ownership; privacy and security; and data access and supply. Along this phase citizen and stakeholder engagement is essential to establish a supported value case and UDP definition.

Challenges to cope with:

- Including data quality and consistency; data sharing standards and protocols; and rights to use data in governance schemes, without necessarily knowing what data will be the UDP.
- Guaranteeing data security and user privacy in governance schemes with adequate instruments and measures for proactive assessment and actions, without necessarily knowing what data will come on the UDP.
- Prioritise UDP purpose and functionality, amidst the dynamic and heterogenous ecosystem, via a clear strategy on the starting point and how to expand the scope and functionality as the UDP evolves together with the stakeholders.

4. Building the UDP

Subsequently, in the fourth phase of *Building the UDP,* the UDP is established via a) a journey of in-house design and building, b) a journey of heading to the market for UDP procurement, or c) a combination of in-house development and activities left over to the market. Moreover, the governance design from the previous phase and the UDP design, are translated in governance agreements. Manuals are established to guarantee the functionality and utilisation of the UDP, and its gradual evolvement. Citizen and stakeholder engagement, during the development process and in launch or promotional events, will boost the match between the UDP design and the needs.

Challenges to cope with:

- Effective interface design for maximum utilisation by the identified actors, often composing a heterogenous population of culture, interests, expertise, skills, needs and communication preferences.

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Public (PU)

- Cultural differences, between municipal departments, may manifest more distinctively during the implementation of the UDP, and be a barrier e.g. when it comes down to really work in one team to build and procure a UDP.

5. UDP Operation and Utilisation: UDP performance and ecosystem dynamics monitoring

Finally, the UDP journey enter the phase of *Operation and Utilisation*, realizing its desired functionality and performance. This phase entails the incremental evolvement of the UDP based on e.g. innovation, and the changes in the needs and data supply in the city. For this, it is essential that the UDP performance is continuously monitored and combined with insights from the monitoring of the city data ecosystem to proactively cope with its previously mentioned dynamic nature. Additional activities include the promotion of the UDP for new users and suppliers, and the training of these potential users and suppliers to benefit from the UDP.

Challenges to cope with:

- Have the flexibility to adapt a UDP according to its performance, by engaging in the continuous loop of UDP evolvement.
- During the operational phase of a UDP it may proof a challenge to populate the UDP with sufficient and relevant data; to convince the citizens and stakeholders of the value of publishing data as open data on the platform; and to generate the desired amount of business models and traffic on the UDP use side. This requires an important role for the UDP manager to nurture and motivate the users and suppliers of the UDP, proportional to the need therefor, along the lifecycle of the UDP.

This development guide is generic and based on the lessons learned from the three RUGGEDISED cities. As summarised in section 2.2 each of these cities faces different challenges and therefore takes a different route and starting position in developing their UDP. Figure 6.3 depicts the position of the UDP in the city of Rotterdam's digital ecosystem. The open urban platform and 3D digital twin connects the digitalisation policy (inside out approach) with the smart city policy (outside in approach), building upon a digital foundation in the municipality.
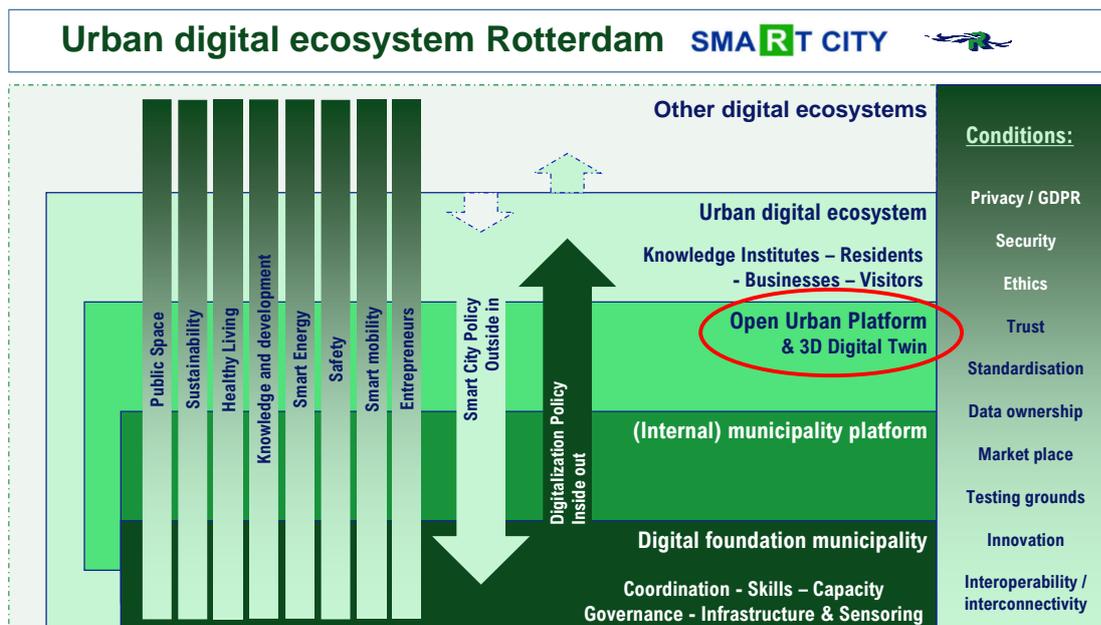

Figure 6.3 – The developmental position chosen by the city of Rotterdam (Municipality of Rotterdam)

6.4 Further Research

The research underlying this report set out to answer several questions including:
- What are UDPs?
- How should they be governed?
- What are drivers, inhibitors, and enablers?
- What is the state of play in Europe?

Our research greatly improved our understanding of UDPs, but several issues remain, some new questions came to the fore, and several assumptions have remained untested. The following practical and academic questions need further research.

(1) Will the triple bottom line nature of a UDP be a catalyst or showstopper for companies (that may or may not be seeking a dual purpose) to engage in their governance or want to connect their business model to it?
(2) How can trust be 'engrained' in the design and development process of a UDP?
(3) What does ecosystem nurturing entail? Does it differ from ecosystem orchestration? And what makes these processes specific in the context of UDPs?
(4) Do we really understand why we want citizens to engage with UDPs? What role do we see and facilitate for them: consumers, entrepreneurs, co-creators, participants in a democracy, or subjects to be nudged? What mechanisms can be used to get citizens engaged?
(5) What is the role of a UDP in the data ownership debate, particularly considering monetizing (personal) data?
(6) What is the root cause of the dichotomous thinking about the nature of UDPs as just 'another IT project' versus 'vital public infrastructure'? What criteria should drive the decision making regarding these options? What new legislation is needed, if any, in either case?
(7) If the UDP is going to fulfil the by some envisioned role of vital public infrastructure in a data driven world, how will they be positioned and regulated in order to 'hold their ground' in a winner-takes-all platform landscape? (Feld, 2019).
(8) How will municipality driven UDPs co-exist with pure commercial platforms and where are potential collaboration synergies?

Several assumptions underlying our research remain untested. We therefore recommend some further research is required to validate the following assumptions.

(1) Are UPDs indeed the right mechanisms to scale Smart City initiatives and can we find empirical evidence for this?
(2) Can we provide evidence for the four characteristics (see section 5.1) that make Smart City business models specific?
(3) What are the risks of assuming that public value creation with UDPs is predominantly best left in the hands of government?

Finally, our overall recommendation for further research is that the conceptual model, that provided the structure for this report and underlies our thinking about UDPs is tested through e.g. surveys, case studies and longitudinal research. Figure 6.3 represents the same conceptual model we showed in chapter one (Figure 1.10) but now with all the details that we have discussed throughout the report. Each of the sub-components of this conceptual model require further investigation in the context of urban data platforms.
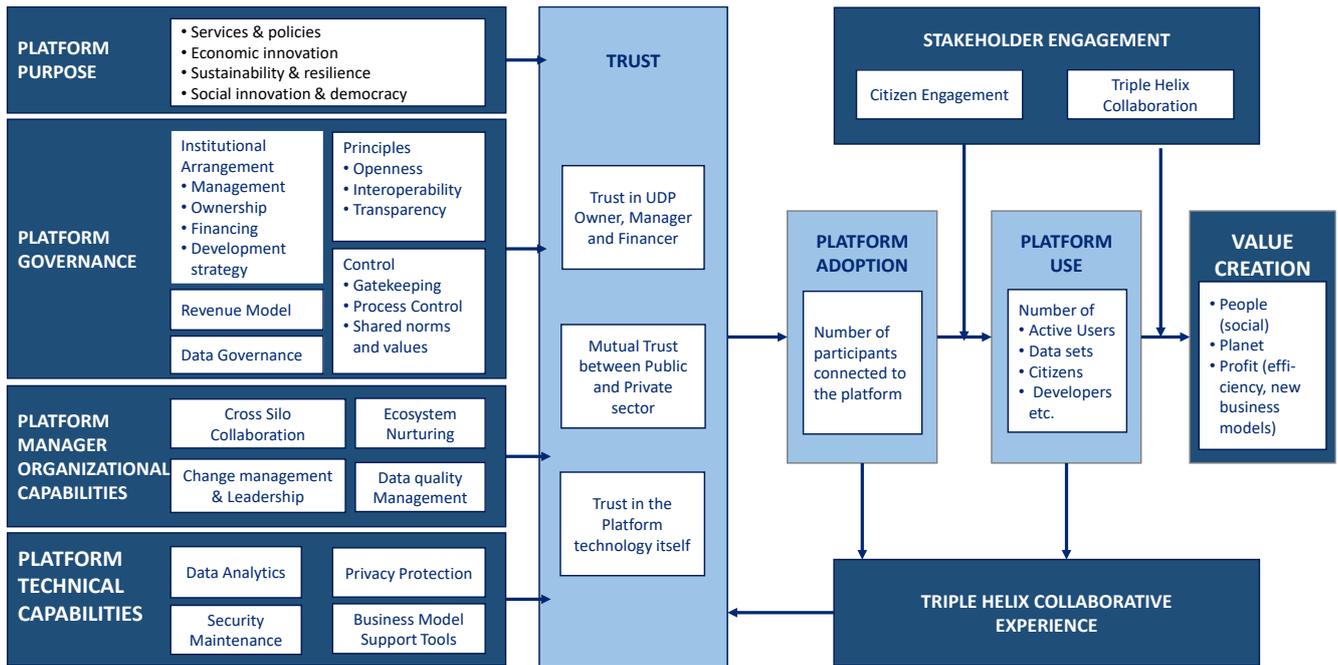
Figure 6.3 – Detailed conceptual framework for value creation in Urban Data Platform Ecosystems

Going forward it will be interesting to see if this conceptual framework for value creation works for practitioners designing, governing and participating in UDP ecosystems. Trust which has been defined as the central concept in the framework, is elusive in both theory and practice, and warrants much more context specific research and theoretical grounding. The current conceptual framework helped to describe the state of play for UDPs in Europe well, as demonstrated by this report. However, much more theoretical and empirical work is needed to validate and strengthen the framework, so that we fully understand UDPs: why we need them, what they are, and how they work. Once we learn how to design, build and run UDPs and their ecosystems well, they will become an important and integral part of Europe's digital future.

*   *   *

UDPs are systems that will transform cities by enabling access to data and thus creating public value across a wide variety of domains. It is easy to get intimidated and paralyzed by their vast potential, risks and opportunities, and by their technical and organisational complexity. However, the only way to start learning is to start doing. This is the best way to understand what a UDP is really all about and how it can be exploited. Start with a part of the organisation that is most likely to build the capacity for true platform management. Start small scale, but never lose sight of the big picture! This is a necessary bottom-up approach that only works with a simultaneous top-down approach.

Get started. The sooner the better!

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Appendices

Appendix 1: Survey participants

The research underlying this report comprises two surveys (2018 and 2019), a Delphi study with global experts from the public and private sector (2020), and sixteen Master Thesis projects (2018 – 2020, see Appendix 4). The research instruments used can be found in a separate Addendum to this report. Please find below the combined list of participants of both surveys.

| Position	Organization	City / region
Technical expert CityxChange project	Alba Iulia Municipality	Alba Iulia
Project manager	Gesnaer consulting	Albacete
Director of Administrative Services	Municipality of Alexandroupolis	Alexandroupolis
Owner	Duurzaam Bouwloket (DBL)	Alkmaar
Senior information specialist	City of Amsterdam	Amsterdam
Professor	Amsterdam University of Applied Science	Amsterdam
EU advisor	Gemeente Amsterdam	Amsterdam
Enterprise Architect / Program Manager Smart Zone	Digipolis	Antwerp
Manager Open Data Barcelona	Ajuntament de Barcelona	Barcelona
Coordinator	Barcelona City Council	Barcelona
Consultant	VSassociati	Bassano del Grappa
Expert leader	Senatsverwaltung für Wirtschaft, Energie und Betriebe des Landes Berlin	Berlin
Advisor at the Mayor's Office	City Hall of Bilbao	Bilbao
Project manager smart city	Bordeaux Métropole	Bordeaux
Project manager	Bristol is Open	Bristol
GIS specialist	Brno CIty Hall	Brno
Data Analyst	Brno CIty Hall	Brno
head of project management	Municipality of Budapest	Budapest
managing director	CEURINA Central European Urban Research and Innovation Nonprofit Association	Budapest
Project coordinator	Municipality of Burgas	Burgas
Executive Director	Cluj-Napoca	Cluj-Napoca
Plattform Operator	[ui!] – the urban institute®	Cologne
Project manager	Cologne	Cologne
Development Consultant	Copenhagen Municipality, City Data Dept.	Copenhagen
Project manager	The City of Copenhagen	Copenhagen
Project Officer	Derry City and Strabane District Council	Derry City and Strabane District Council
Manager eGovernment and IT services to citizens	DonostiaTIK-San Sebastian City Council	Donostia/San Sebastian

Position	Organization	City / region
Manager smart City	City of Dresden	Dresden
Project coordinator	City of Eindhoven	Eindhoven
PhD	Technival University Eindhoven	Eindhoven
Director of EU Coordination Centre	Tepebaşı Municipality	Eskişehir
Project manager	City of Essen	Essen
Manager urban planning	Câmara Municipal de Évora	Évora
Energy manager	Evora Municipality	Évora
New business manager	PACT	Évora
Chief Data Officer	Comune di Firenze	Florence
IT Manager	Florence	Florence
Chief Data Officer	Ghent CIty Council	Ghent
Group Manager - City Energy & Sustainability	Glasgow City Council	Glasgow
Development leader Digital Services	City of Gothenburg, consumer and citizen services	Gothenburg
IT-strategist	City of Gothenburg, Environmental dep.	Gothenburg
IT Project manager	Urban Transport Authority, City Of Gothenburg	Gothenburg
European Projects Responsible	Granada Energy Agency	Granada
Head of EU-Unit	City of Graz - EU-Unit	Graz
Project manager	GREENALP	Grenoble
Consultant	CGI	Groningen
Geo-IT specialist	Municipality of Groningen	Groningen
Head of Urban Data Hub Hamburg	Free and Hanseatic City of Hamburg	Hamburg
Program Director	Forum Virium Helsinki Oy	Helsinki
Project Manager	Municipality of Helsinki	Helsinki
lead expert	Lechner Knowledge Center	Hungary (various cities)
Programme manager, climate actions	Municipality of Kerava	Kerava
Manager programming office	Municipality of Kozani	Kozani
Electrical Engineer	Municipality of Kozani	Kozani
Enterprise Architect	Linköpings kommun	Linköping
Director	Lisbon Urban Management and Intelligence Center	Lisboa
Energy manager	Litoměřice	Litoměřice
Senior Manager - City Data	Greater London Authority	London
Deputy Inspector	Lublin City Office	Lublin
Quality Manager	Município da Maia	Maia
Officer Principal Resources and Programmes	Manchester City Council	Manchester
Officer Mayor's Office	Mestna občina Maribor / Municipality of Maribor	Maribor
Technician	Municipality of Matosinhos	Matosinhos
Project manager Digital	Métropole de Lyon	Lyon
Interoperability Architecture management office responsible	Municipality of Milan	Milan
Consultant IoT	Municipality of Milan	Milan

Position	Organization	City / region
Senior specialist	Municipality of Milan	Milan
Analyst-monitoring officer	Municipality of Miskolc	Miskolc
IT Strategy for Smart City	City of Munich	Munich
Enterprise Architect	Municipality of Nantes Metropole	Nantes
Project manager mySMARTLife Nantes	Municipality of Nantes Metropole	Nantes
IT Unit director	Municipality of Nice	Nice
Project manager Remourban project	Nottingham City Council	Nottingham
Director ICT, GIS and Data	City of Ostend	Oostende
Coordinator smart city and EU projects	City of Ostend	Oostende
Project manager	City of Oulu	Oulu
Head of IT	City of Pamplona	Pamplona
Energy expert	Municipality of Parma	Parma
ICT manager	Municipality of Parma	Parma
Head of Urban Platform, Data Analysis and Digital Services	Associação Porto Digital	Porto
Officer European Affairs	Rennes Metropole	Rennes
Chief Data officer	City of Reykjavik	Reykjavik
Urban Planning Expert	City of Riga | Riga Municipal Agency "Riga Energy Agency"	Riga
Consultant Energy Efficiency	OV Group	Roma
Program manager Digital City of Rotterdam	Municipality of Rotterdam	Rotterdam
Productmanager Digital City Rotterdam	Municipality of Rotterdam	Rotterdam
Innovation manager	City of Saint-Quentin	Saint-Quentin
Manager smart strategy and sector Specialisation	San Sebastian	San Sebastian
Director General Innovación Tecnológica	Ayuntamiento de Santa Cruz de Tenerife	Santa Cruz de Tenerife
General Coordinator	Ayuntamiento de Santa Cruz de Tenerife	Santa Cruz de Tenerife
Technical Innovation Manager	Santander City Council	Santander
CIO	Skellefta municipality	Skellefteå
Project Coordinator	Energy Agency of Plovdiv (EAP)	Smolyan
Managing director	ProjectZero	Sonderborg
Project Coordinator	University of Stavanger	Stavanger
Site Manager	City of Stockholm	Stockholm
Department manager	Landeshauptstadt Stuttgart, Stadtmessungsamt, department geo information and maps	Stuttgart
Project manager	Municipality of Suceava	Suceava
Project Coordinator	City of Tampere	Tampere
Project manager	Sustainable Tampere 2030	Tampere
Director	Business Tampere	Tampere
Project manager	Tartu City Government	Tartu
Project manager	ICT Partner City of Tartu	Tartu
Chief Data Officer	City of The Hague	The Hague

Position	Organization	City / region
Assistant project manager	Municipality of Trento	Trento
Technology Manager	Fondazione Bruno Kessler	Trento
Project manager	Umeå kommun	Umeå
Innovation strategist CIO	Municipality of Utrecht	Utrecht
Coordinator of MAtchUP project	Las Naves, Municipality Valencia	Valencia
Project Coordinator	Municipality of Valencia	Valencia
Coordinator Data Governance	City of Vienna	Vienna
Specialist Smart City Projects	City of Warsaw, Digitalization Departm.	Warsaw
Head of Smart City Projects Division	City of Warsaw	Warsaw

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Appendix 2: Urban data business model framework

The following business model framework complements the one presented in section 5.3, particularly by giving more detail on the "data" component of the business model framework.
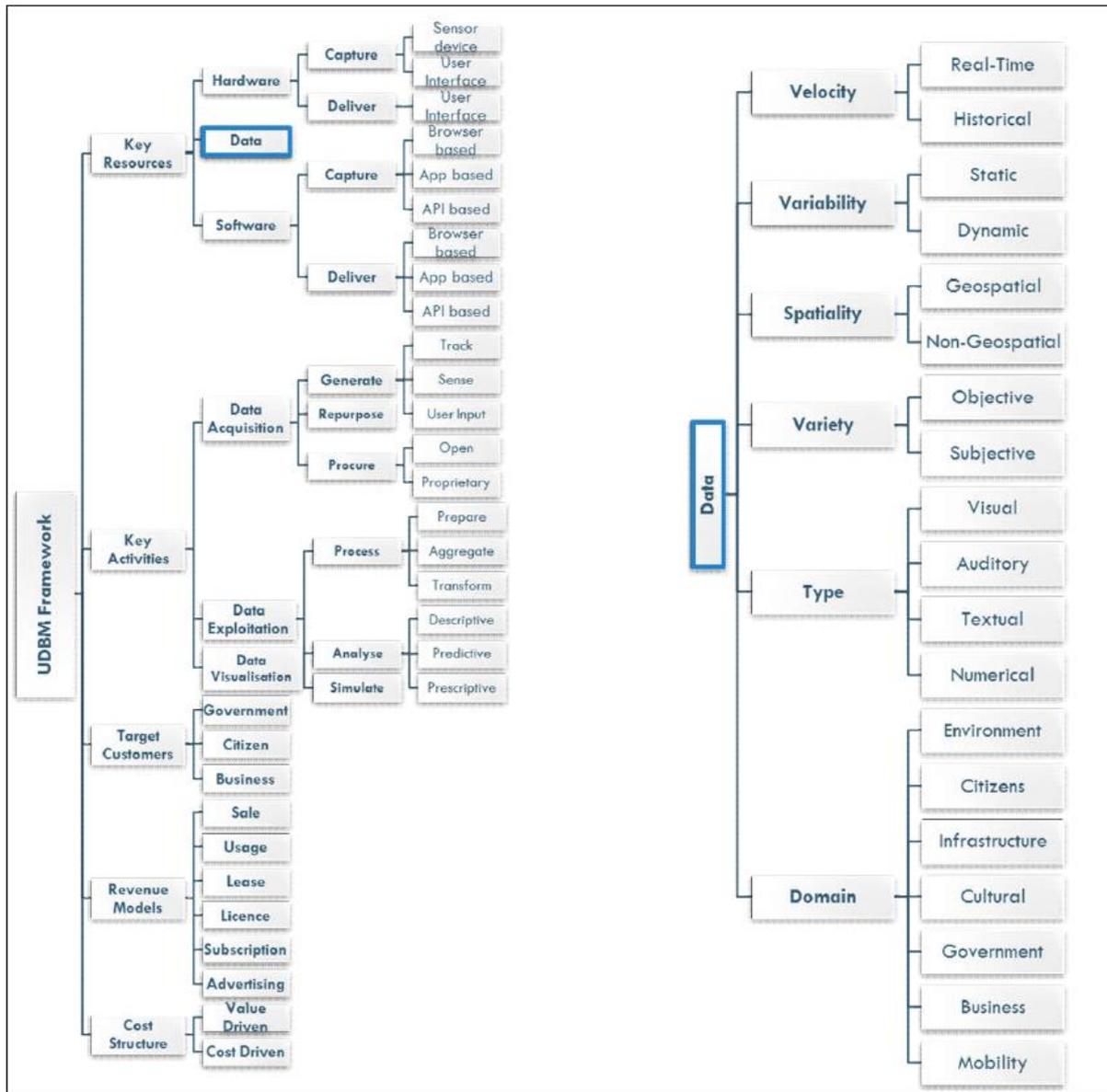
Source: Mcloughlin et al. (2018) **Urban Data Business Model Framework**

Appendix 3: Data Governance recommendation for a RUGGEDISED City

Van den Berg (2020) developed some specific data governance recommendation for the municipality of Rotterdam, who is planning to develop a UDP in close collaboration with the market. An independent committee with data stewards is therefore recommended, something which is seen less often in cities where the municipality is the platform owner.

Data Governance Design Process	In the data governance program, at least the following dimensions should be included: Data Quality, Open Data, Security, Privacy, Roles and Responsibilities Data Use, Data Management and Data Ethics. Besides, Interoperability of data should also receive attention in the program.
	The data governance program should be designed in an agile process. This means that the program should be designed in a small group, with an iterative, case-by-case approach. Besides, the content of the program should regularly be tested at a bigger audience of stakeholders.
Data Quality	Standards for data quality should be fit-for-purpose.
	Data sources must provide accurate descriptions of data quality in the metadata. A feedback system should be in place to reward high-quality data quality descriptions.
Privacy	Applications, databases and other mechanisms should all follow the principle 'privacy-by-design', or when this is not in place, 'privacy-by-default'.
	All stakeholders should ensure compliancy to the GDPR or other relevant legislation. In the following cases, extra attention needs to be paid to whether legislation is being followed: • When AI/Machine Learning is used • When the GDPR can possible be outdated due to the novelty of an application • When just complying to the legislation does not ensure ethical behaviour
Open Data	The principle regarding open data should be 'open data, unless'. In the basis the 'unless' applies: • For personal data • For commercial data • When conflicting interests exist
	Stakeholders should indicate available data sets in a data index on a data marketplace
	Data should be made available via the data marketplace, when the demanding party meets the right conditions, set by the data owner.

Security	The principle for data storage on the Urban Data Platform should be 'as minimal as possible'. Three exceptions on this principle exist: • When data storage on the platform increases performance of applications • When historical patterns are necessary to extract value from data, and this data is not stored at the source • When the data source does not have the resources to store data itself. This can also be a business model for the UDP
	A committee with data experts should be installed, and the municipality should be represented in this committee
Data Use	Stakeholders need to be fully transparent towards usage of personal data, unless the 'unless' of 'open data' unless applies. In that case, stakeholders should regularly be checked by data stewards.
	A feedback mechanism to reward transparency should be in place.
Data Management	Stakeholders need to ensure that an organisational focus towards day-to-day operations around data are embedded in the organisational culture.
Data Ethics	Stakeholders need to take ethical considerations into account when using data. A feedback mechanism to reward ethical behaviour should be in place.
Role of Municipality	The municipality should be involved in the data governance design, as well in the data management, herewith ensuring that it takes a certain responsibility for data governance in the ecosystem.

Source: A van den Berg (2020)

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Public (PU)

Appendix 4: Overview EUR master thesis research on urban data platforms

1. Takacs (2018) Strategic options for Urban Data Platforms

2. Honcoop (2018) Urban Data Platforms to facilitate the development of new business models

3. Bos (2018) The Perceived Impact of GDPR Readiness on the Evolution of European Urban Data Platforms

4. Ouwerkerk (2018) Smart City Platform Interoperability and Vendor Lock-in

5. Ceric (2018) How do Strategy and Governance affect Citizen Engagement in Urban Platforms

6. Das (2018) Factors driving business stakeholders to collaborate in smart city ecosystems and the role of local government

7. Van der Nat (2018) Een Governance Perspectief op de toekomstige Opschaling van RUGGEDISED-initiatieven (in Dutch)

8. Blom (2019) Implications for Implementing Personal Data Vaults

9. Lisizki (2019) Assessing economic growth in the context of open data initiatives

10. Ramm (2019) Business Models of Organizations engaging with Urban Data Platforms

11. Vermeulen (2019) How do open data features impact third party App developer's propensity to contribute to the platform

12. Wu (2019) Antecedents of city operational agility

13. Gaffron (2020) The Role of Multi-Stakeholder Collaboration in Building Trust in Urban Data Platforms

14. Van den Berg (2020 Data governance in the smart city eco system

15. Holst (2020) Private-Public Partnerships for digital platforms: Finding the right governance model to increase adoption and use of Urban Data Platforms

16. Weber (2020) Crowdsensing Air Quality with Mobile Devices: a Mixed Methods Study on Usage Motivations and Barriers

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ADDENDUM Research Instruments

EUROPEAN COMMISSION

Horizon 2020

H2020-SCC-2016

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Deliverable No.	RUGGEDISED D6.6	**Addendum on Research instruments**	
Deliverable Title	**Governance, Trust and Smart City Business Models:** **the Path to Maturity for Urban Data Platforms**	
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Written By	Dr. Haydee Sheombar (Erasmus University Rotterdam) Dr. Marcel van Oosterhout (Erasmus University Rotterdam) Ir. Devin Diran (TNO) Dr. Samaneh Bagheri (Erasmus University Rotterdam) Dr. Claus Popp Larsen (RISE)	
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D6.6 – Governance, trust and smart city business models: the path to maturity for Urban Data Platforms - Addendum

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Project partners:
01 - GEMEENTE ROTTERDAM (ROT)- NL
02 - UMEA KOMMUN (UME) - SE
03 - GLASGOW CITY COUNCIL (GCC) - UK
04 - RISE RESEARCH INSTITUTES OF SWEDEN AB (RRI)- SE
05 - ISTITUTO DI STUDI PER L'INTEGRAZIONE DEI SISTEMI SC (ISSINOVA) - IT
06 - AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH (AIT) - AT
07 - NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO (TNO) - NL
08 - ICLEI EUROPEAN SECRETARIAT GMBH (ICLEI) - DE
09 - ERASMUS UNIVERSITEIT ROTTERDAM (EUR) - NL
10 - UMEA UNIVERSITET (UU) - SE
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16 - Ballast Nedam Bouw & Ontwikkeling Holding B.V. (BN) - NL
17 - ROTTERDAMSE ELEKTRISCHE TRAM NV (RET) - NL
18 - ENECO ZAKELIJK BV (ENE) - NL
19 – Koninklijke KPN NV (KPN) - NL
20 – AKADEMISKA HUS AKTIEBOLAG (AHAB) - SE
21 – VASTERBOTTENS LANS LANDSTING (VCC) - SE
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33 - GDANSKA INFRASTRUCTURA WODOCIAGOWO-KANALIZACYJNA SP ZOO (GIWK) - PL
34 - RISE ACREO AB (RA) – SE

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RUGGEDISED DELIVERABLE D6.6 | ADDENDUM

Research Instruments

"Governance, Trust and Smart City Business Models: the Path to Maturity for Urban Data Platforms"

Research Instruments developed by Erasmus University Rotterdam
Team led by Dr. Haydee Sheombar and Dr. Marcel van Oosterhout

Introduction to this Addendum

This document contains the research instruments that were used in this study. Please refer to the main report for the full description of our research activities, which comprised two surveys among European cities and a Delphi study among global experts.

- The first survey was conducted in the first half of 2018. About 30 cities responded to this broad exploratory sweep covering a wide range of UDP topics.

- The second more focused survey study was conducted among a representative sample of 80 cities in Europe, with in total 105 respondents. The study was executed in the period November 6, 2019 until January 10, 2020.

- A Delphi study was executed in the period February till April 2020. In the first round, a global panel of 30 experts from government, companies and other institutions, including academia, was consulted. The aim was to solicit from these experts their beliefs and rationale about the best way to govern UDPs.

- In the second round of the Delphi study, 20 of the original 30 experts participated. This questionnaire was designed to focus on key points that needed more deliberation to either establish consensus or to understand the disagreement among panel members.

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Survey 2018

Dear Sir / Madam,

As part of the SCC01 collaboration group *Task group Finance and Business Models & data management* we are conducting a European wide research about the state-of-the-art of Urban Data Platforms in Europe. To this purpose we would like to ask you as coordinator of …….. to forward this questionnaire to every participating city (lighthouse and fellow) in your project and for every city we look for a representative of the platform owner (usually the municipality) and platform operator to fill out the questionnaire.

The principle question underpinning this questionnaire is what it will take to help speed cities in deploying solutions that help digitize their services, and connect across them to extract the benefits of modern ICTs? The questionnaire forms a vital part of the European Innovation Partnership for Smart Cities and Communities, and specifically informs plans for the Integrated Infrastructure action cluster. The results will be analyzed, and insights made open among the SCC01 collaboration group and during the next EIP General Assembly 2018 on June 27-28, 2018 in Sofia. We will not make available individual responses; thus please complete the questionnaire openly and as best possible, to the benefit of the EU cities community!

Our basic assumption is that Cities will, with all probability, provide an Urban Data Platform on which most City Applications and Services will run, integrating data from the Internet of Things to other data sources. The urban data platform will be the main backbone that will vertebrate many existing sectorial systems (like Energy Efficient Buildings, Smart Grid, Intelligent Transport Systems, EHealth Systems) and many new applications and systems specifically designed for the City and running on the Urban Data Platform.

As the questionnaire follows the full development-cycle of an Urban Data Platform, encompassing all the main decisions about an UDP, completing it will provide you with a "comprehensive checklist" for developing your Urban Data Platform. Completing this questionnaire you will give you full access to the outcome of the research.

Completing the questionnaire takes about 30 to 40 minutes. At any point in time you can decide to save your answers, by answering YES to the question which is included at the end of every page. You will then receive an email with a link to your saved survey, which you can use to continue the survey at a later moment in time. You can also use this link to forward the survey to one of your colleagues, in case some questions cannot be answered by yourself. We have attached the full survey as PDF for your information. When filling in the questionnaire we will provide you with the opportunity to talk to some-one on the research team for clarification, guidance and if so desired, discussion.

Please complete the questionnaire in the coming three weeks before 27 April 2018. We will send a reminder in 2 weeks. We look forward to engage with you. If you have any questions please do not hesitate to contact us.

<<< START QUESTIONNAIRE : https://goo.gl/forms/BQKpafC7m1MgftDV2 >>>

Kind regards,

Dr Marcel van Oosterhout

Questionnaire Urban Data Platforms & Data Management

Questionnaire Sponsorship Information

This   questionnaire   is   conducted   under   the   guidance   of   the

SCC01 Collaboration Framework: Nathan Pierce, Programme director Sharing Cities
SCC01 Task group Finance and Business Models: Graham Colclough, partner Urban DNA
SCC01 Task group Data management: Albert Engels, Programme director Ruggedised

Execution of the Questionnaire by:

Rotterdam School of Management, Erasmus University*, partner in Ruggedised*
Prof. dr. Eric van Heck, Dr. Marcel van Oosterhout, Dr. Haydee Sheombar

Contact person Dr. Marcel van Oosterhout
Email: moosterhout@rsm.nl   Phone: + 31 (0)6-48632174

Respondent Details

EU project	
Name respondent	
Position	
Name of organization	
Represented city	
Email	
Phone	

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Public (PU)

Introduction Questionnaire

Many Smart Cities start with (pilot) projects that are confined to a specific vertical domain of the city, e.g. energy management or mobility. The EIP-SCC envisions Urban Data Platforms (UDPs) to cut horizontally across verticals, bringing cross-silo data (virtually) together in one platform that aims to foster ecosystem innovation and community building. This vision is based on the following two premises:

1. A truly smart city uses an Urban Data Platform to maximise the value from city data by managing data as an asset

2. Every Smart City project, apart from being scalable in its own right, must be able to connect to an Urban Data Platform sooner or later.

How do European cities envision the role of Urban Data Platforms in society? What role do they see for themselves in creating and using these platforms? What business and technical design choices have they made? And what are their in experiences and practices when implementing these platforms?

The objective of this questionnaire is to get an overview of state of the art of Urban Data Platforms in European Cities. You are kindly requested to answer the questions for your specific Urban Data Platform (UDP).
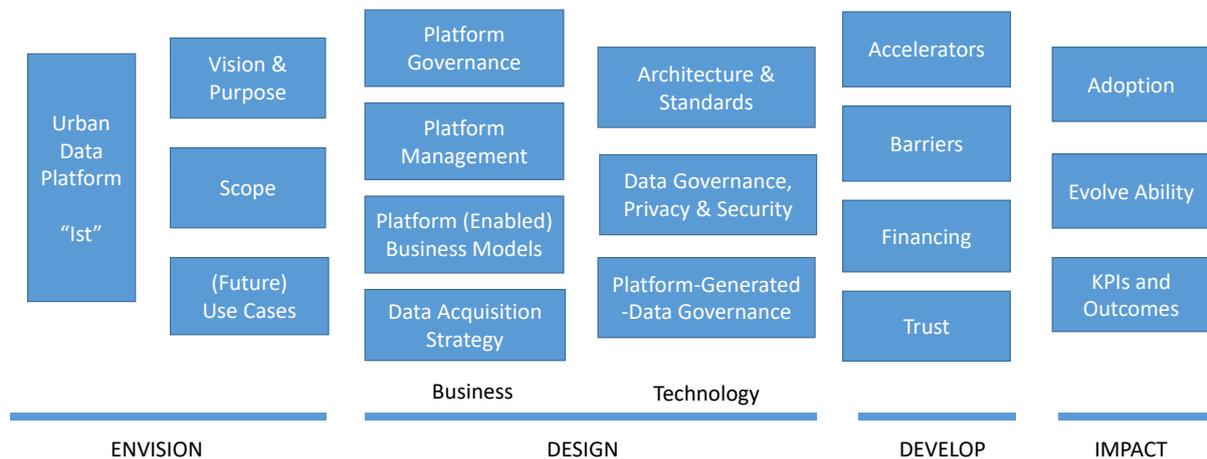
The questionnaire is structured in SIX parts that follow the platform life cycle:

1. IST: Current situation of the Urban Data Platform in your city
2. ENVISION: Vision & Purpose, Scope and Use Cases
3. BUSINESS DESIGN: Platform Governance, Business Models and Strategy
4. TECHNOLOGY DESIGN: Architecture, Data and Standards
5. DEVELOP: Accelerators and Barriers for adoption and financing the UDP
6. IMPACT: Expected impact and KPIs

Each part consists of an introduction and questions. The introductions aim to create a common "vocabulary" about Urban Data Platforms in order to increase the consistency of the answers across cities.

PART 1 – CURRENT SITUATION

INTRODUCTION

This part of the questionnaire focuses on the current situation of the Urban Data Platform (UDP) in your city. While part 2 gives a more detailed description of an Urban Data Platform, to answer the questions in Part 1 it suffices to understand the following definition of an Urban Data Platform:

> **"An Urban Data Platform exploits modern digital technologies to bring together (integrate) data flows within and across city systems and make data (re)sources accessible to participants in the cities' ecosystem"**

In its most rudimentary form the UDP can be an Open Data portal, and in its most sophisticated form a UPD includes a developer space and facilitates market transactions of commercial value propositions. In the next part we will introduce, for the purpose of this questionnaire, a "default" version of a UPD.

1.1 What stage of development are you currently at with your Urban Data Platform?

Please check a box and provide an optional comment

Development Stage	Check box	Comment
Exploring possibilities		
Planning: getting stakeholders on board and designing the UDP		
Building: actual construction of the digital manifestation of the platform is ongoing		
Implementing: making the platform available for use to participants		
Operational: first wave of participants on board (and further developments started)		

1.2 When did you start working on the Urban Data Platform, and what is your Platform called?

Please specify month and year   *Please specify the name of your Urban Data Platform*

1.3 What kind of participants are (foreseen to be) involved in the current version (vision) of the UDP?

Please check the box for the appropriate type of participant per Activity. Add other Activities if applicable

Activity	Local Government (Municipality)	Regional or central government	Busi-ness	Citi-zens	Other Participant (Please specify)
Exploring and planning the UDP					
Technical development of the UDP					
Investing in the UDP					
Providing data					
Consuming data & apps					
Developing apps on the platform					
Other activities					

PART 2 – VISION, PURPOSE AND SCOPE

INTRODUCTION TO URBAN DATA PLATFORMS

The premise of a UPD is that data is a resource that can be turned into (societal) value, through e.g. innovation, community building and ultimately the transformation of city services. The UDP does this by providing access to data from a variety of silos and data sources. Thus in general the **Core Interaction** that a UPD facilitates is to connect data sources and participants in a cities' ecosystem.

Participants on the platform either have the role of data providers, app producers (i.e. developers), data consumers, or app consumers. The term "data provider" covers a broad range of government, public sector, private sector or not-for profit organisations. Also individual **citizens** can provide data to the UDP – either direct of through a data broker – assuming privacy and trust considerations are met. A specific participant can have a combination of these roles.
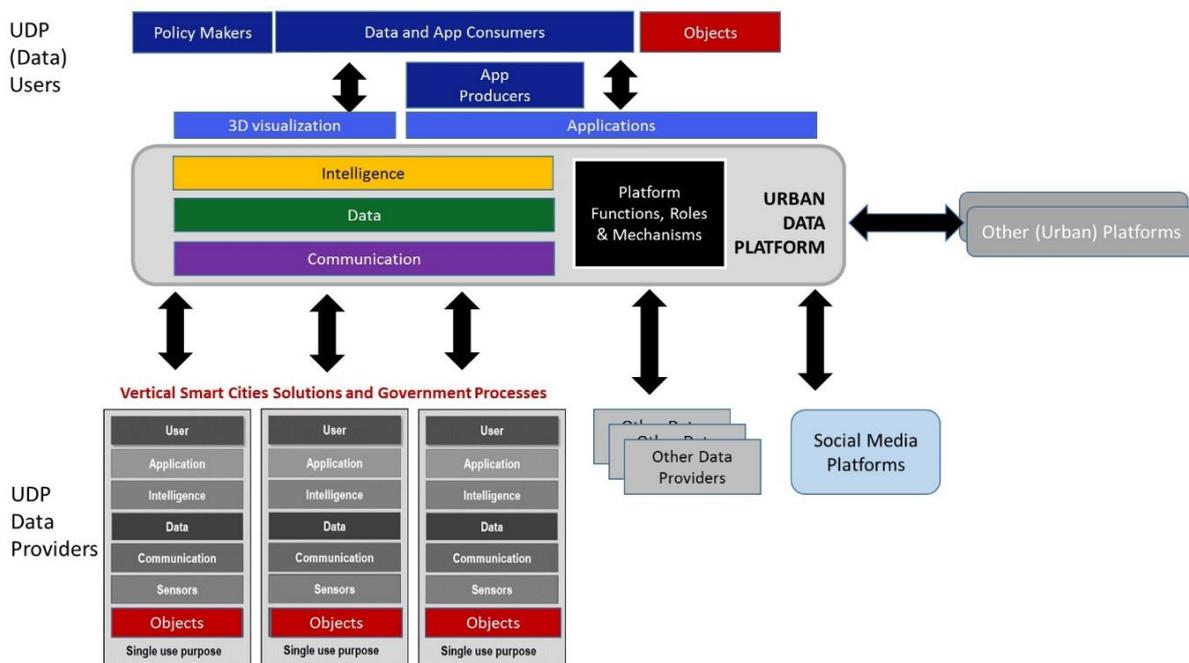
Figure – The Default view of an Urban Data Platform as used in this research

In the **default view** of a UPD for the purpose of this questionnaire, depicted in the figure above, applications that are developed "sit on top of" the data platform, and are hence not part of the data platform itself. A Platform Manager may choose to make these applications visible in an **application catalogue**. Of course the questionnaire (question 2.5) will investigate if cities have chosen other commercial platform designs, e.g. running and selling apps within the platform.

2.1. What is your opinion about the following premises about <u>your</u> Urban Data Platforms?

Please score the extent to which you agree or disagree with the follow statements

	Premise	Strongly --------------------------------Strongly Disagree Agree				
1	A truly smart city uses an Urban Data Platform to maximise the value from city data by managing data as an asset	1	2	3	4	5
2	Every Smart City project, apart from being scalable in its own right, must be able to connect to an Urban Data Platform sooner or later	1	2	3	4	5

2.2 Building on your answer to the previous questions, what is your vision for an Urban Data Platform?

Please provide your answer in the box below. You may also share a relevant link. 500 character(s) maximum

2.3 Why is your city developing an Urban Data Platform?

Please score the extent to which the purpose aligns with yours and optionally provide a comment

Purpose of your UDP	Strongly ----------------------------Strongly Disagree Agree					Optional Comment or link to a document
To make city operations more efficient and effective	1	2	3	4	5	
To engage and empower citizens and make the city more inclusive	1	2	3	4	5	
To stimulate entrepreneurship and innovation	1	2	3	4	5	
To meet the city's sustainability objectives	1	2	3	4	5	
To co-create city services and outcomes with business and citizens	1	2	3	4	5	
To increase security and public safety	1	2	3	4	5	
Other reason:						

2.4 What is the scope of the data platform you are developing?

Please check a box

MUNICIPALITY   OTHER ENTITIES IN CITY

☐ Scope 1: Across silos within the municipality

☐ Scope 2: Outside the municipality

☐ Scope 3: Ecosystem-wide platform
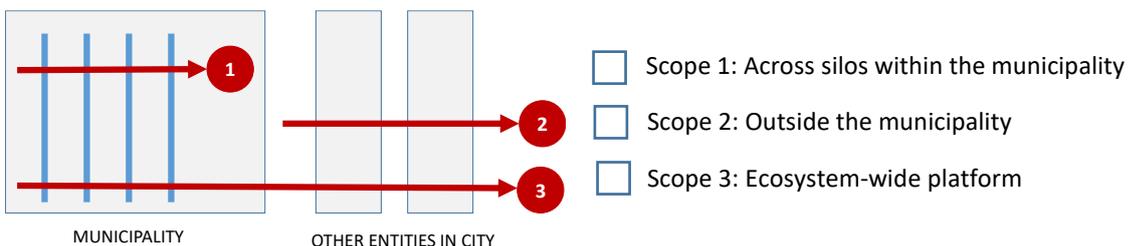
2.5 What is the Core Interaction that you envision to happen on the platform?

Please check all applicable boxes

Make data available to users in what is called an Open Data Platform	
Connect data users, app providers and data sources	
Connect buyers and sellers of data and applications through an application **catalogue**	

| Allow buyers and sellers of data and applications to trade on the platform through an **app store** (and share in the revenue). Optionally facilitating the trade through price setting market mechanisms | |
| Enabling the development of applications within the platform by providing a **Software Development Toolkit** (SDK). Selling these apps through the platform and sharing in the revenue | |

Other please specify

2.6 What use cases are or will be supported by the Urban Data Platform in the coming 3 years?

Data can be used in four distinctive ways. In order of increasing maturity: descriptive (what happened?), diagnostic (why did it happen?), predictive (what will happen?), prescriptive (how can we make it happen?). Furthermore please indicate if your use case employs 3D-visualisation and whether this visualisation is embedded within the UDP or that it is part of the application that "sits on top of" the platform.

Check all applicable Use Case Domains. More data usage options are possible per row.

Use Case Domain	Data Usage				**3D** Visua-lisation available	Please check this box if the 3D model is part of the UDP
	Descrip-tive	Diag-nostic	Predic-tive	Prescrip-tive		
Built environment						
Mobility & logistics						
Water & waste water management						
Energy						
Telecommunications						
Waste management						
Health(care) & Human service (e.g. permits)						
Public safety, Security and Emergency response						
Education & Skills						
Economic Development						
Sport, Leisure, Culture & Tourism						
Others, please specify:						

Please add any comment you may have about use cases here.

PART 3 – BUSINESS DESIGN: GOVERNANCE, BUSINESS MODELS AND STRATEGY

INTRODUCTION

Governance

In principle there are nine models of governance of a UPD. A governance model is defined here as the combination of platform ownership and platform management. The Platform Owner has the legal control over the platform technology and the intellectual property of the platform. This excludes ownership of the data provided by participants and the applications developed by app producers on top of the platform, unless agreed otherwise. The Platform Manager maintains, runs and develops the platform within the guidelines (however strict or loose) provided by the Platform Owner. In other words the Platform Manager executes the platform functions that are necessary to make the platform business model work. Each role can be taken by the local government (municipality), a private partner or via a public-private partnership (PPP).

Platform Business Models

The Business model for the platform itself consists of the contract between the Platform Owner and the Platform Manager, and the way the Platform Manager chooses to create value with the platform management functions and capture value from the platform. Other business models will be developed within the ecosystem of the platform as is depicted in the chart below.
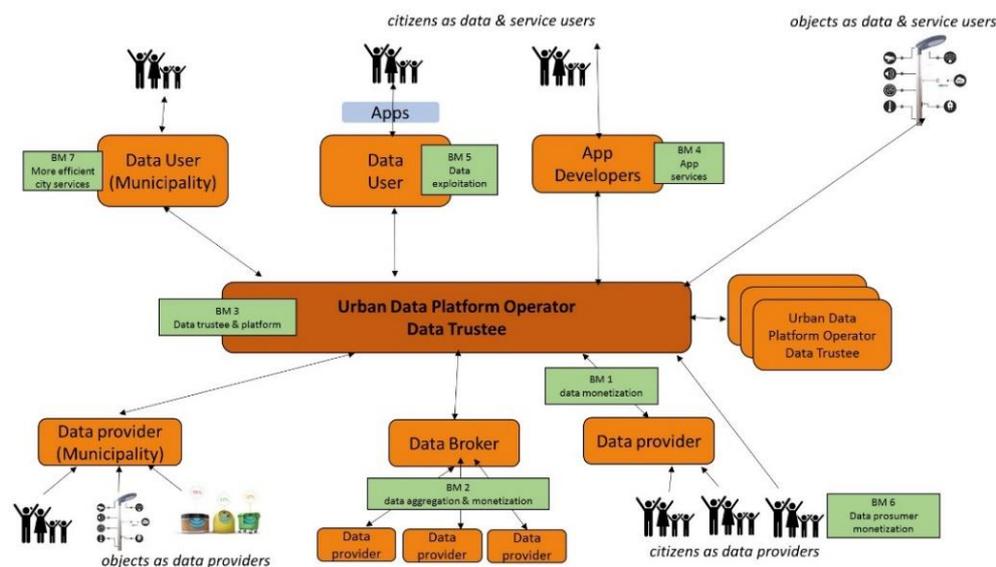
3.1 Platform Governance

What Governance model have you adopted?

Please specify the name of the parties involved

Who is the Platform Owner?	
Who is the Platform Manager?	
In case the Platform Owner and Platform Manager are different entities, what are the most important elements of the agreement between them? Can you please, if possible, share the agreement?	*Please paste link to agreement here*
Are you subcontracting the building of the UDP to a third party, i.e. systems integrator?	NO / YES
In case of YES, who is the Third Party subcontractor?	

3.2 Platform Management

The purpose of this part to explore the potential connection between openness of the platform and the adoption (performance) of the platform.

Openness

	Yes/No	If Yes, please specify
Are there any restrictions for data users willing to join to the platform?		
Are there any formal processes that one has to do when joining the platform as a data user?		
Is there a possibility for external data providers to join the platform?		
Are there any restrictions for data providers willing to join to the platform?		
Are there any formal processes that one has to do when joining the platform as a data provider?		

In your opinion, on a scale of 1-5, how easy it is for data providers to join the platform?
Very Hard   1   2   3   4   5   Very Easy
In your opinion, on a scale of 1-5, how easy it is for data users to join the platform?
Very Hard   1   2   3   4   5   Very Easy

3.3 Platform Incentives

Are there any incentives for data provider to join the platform and provide data to the platform?

YES   NO   *If YES, please specify.*

If yes, what are these incentives based on? Please check all boxes that apply.

The amount of data	The quality of data	The type of data	The source of data	Other Please specify

The urban data platform facilitates direction on data, which is provided to the platform (i.e. the data provider can define access rights to data and usage rights on what can be done with the data)

Strongly disagree 1   2   3   4   5   Strongly Agree

Are there any incentives for data users to join (and remain on) the platform?

YES   NO   *If YES, please specify:*

Is there a fee for acquiring / using data?   YES   NO

If yes, what is this fee based on?   *Please check all boxes that apply.*

The amount of data	The quality of data	The type of data	The source of data	Intentions with the data	Other Please specify .

3.4 Inclusivity of the innovation

In your opinion, how much the data users were involved in the platform specification and development?
Not at all   1   2   3   4   5   To all extent
In your opinion, how much the data providers were involved in the platform specification and development?
Not at all   1   2   3   4   5   To all extent
In your opinion, how flexible is currently the platform governance, to accommodate user needs?
Not at all   1   2   3   4   5   To all extent

3.5 Platform Business Models

This part will look at the Platform Business Model as well as at other external Business models that are enabled by the platform.

The UDP facilitates the development of new business models for third parties (such as App developers, who use data in the platform)

Strongly DISAGREE   1   2   3   4   5
            strongly AGREE

New business models have already been implemented, using data in the urban data platform

Strongly DISAGREE   1   2   3   4   5
            strongly AGREE

Comments:

```



```


There are dependencies among these business models

Strongly DISAGREE   1   2   3   4   5
            strongly AGREE

disagree

Comments:

```



```


Volume determines the success of an urban data platform

Strongly DISAGREE   1   2   3   4   5
            strongly AGREE

Comments:

```



```


Cross-city exchange between platforms is necessary for the success of an urban data platform

Strongly DISAGREE   1   2   3   4   5
            strongly AGREE

Comments:

```



```


Network effects contribute to the success of an urban data platform

Strongly DISAGREE   1   2   3   4   5
            strongly AGREE

Comments:

```

```

3.6 Platform Strategy

A core task of an Urban Data Platform is the acquirement of data that can then be offered to others on the platform. This data can be provided either by individuals or by data brokers who aggregate the data and then provide it to the platform. This part of the questionnaire will focus more specifically on the strategic decisions taken with regards to the stimulation of (individual) data sharing, as well as the communication of the 'rules' within the platform. If your platform is still in the planning phase please rate the statements in terms of whether they align with your plans for the platform.

There is a clear strategic guideline to follow when making decisions regarding the platform

Strongly DISAGREE   1   2   3   4   5
            strongly AGREE

The platform is designed to be intuitive for users of the platform

Strongly DISAGREE   1   2   3   4   5
            strongly AGREE

Is there a distinction made between different categories of users of the platform?   YES
            NO

Q1. If yes, what is this distinction based on? *Please check all boxes that apply.*

Demographic characteristics	Behavior on the platform	Data providers (individual) versus data brokers (aggregate)	Data providers versus app developers	Other Please specify

Q2. If yes, is a different version of the platform displayed depending on their category?   YES
            NO

Users of the platform are able to voice their concerns and provide recommendations regarding the platform

 Strongly DISAGREE   1   2   3   4   5
            strongly AGREE

There are valuable products or services developed specifically to attract individuals to share their data on the platform

Strongly DISAGREE   1   2   3   4   5
            strongly AGREE

The right of access to the data is clearly communicated to users within the platform

Strongly DISAGREE   1   2   3   4   5
        strongly AGREE

The conditions on re-use of the data are communicated clearly to parties that acquire the data

Strongly DISAGREE   1   2   3   4   5
        strongly AGREE

Subsets of data come with specific recommendations and potential uses for that subset

Strongly DISAGREE   1   2   3   4   5
        strongly AGREE

Subsets of data have different levels of access depending on the data included

        YES   NO

If they do, what determines the level of access a data user has? *Please check all boxes that apply.*

Specificity How specific is the data included	Sensitivity How sensitive is the data included	Type What type of data is provided	Providers The data providers choose who has access	Other Please specify:

Data providers are given a list of potential benefits that could result from providing the data to the platform

            YES   NO

If yes, is this list personalized (based on e.g. the type of data being provided)?
            YES   NO

3.7 Citizen involvement

Have citizens been consulted in the design of your UDP?

 [scale 1-5: not at all, barely, somewhat, a lot, too much]

Do citizens have a say in the amount and/or type of data collected from them by your UPD?

    [scale 1-5: not at all, barely, somewhat, a lot, too much]

How openly are citizens informed about (potential) privacy implications for their personal data?

    [scale 1-5: not at all, barely, somewhat, a lot, too much]

How intrusive do you consider your UDP with regards to citizens' privacy?

    [scale 1-5: not at all, barely, somewhat, a lot, too much]

Should citizens be informed about new functionalities and related extensions of data collection?
[answer options: yes/no/don't know]

Is your UDP available for use by individual citizens?

       YES   NO

If no, what are the objections to allow citizens to have access to the UDP?

If yes, in which way can individuals use the UDP?

What are you currently doing (e.g. training, promotion) to engage citizens?

PART 4 – TECHNOLOGY DESIGN: ARCHITECTURE AND DATA

INTRODUCTION

The architecture of an Urban Data Platform needs to dovetail with the vision of the UDP and its governance and business model. The upcoming GDPR legislation about data privacy offers both challenges and opportunities for organisations. This part of the questionnaire seeks to understand your choices about architecture and your readiness for GDPR.

4.1 Architecture & Standards

What approach best describes how your smart city is being developed (if neither, please explain in the subsequent open question)?

1	2	3
Bottom-up, demand driven individual use cases, may or will eventually be unified on a platform.	Combination of bottom up and top down	Top-down,overarching platform, allows for a variety of use cases (services) to eventually be on the platform

What are your reasons for this approach?

What situation best describes the envisioned result of your smart city (if neither, please explain in the subsequent open question)?

1	2	3
A data market where everyone can pull data from.		A digital community where everyone can use and develop services and applications.

What are your reasons for desiring this outcome?

What architectural framework best describes your smart city (if neither, please explain in the subsequent open question)?

1	2	3
An integrated and controlled system in which modules are documented and developed by a private party, guaranteeing the quality of these modules when working together (e.g. FIWARE).		A set of interface-related standards that are already widely in use, allowing other parties to develop their own products while accounting for these standards (e.g. ESPRESSO's MIMs and PPIs).

What are your reasons for choosing this architectural framework?

How likely do you think it is to encounter a vendor lock-in?
For example, if you are using four modules from one developer, how free are you to use a fifth module from a different developer? Similarly, if someone has developed an application for your platform, how free are you to use the data that this application has generated?

1	2	3	4	5
Very Unlikely				Very Likely

Please expand upon your reasons for choosing the above answer:
Perhaps you have taken certain measures to prevent a vendor lock-in from occurring, such as using design principles for certain components (e.g. infrastructure, data sources, service hubs, applications and services, users)?

Should you encounter a vendor lock-in, how high do you expect switching costs, in terms of time and money, to be?

1	2	3	4	5
Very Low **(time)** **(time)**				Very High

1	2	3	4	5
Very Low **(money)** **(money)**				Very High

4.2 Data Governance, Privacy & Security (GDPR)

How would you, in general, describe the degree of GDPR readiness in your organization?

Please check all applicable boxes

Our Urban Data Platform is not GDPR compliant	
We have done a risk analysis	
We have installed a Data Protection Officer	
We have done one or more Privacy Impact Assessments	
We make use of Privacy by Design	
We are fully GDPR compliant	

Privacy Protection Tools can be used to achieve trust among customers/citizens in the UDP. The platform owner can check if these protection tools are in place (within data providers) when these organizations supply data to the urban data platform or integrate these tools in the UDP itself.

Please Check the applicable box for each protection tool

Privacy Protection Tools	Part of the UDP	Check by the platform owner whether data providers applies these tools
Anonymity of data (pseudonyms)		
Presence of a privacy statement		
Presence of a security seals		
Information transparency towards data owners / citizens (who has access to which data and how is the data used)		

Gatekeeping is the degree to which the platform manager uses predefined criteria for what kind of data is allowed into the urban data platform so that the urban data platform can be GDPR compliant.

Please describe the degree in which gatekeeping is used as a control mechanism in the UDP
Very low   1   2   3   4   5   very high

Process control is the degree to which the platform manager hands out rewards or penalizes app developers based on the degree to which the app developers follow the development methods, rules, and procedures based on the GDPR regulations.

Please describe the degree in which process control is used as a control mechanism in the UDP
Very low   1   2   3   4   5   very high

Relational control is the degree to which the platform manager relies on norms and values that it shares with app developers to shape their behaviours.

Please describe the degree in which relational control is used as a control mechanism in the UDP
Very low   1   2   3   4   5   very high

4.3 Platform Generated Data

In the default description of a UDP as defined for this questionnaire, the platform manager does not have access to the content of the data streams on the platform. However the platform manager can generate management data from the interactions that are happening on the platform. We are interested in your views and policies about platform generated data.

Data generated on the platform based on platform interactions belong to the platform manager

Strongly disagree   1   2   3   4   5
          Strongly agree

If for whatever reason the platform manager has access to the data (this is not the default) he / she can generate insight and data by combining data sources.

Data generated by the platform manager through the combination of data sets that are exchanged on the platform (this is not the default) belong to the platform manager

Strongly disagree   1   2   3   4   5
          Strongly agree

PART 5 – DEVELOPMENT: BARRIERS, ACCELLERATORS AND FINANCING

INTRODUCTION

During the development of the UDP you may have encountered factors that where positive for the speed and ease of developing the platform (accelerators), as well as factors that inhibited the implementation (barriers). Financing of infrastructure solutions such as a UPD platform has its own complexities and is investigated in a separate question.

5.1 Barriers

What implementation barriers have you encountered / do you anticipate during the development of your UDP?

Please check all applicable boxes and provide any comments you may have (e.g. on the stage)

	Check Box	Severity of Barrier Scale 1 (very low) to 5 (very high)	Comment
Change management			
Risk management			
Investment solutions			
Procurement legislation			
Privacy legislation			
Lack of Business Case			
Contractual complexities			
Technical standards			
Technology defects			
Political issues			
Skills			
Lack of Trust			
Cross silo/ org. collaboration			
Cultural and Social issues			
Others, please specify			

5.2 Accelerators

What factors have facilitated and / or accelerated the implementation of the UDP?

Please check all applicable boxes.

Accelerator	Check box	Acceleration Very weak1 – 5 (very strong)	Comment
Subsidies, Grants			
Legislation			
Citizens' actions			
Policy commitments			
Political sponsorship			
Standards & Protocols			
Private sector drive			
Other, please specify			

5.3 Trust

Trust in the UDP is a complex mix of trusting the security of the platform, the risks of using the platform and interacting with other participants in the ecosystem, and the trust that is placed in the Platform Manager and the Platform Owner. Trust in the latter parties is combination of their integrity, capability and the perception that they have the best interest of the platform participants at heart.

Please indicate the importance of the factor and give an estimation of current performance perceived by the participants

TRUST	Importance (scale 1 – 5) 1= not important 5=very important	How do participants of the platform perceive its performance (scale 1 – 5) 1=poor 5=excellent	Comment
Platform Security			
Risks of Using the platform			
Trust in Platform Owner			
Trust in Platform Manager			
Trust in data quality of the platform			

Have you measured (any proxy) of the trust participants have in the platform?   YES

NO

Can you please comment on the difference between a public and private entity in terms of Trust in the Urban Data Platform?

5.4 Financing and Funding of the Platform

One of the known barriers in developing UDPs is their initial financing and funding. A business case (based on a sound business model) is often an essential first step in allocating financial means and securing funding.

What is the status of the business case for your UPD?

Please provide a description and share a link if possible

Is there a shared value case encompassing cost and benefits of multiple ecosystem stakeholders?

YES   NO

In case of "YES" please comment

What does the overall investment look like?

Amount of Investment	EURO

Please detail the investment per investor

Investor	Amount (in EUROs)
Local Government / Municipality	
Business	
European Commission	
Investment fund	
Commercial bank	
Development bank	
Other	

What financing models are in place or planned?

Please describe – if applicable – the financing models you use and or provide a link to a document

What are the sources of finance?

Sources of Finance	Currently in play	Under consideration Please comment on pros and cons
Internal financing from capital budget		
Internal financing from operating budget (possibly shared x-organisations / departments)		
Public Grant of Competition Funds		
Industry Research Development & Innovation investment		
Industry Public Private Partnership		
Market funds (loan, project, equity, concession)		
Other		

Conditions for bankability and strengthening of credit quality of UDP

Please describe – if applicable – whether the following conditions for bankability are applicable to the development of the UDP and how they are met

Conditions	Applicable	Explanation
Third party guarantees	Yes / No	
Inherently stable and predictable cash flow	Yes / No	
Predictable and stable cash flow through long-term contracts	Yes / No	

Conditions	Applicable	Explanation
Large amounts of pledge able collateral / fixed assets	Yes / No	
Low leverage (i.e., equity is a substantial part of balance sheet)	Yes / No	

What investor categories are you considering? (e.g. (Investment) Banks, Pension funds, Insurance Co.'s)

PART 6 – IMPACT

INTRODUCTION

The current and potential impact of your Urban Data Platform can be measured in various ways. First of all the current state of Adoption is a good predictor of future platform use and impact. The Evolve ability of the platform needs to be at the right level to allow your platform to grow. Key Performance Indictors (KPIs) are used to measure the current (technical) performance of the platform. The impact of the platform, is measured in terms of Outcomes, i.e. the extent to which city management, city service delivery, and citizen engagement are improved.

6.1 Adoption of the UDP

Adoption of the Platform

How many applications there are on the platform (estimated)?						
How long did it take you to get these application on the platform?						
How many participants are there are on the platform?						
	Data providers					
	Developers of Applications (using the platform)					
	End users					
How long did it take you to get these participants on the platform?						
How would you rate the adoption of the platform? Very Low	1	2	3	4	5	Very High
To what extent is the adoption of the platform fulfilling your preliminary expectations? Very Low	1	2	3	4	5	Very High

Maturity of the platform

	Yes/No
Do you consider the platform users early adopters?	
Do you consider the platform mature?	
Do you consider the business model of the platform sustainable?	

6.2 Evolve ability

Being able to grow and evolve the platform by adding e.g. new features, participants and functionalities is a critical success factor in the early stages of a platform. This evolve ability consists of three factors. Please indicate how you currently perform for each of these factors.

Resilience can be explained as the capacity of a subsystem to function acceptably in the event of a failure elsewhere within or outside the ecosystem. **How do your rate the resilience of your Urban Data Platform?** Very Low	1	2	3	4	5	Very High

Composability is the ease with which changes can be made within a subsystem without compromising its reintegration with the ecosystem

How do your rate the Composability of your Urban Data Platform?

Very Low   1   2   3   4   5   Very High

Scalability is the degree to which a subsystem can maintain its performance and function, and retain all its desired properties without a corresponding increase in its internal complexity

How do your rate the Scalability of your Urban Data Platform?

Very Low   1   2   3   4   5   Very High

6.3 KPIs and Outcomes

Do you use a specific performance measurement framework to assess the performance and impact of the UDP?

Please check box and provide comment if applicable

No		
Yes, we use City keys (http://www.citykeys-project.eu/)		
Yes, other, namely		

What are the most important KPIs (key performance indicators) you use to assess (technical) platform performance?

Please specify KPIs and Outcomes and / or provide a link to a document

What are the KPIs you use to assess whether your UDP has enabled your city to become more smart and sustainable (i.e. outcomes that transform how the city is managed, city services are delivered, and citizens are engaged)?

Please specify KPIs and Outcomes and / or provide a link to a document

What are your criteria for success for your UDP

Please specify

-END-

Survey 2019

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Designing smart, resilient cities for all

Questionnaire Urban Data Platforms & Data Management

Welcome to this questionnaire about Urban Data Platforms (UDPs) and the urban data ecosystem in your city. Completing the questionnaire takes around 30 minutes.

On behalves of the SCC01 collaboration Task Groups Business Models & Finance, and Data Management, Erasmus University is conducting a European wide research about the state-of-the-art of UDPs in Europe. The research explores "**what it will take to help speed cities in deploying solutions that help digitize their services, and connect across them to maximise the benefits of modern ICTs?**"

Please complete the questionnaire openly and to the best of your abilities, for the benefit of the EU cities community!

Please also note that individual responses will remain confidential and reporting will only be based on aggregated responses. We ask for personal data only to be able to contact you if we have specific questions on your answers. All data will be processed in compliance with GDPR legislation.

- o   I consent that my data will be processed in accordance to the above mentioned statement

Please note that Qualtrics will only **record your answers** once you press the right arrow button to switch to the next page. In case you do not want to finish the survey within one sitting, **please enable cookies** and access the survey again through the same browser once you return. The progress of participants using a **personalized link** will **automatically be saved**. A summary of your responses will be sent to you after you have completed the questionnaire. By completing this questionnaire, you will be **granted full access to the outcome** of the research.

Respondent Details

Name respondent*	
Position*	
Name of organization*	
Represented city *	
Email*	
Phone	
Participates in EU project:*	

Introduction

The premise of an UDP is that data is a resource that can be turned into (societal) value, through e.g. innovation, community building and ultimately the transformation of city services. The UDP does this by providing access to data from a variety of silos and data sources. In general, the **Core Interaction** that an UDP facilitates is to connect data sources and participants in a cities' ecosystem. **Participants** on the platform either have the role of data providers, app producers (i.e. developers), data consumers, or app consumers. The term "data provider" covers a broad range of government, public sector, private sector or not-for profit organisations. Also, individual **citizens** can provide data to the UDP– either direct of through a data broker – assuming privacy and trust considerations are met. A specific participant can have a combination of these roles.
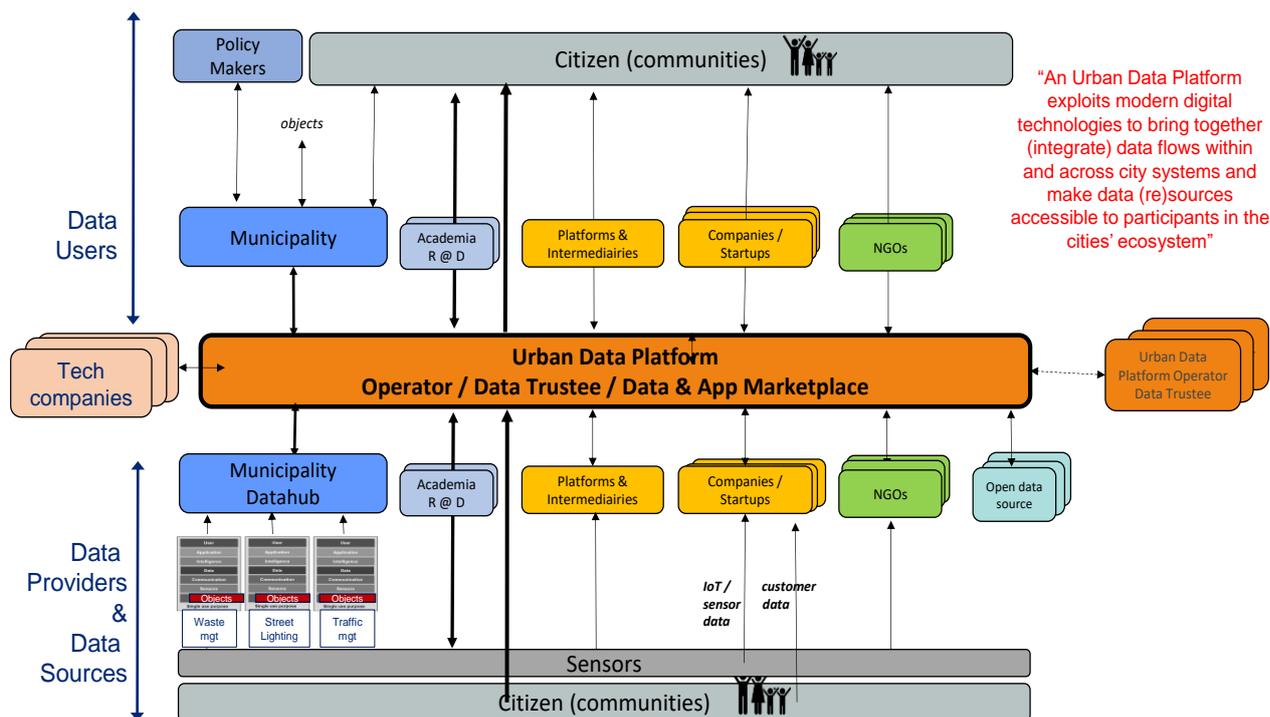
Figure – The view of an Urban data Platform (UDP) and the data ecosystem of a city as used in this research

In the **default view** of an UDP for the purpose of this questionnaire, depicted in the figure above, applications that are developed "sit on top of" the data platform, and are hence not part of the data platform itself. A Platform Manager may choose to make these applications visible in an **application catalogue**. Of course, the questionnaire will investigate if cities have chosen other commercial platform designs, e.g. running and selling apps within the platform.

You are kindly requested to answer the questions for your specific UDP. The questionnaire is structured in seven parts:

1. Current Situation and context
2. Governance and Stakeholder Involvement
3. Business and Technological Design
4. Enablers and barriers
5. Funding
6. Trust
7. Adoption, Performance and Impact

1. Current Situation and context

1.1 How would you characterize the predominant data ecosystem in your city?

Please select all options that apply.

MUNICIPALITY   OTHER ACTORS IN THE CITY
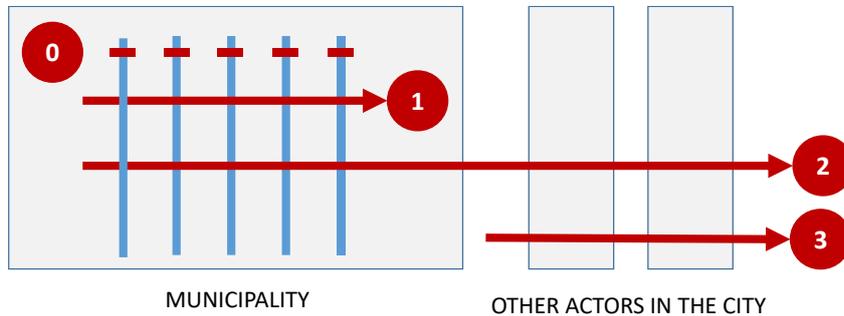
The graph above aims to visualize 4 different approaches to managing the data ecosystem.

Development Stage	Check box
0. No UDP, closed data (no sharing) in silos within the municipality	
1. Internal data platform within the municipality (across silos)	
2. UDP (across silos within municipality) and linking other stakeholders and data sources outside the municipality	
3. UDP, linking other stakeholders and data sources outside the municipality	

1.2 What stage of development are you currently at with your UDP?

Please select a single option

Development Stage	Check box	Comment
Exploring: Investigating possibilities		
Planning: getting stakeholders on board and designing the UDP		
Building: actual construction of the digital manifestation of the platform is ongoing		
Implementing: making the platform available for use to participants		
Operational: first wave of participants on board (and further developments started)		

Do you have any additional comment about the UDP's stage of development?

Please add any comment you may have about the development stage here

1.3 When did you start working on the UDP, and what is your Platform called?

Please specify month and year   *Please specify the name of your UDP*

1.4 What is purpose and objectives behind your UDP's strategy

Please rate the degree of importance to your UDP for each value.

Public Value	Not at all important – Extremely important				
Better informed decision-making by policy makers	1	2	3	4	5
Citizen Engagement	1	2	3	4	5
Co-create city services and outcomes with business and citizens	1	2	3	4	5
Democracy	1	2	3	4	5

Public Value	Not at all important – Extremely important				
Entrepreneurship and Innovation	1	2	3	4	5
Environmental sustainability	1	2	3	4	5
Facilitate economic growth	1	2	3	4	5
Guarantee inclusion and diversity	1	2	3	4	5
Liveability (e.g. combat loneliness)	1	2	3	4	5
More cost-efficient and effective city operations	1	2	3	4	5
Privacy and data security	1	2	3	4	5
Public Health (e.g. support elderly)	1	2	3	4	5
Public Safety	1	2	3	4	5
Reduce inequality	1	2	3	4	5
Resiliency of the city	1	2	3	4	5
To fight poverty	1	2	3	4	5
Other: _____	1	2	3	4	5

1.5 Where in your city is the UDP strategy executed?
Please select a single option.

	Check box
Separate staff unit, directly advising the City Council / Executive Board	
Part of the municipality's IT department	
Part of another department within the municipality: _____	
Separate organizational unit outside the municipality _____	
Other, _____	

1.6 Does your city have a Chief Data Officer role?
Please select a single option.

- o   No
- o   Yes
- o   I don't know

If so, who does the Chief data officer report to? _____
What are the top three priorities for this role?
Please specify the priorities in descending order, starting with the most important priority.
1. _____
2. _____
3. _____

1.7 Which data sources and use cases currently are currently connected to your UDP?
Please select every functional domain if related data sources (such as sensor networks) are currently connected to the UDP (as data provider). Please also select every functional domain if there are use cases (i.e. applications and Apps) developed that use data and functions from the UDP.

Functional Domains	Data providers *functional systems and data sources currently connected to the UDP*	Data users *applications using data and functions from the UDP*
Built environment		
Mobility & logistics		
Water & waste water management		
Energy		

Telecommunications		
Waste management		
Health(care)		
Human service (e.g. permits)		
Social Benefits		
Public safety, Security and Emergency response		
Education & Skills		
Economic Development		
Sport, Leisure, Culture & Tourism		
Others, please specify		

Do you have any additional comments about use cases?

2. Governance and Stakeholder Engagement

2.1 What Governance model have you adopted?
Please specify the name of the parties involved

Who is the Platform Owner? Platform **Owners** have the legal control over the technology and the intellectual property of the platform. Ownership of the data provided by participants and the applications developed by app producers are excluded unless agreed otherwise.	Municipality Private partner Public-Private Partnership Other: _____
Who is the Platform Manager? Platform Managers maintain, run and develop the platform within the guidelines, provided by the platform owner. The manager executes the functions necessary to make the platform's business model work.	Municipality Private partner Public-Private Partnership Other: _____
Are you outsourcing the building of the UDP to third parties?	NO / YES/ I don't know

Optional if „other is selected": Who is the owner of the UDP?
Please specify

2.2 What role is public administration currently taking in the governance and organization of UDPs in your city?
Please score the extent to which the following statements apply to your city and your role as municipality in the development of the UDP

	Strongly --------------------------Strongly Disagree Agree					Optional Comment
Our municipality has limited role., it only focuses on legal tasks such as security and privacy of citizens	1	2	3	4	5	

Our municipality facilitates the development of an UDP. It provides some requirements for the design and acts as launching customer. The market remains in the lead	1	2	3	4	5	
Our municipality is the orchestrator in the development of the UDP. It is responsible for the governance of the UDP, it provides data and uses data from the UDP	1	2	3	4	5	
Our municipality owns the UDP and sees this as a public and not a market task	1	2	3	4	5	
Other role for the municipality: _____	1	2	3	4	5	

2.2.1 Do you have any additional comments about the role that public administration is currently taking in the governance and organization of UDPs in your city?

2.3 How is the platform manager governing and controlling the UPD?

Gatekeeping is the degree to which the platform manager uses predefined criteria for what kind of data is allowed into the UDP so that the UDP can be GDPR compliant.

Please describe the degree to which gatekeeping is used as a control mechanism in the UDP
Never, Sometimes, About half the time, most of the time, always

Process control is the degree to which the platform manager hands out rewards or penalizes users of the platform (such as app developers) based on the degree to which they follow the development methods, rules, and procedures based on the GDPR regulations.

Please describe the degree to which process control is used as a control mechanism in the UDP
Never, Sometimes, About half the time, most of the time, always

2.4 To which degree are citizen engaged with the UDP and the data ecosystem in your city?
Please specify the degree of applicability for each statement.

	not at all, a little, a moderate amount, a lot, a great deal				
Citizens have been consulted in the design of your UDP	1	2	3	4	5
Citizens have a say in the amount and/or type of data collected from them by your UPD	1	2	3	4	5
Citizens are informed about (potential) privacy implications for their personal data	1	2	3	4	5
The UDP is available for use by individual citizens	1	2	3	4	5
Gamification is used to engage citizens with the UDP	1	2	3	4	5
Citizens can co-decide on future functionalities and/or applications running on the UDP	1	2	3	4	5
Citizens are provided with means such as Apps, sensors to collect data (that can be a data source for the UDP)	1	2	3	4	5
Citizens are facilitated to develop Apps using data in the UDP	1	2	3	4	5
The UDP facilitates citizens to monetize their data	1	2	3	4	5

In case citizens have no access to the UDP, what are the objections to allow citizens to have access?

What are you currently doing (e.g. training, promotion) to engage citizens?

2.5 How are companies engaging and benefitting from the UDP?
Please answer these questions with companies as potential future data providers and users of the platform

Have companies been involved in the design of the UDP?
 [scale 1-5: not at all, a little, a moderate amount, a lot, a great deal]

Have companies been involved in the rules and standards of the UDP?
 [scale 1-5: not at all, a little, a moderate amount, a lot, a great deal]

Have companies been involved in the tools and services of the UDP?
 [scale 1-5: not at all, a little, a moderate amount, a lot, a great deal]

2.5.1 Do you have any additional comments about the engagement of companies with the platform?

3. Design: technical and business

3.1 How open is your platform?

In your opinion, how open is your platform ?				
Closed	2	3 partly closed, partly open,	4	Open for anyone
In your opinion, on a scale of 1-5, how easy it is for data providers (organizations providing data from their functional systems / sensor networks) to join the platform? Extremely difficult, somewhat difficult, neither easy nor difficult, somewhat easy, extremely easy				
How easy it is for <u>data users</u> to join the platform? *Data users are organizations that want to use data from the UDP to develop applications, using data and functions from the UDP.* Extremely difficult, somewhat difficult, neither easy nor difficult, somewhat easy, extremely easy				

3.2 Do you use open-data standards?
An **open data standard** is a set of specifications (or requirements) for how some sets of **data** should be made publicly available. Open non-proprietary data standards enable the free flow of information and support the convergence of emerging technologies within a single digital platform

- o   No
- o   Yes
- o   I don't know

If yes, which ones? _____

3.3 How interoperable is your UDP?
 Interoperability is the ability of two or more components or systems to exchange information and to use the information that has been exchanged. The use of open standards such as O-MI and O-DF provide service interoperability, they provide the structure and common language for vendor-neutral conformance.

Please indicate the degree of interoperability.

Not interoperable	1	2	3	4	5	fully interoperable

3.4 What architectural framework have you used in developing the UDP?
We define **smart city IT architecture** framework as a series of principles, guidelines or rules used to direct the process of acquiring, building, modifying and interfacing IT resources throughout the smart city.

3.5 How would you characterize this architectural framework?

1	2	3
An integrated and controlled system in which modules are documented and developed by a private party, guaranteeing the quality of these modules when working together	A set of interface-related standards that are already widely in use, allowing other parties to develop their own products while accounting for these standards.	Other ….

If other is selected:
Please specify the characterization of the architectural framework.

3.6 What were your reasons for choosing this architectural framework?

3.7 What core interaction is currently support by the platform and what do you envision to happen on the platform in the future?
Please check all applicable boxes

	Currently supported by the platform	Envisioned to be supported by the platform
Make data available to users in what is called an Open Data Platform		
Connect data users, app providers and data sources		
Visualize data in a **3D digital twin** of the city		
APIs for platform services e.g. analytics, business case modelling, security, etc		
Connect buyers and sellers of data and applications through an application **catalogue**		
Allow buyers and sellers of data and applications to trade on the platform through an **app store**.		
Facilitate trade through **price setting market mechanisms**		
Enabling the development of applications within the platform by providing a **Software Development Toolkit** (SDK).		
Selling Apps through the platform and share in the revenue		
Other please specify,_____		

3.8 Is the UDP facilitating new business models and new social and civic models?
Please indicate the degree to which each statement accurately describes the UDP.

The UDP facilitates the development of new business models for third parties (such as app developers, who use data in the platform).
not at all, a little, a moderate amount, a lot, a great deal

3.9 New business models have already been implemented, using data in the UDP.

not at all, a little, a moderate amount, a lot, a great deal

3.10 The UDP facilitates the development of new social and civic models for third parties (such as neighbourhood groups, who use data in the platform).
not at all, a little, a moderate amount, a lot, a great deal

3.11 New social and civic models have already been implemented, using data in the UDP.
not at all, a little, a moderate amount, a lot, a great deal

3.12 What type of business models are in use by companies, linked to the UDP?

Business Model	Currently supported by platform	Envisioned to be supported by the platform
Barter / data for data (data provider receives access to other data in return)		
Data monetization (data provider is paid for sharing data)		
Advertising business models		
Licence model (pay for a service or app)		
Pay per use model (pay depending on how much a service or App is used)		
Freemium model (App or service is free, additional features require payment)		
Other, _____		

3.13 How sophisticated is your UDP (or the use cases/Apps that make use of the platform) in terms of analytics?

The UDP supports…	
…descriptive analytics (=looking back and analysing what happened)	Strongly Disagree 1 2 3 4 5 Strongly agree
…diagnostic analytics (=looking back and explaining why something happened)	Strongly Disagree 1 2 3 4 5 Strongly agree
…predictive analytics (= make predictions of what is expected to happen) for assistance in decision making of its users	Strongly Disagree 1 2 3 4 5 Strongly agree
…prescriptive analytics (=make predictions of what is expected to happen and prescribe certain actions) for assistance in decision making of its users	Strongly Disagree 1 2 3 4 5 Strongly agree
How complex are models used for analytical processes? Please indicate the degree of complexity.	Extremely easy, somewhat easy, neither complex nor easy, somewhat complex, extremely complex

4. Enablers and barriers

During the development of the UDP you may have encountered factors that where positive for the speed and ease of developing the platform (accelerators), as well as factors that inhibited the implementation (barriers).

4.1 What external factors have facilitated and / or accelerated the implementation of the UDP or likewise caused a barrier for the implementation?
Please check all applicable boxes and provide any comments you may have (e.g. on the stage)

Factor	How do you evaluate the factor in your city context? Scale 1 (strongly restricts) …3 (neutral) … to 5 (strongly stimulates and accelerates)	Comment why
(Open data) standards & Protocols	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	
Business Case	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	
Citizens' actions and involvement	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	
Contractual complexities	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	
Cultural and social issues	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	
Cyber security risks	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	
Data ethics and societal concerns	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	

Factor	How do you evaluate the factor in your city context? Scale 1 (strongly restricts) …3 (neutral) … to 5 (strongly stimulates and accelerates)	Comment why
Digital literacy of end users	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	
Legislation	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	
Political commitment / sponsorship	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	
Privacy legislation	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	
Private sector drive	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	
Procurement legislation	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	
Subsidies, Grants	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	
Triple helix collaboration (Industry-Academia-Government)	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	
Trust among the involved partners	1 (strongly restricts) … 3 (neutral) …5 (strongly accelerates)	
Others, please specify		

4.2 Capabilities

How do you assess the importance and current maturity of the following capabilities of your organization?
Please indicate the applicable degree for each statement and dimension

Generic Capability	Importance (scale 1 – 5) 1= not important 5=very important	Current maturity and level of development within municipality (scale 1 – 5) 1=very poor 5=excellent
Change management and leadership	1 2 3 4 5	1 2 3 4 5
Cross silo/ organizational collaboration	1 2 3 4 5	1 2 3 4 5
Data governance	1 2 3 4 5	1 2 3 4 5
Data security	1 2 3 4 5	1 2 3 4 5
Cross silo data quality management	1 2 3 4 5	1 2 3 4 5
Development in short cycles / agile approach	1 2 3 4 5	1 2 3 4 5
Enabling an open innovation ecosystem	1 2 3 4 5	1 2 3 4 5
Innovation process management skills	1 2 3 4 5	1 2 3 4 5
Learning by doing	1 2 3 4 5	1 2 3 4 5
Risk management: processes and tools	1 2 3 4 5	1 2 3 4 5
Others, please specify _____	1 2 3 4 5	1 2 3 4 5

5. Investment and funding

5.1 What approach is taken to justify investment in the UDP?

	Check box
Seen as core critical infrastructure (no / limited detailed business case is needed)	
Requires detailed stand-alone business case	
Business case is combined with other city infrastructure or services (e.g. smart lampposts)	
Other, _____	

5.2 What are the <u>current</u> source(s) of funding the development of the UDP?

Sources of funding	Please indicate percentages with integers, the total should amount to 100.
Internal financing from capital budget	
Internal financing from operating budget (possibly shared x-departments)	
Public Grant or Competition Funds	
Industry Research Development & Innovation investment	
Industry Public Private Partnership	
Market funds (loan, project, equity, concession)	
Crowdfunding	
Other,_____	

5.3 How likely do you think will be the use of the following (alternative) sources of funding for the (further) development of the UDP?

Sources of funding	Please indicate your preference
Internal financing from capital budget	extremely unlikely 1 2 3 4 5 extremely likely
Internal financing from operating budget (possibly shared x-departments)	Very unlikely 1 2 3 4 5 Very likely
Public Grant of Competition Funds	Very unlikely 1 2 3 4 5 Very likely
Industry Research Development & Innovation investment	Very unlikely 1 2 3 4 5 Very likely
Industry Public Private Partnership	Very unlikely 1 2 3 4 5 Very likely
Market funds (loan, project, equity, concession)	Very unlikely 1 2 3 4 5 Very likely
Crowdfunding	Very unlikely 1 2 3 4 5 Very likely
Other	Very unlikely 1 2 3 4 5 Very likely

6. Trust

Trust in the UDP is a complex mix of trusting the security of the platform, the risks of using the platform and interacting with other participants in the ecosystem, and the trust that is placed in the Platform Manager and the Platform Owner. Trust in the latter parties is combination of their integrity, capability and the perception that they have the best interest of the platform participants at heart (benevolence).

6.1 Which measures are important and have you used to enhance trust among the involved stakeholders in your UDP?
Please rate the importance of the given factors and indicate which have already been applied to your UDP.

Measures to ensure / proof the integrity of the platform manager	Which measures are important to enhance trust among the involved stakeholders in your UDP? (scale 1 – 5) 1= not important 5=very important	Have you used any of the following measures to enhance trust among the involved stakeholders in your UDP? Y / N
Charter describing the key principles of the data ecosystem and data platform	1 2 3 4 5	
Privacy statement / compliancy to GDPR / E.g. through Anonymity of personal data (pseudonyms)	1 2 3 4 5	
Security 'seal of approval' A **trust seal** demonstrates that an online entity is legitimate and concerned, taking an active role, in managing online security and protecting identity	1 2 3 4 5	
External data governance and ethics board	1 2 3 4 5	
Information transparency dashboard towards data owners / citizens (who has access to which data, how is the data used providing control to the data owner)	1 2 3 4 5	
Having a fully integrated data management plan, that describes in depth how data is managed, what security measures are taken and how data ethics is guaranteed	1 2 3 4 5	

Please add any comment you may have about the how you enhanced trust in the platform

6.2 How would you rate the following aspects with regards to building trust?
Please indicate the importance of the factor and give an estimation of current performance perceived by the participants

TRUST	How important are the following aspects in building trust? (scale 1 – 5) 1= not important 5=very important	How do participants of the platform perceive the performance of the following aspects? (scale 1 – 5) 1=poor 5=excellent	Comment
Platform Security	1 2 3 4 5	1 2 3 4 5	
Risks of Using the platform	1 2 3 4 5	1 2 3 4 5	
Trust in Platform Owner	1 2 3 4 5	1 2 3 4 5	
Trust in Platform Manager	1 2 3 4 5	1 2 3 4 5	
Trust in data quality of the platform	1 2 3 4 5	1 2 3 4 5	

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7. Adoption and Performance

How many applications are there on the platform (? Please specify the number as an integer.	
What percentage of your citizens are currently using the platform?	__ %
How many existing companies are connected to the platform?	
How many start-ups and spin-offs have emerged from using the platform?	
How would you rate the overall adoption of the platform by data providers? Very low, Low, Medium, High Very High	
How would you rate the overall adoption of the platform by data users? Very low, Low, Medium, High Very High	
What has helped achieve adoption? Please feel free to indicate your opinion and share your experience. _____	

What are the most important KPIs you use to measure the <u>impact and success of the UDP on the city</u>? (i.e. Outcomes that transform how the city is managed, which city services are delivered, and how citizens are engaged)?
Please specify KPIs and outcomes and / or provide a link to a document

Are you available to collaborate in a comparative case study on UDPs?
One of our master students will contact you and arrange an interview via phone.

- Yes
- No

Please note that by clicking the right arrow button below, you will submit your answers irrevocably.*
- I consent to submit my responses

Thank you very much for taking the time to fill out the Questionnaire UDPs & Data Management 2019! Please feel free to contact us in case you have any questions.

COLOFON

This questionnaire is conducted under the guidance of

EIP-SCC Marketplace Integrated Infrastructure Action Cluster - Graham Colclough, partner Urban DNA
SCC01 Board of Coordinators: Philippe Fournand, Wavestone
SCC01 Task group Finance and Business Models: Graham Colclough, partner Urban DNA
SCC01 Task group Data management: Albert Engels, Programme director Ruggedised, City of Rotterdam

Execution of the Questionnaire by:

partner in Ruggedised

Dr. Marcel van Oosterhout
Dr. Haydee Sheombar
Julia Holst
Dr. Tobias Brandt
Prof. dr. Liesbet van Zoonen
Prof. dr. Eric van Heck

In case of enquiries, please contact:

Julia Holst
Research Assistant RUGGEDISED
Email: 74078jho@eur.nl

END

Delphi Round 1

Delphi Study

Start of Block: Default Question Block

Q1 Browser Meta Info
Browser (1)
Version (2)
Operating System (3)
Screen Resolution (4)
Flash Version (5)
Java Support (6)
User Agent (7)

Q2
Delphi Study on Urban Data Platform & Data Management
 A European-wide study conducted by Erasmus University Rotterdam

Dear Panel Member,
 Welcome to this study about the governance of Urban Data Platforms (UDPs). To understand UDP governance mechanisms we are consulting a panel of selected experts like yourself from academia, the public, and private sector. The study is conducted in two rounds. In the first round, we cast a wide net on the subject of UPD governance. After analyzing your responses we will issue a second, shorter and more focused questionnaire. The objective of this second round is to validate points of consensus among the panel members and explore the topics of disagreement.

 The purpose of this research is to:
 (1) inform policy makers and business developers to craft the right strategy, scope and reach for an UDP and its ecosystem
 (2) give city and industry executives the confidence to act and collaborate.

Completing the questionnaire takes around 30 minutes.

 After the description of an UDP, we present you with statements related to evaluate, some of which are accompanied by a box for you to give some free format comments. We encourage you to use the free format comments due to the exploratory nature of this study.
 Please complete the questionnaire openly and to the best of your abilities, for the benefit of the EU, global cities and their communities. **Please also note that individual responses will remain confidential. We ask for personal data only to be able to contact you if we have specific questions on your answers. All data will be processed in compliance**

with GDPR legislation.

○ I consent that my data will be processed in accordance to the above mentioned
statement* (1)

Page Break ───

Q3 **Details about respondent**

○ Name* first and last name (1)

_____

○ Email* (2) _____

○ Position* (3) _____

○ Organization* (4) _____

Q4 **Which sector do you associate with?**

○ Governmental Institution (1)

○ Company (2)

○ Non-Governmental Organization (3)

○ Academic Institution (4)

○ Other (5)

Display This Question:

If Which sector do you associate with? = Other

Q5 **Which other sector do you associate with?**

_____

Page Break ——————————————————————————————————————

Q6 **What is an Urban Data Platform?**

"An Urban Data Platform exploits modern digital technologies to bring together (integrate) data flows within and across city systems and make data (re)sources accessible to participants in the cities' ecosystem" Please note that city systems are not confined to municipal systems, but include systems and data of all possible actors in the cities' ecosystem (see figure). These actors may supply and sell data to the platform or build new business models on top of the platform. An Urban Data Platform should not be confused with an Open Data Platform which generally provides a unilateral source of open government data.

To explore this further, this study is structured into the following 5 sections

1) Governance
2) Platform Purpose
3) Value Creation
4) Scaling
5) Trust

Page Break

Q7 **1. Governance**

 Governance is a multi-facetted concept comprising norms, decision making processes principles and institutional arrangement (WEF 2019). The institutional arrangement of an Urban Data Platform is defined by two aspects: ownership of the platform and the day-to-day management of the platform, e.g. determining the rules and standards for the platform. The actual building and hosting of the platform can be subcontracted to a third party, regardless of the governance arrangement chosen. The nine possible governance arrangement options are shown in the matrix, where "Joint PP Set-up" refers to a public-private arrangement e.g. a PPP, a third-party entity or a data trust. In your opinion, what is the appropriate form of governance for an Urban Data Platform?

Q8 **Ownership of Urban Data Platforms should be...**
Please click and drag the button to the respective position you want to assign.

○ ...taken on by the local government (1)

○ ...taken on by joint private-public set-up (2)

○ ...taken on by the market (3)

Q9 **Management of Urban Data Platforms should be...**
Please click and drag the button to the respective position you want to assign.

○ ...taken on by the local government (8)

○ ...taken on by joint private-public set-up (11)

○ ...taken on by the market (12)

Q10 **Urban Data Platforms are best initiated by the market...**
Please select all answers that apply

☐   because government lacks the knowledge and skill to run them (1)

☐   because competition is the best way to make Urban Data Platforms successful (2)

☐   do not agree (3)

Display This Question:

> *If Urban Data Platforms are best initiated by the market... Please select all answers that apply = do not agree*

> *Or Urban Data Platforms are best initiated by the market... Please select all answers that apply = because competition is the best way to make Urban Data Platforms successful*

> *Or Urban Data Platforms are best initiated by the market... Please select all answers that apply = because government lacks the knowledge and skill to run them*

Q11 **What are other reasons for markets (not) to initiate an Urban Data Platform?**

_____

_____

_____

_____

_____

Q12 **Urban Data Platforms are best initiated by the Government...**
Please select all answers that apply

☐   to counterbalance the power of private sector big tech platforms (1)

☐   because an Urban Data Platforms must create public value (2)

☐   do not agree (3)

Display This Question:

> *If Urban Data Platforms are best initiated by the Government... Please select all answers that apply = do not agree*
>
> *Or Urban Data Platforms are best initiated by the Government... Please select all answers that apply = because an Urban Data Platforms must create public value*
>
> *Or Urban Data Platforms are best initiated by the Government... Please select all answers that apply = to counterbalance the power of private sector big tech platforms*

Q13 What are other reasons for governments (not) to initiate an Urban Data Platform?

_____

_____

_____

_____

_____

Q14 **Urban Data Platforms are vital public infrastructure.**
Please indicate to which extend you agree with the statement

○ Strongly agree (22)

○ Somewhat agree (23)

○ Neither agree nor disagree (24)

○ Somewhat disagree (25)

○ Strongly disagree (26)

Display This Question:

> *If Urban Data Platforms are vital public infrastructure. Please indicate to which extend you agree w... = Strongly agree*
>
> *Or Urban Data Platforms are vital public infrastructure. Please indicate to which extend you agree w... = Somewhat agree*
>
> *Or Urban Data Platforms are vital public infrastructure. Please indicate to which extend you agree w... = Neither agree nor disagree*
>
> *Or Urban Data Platforms are vital public infrastructure. Please indicate to which extend you agree w... = Somewhat disagree*
>
> *Or Urban Data Platforms are vital public infrastructure. Please indicate to which extend you agree w... = Strongly disagree*

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Q15 **Cloud you please clarify your answer?**

_____

_____

_____

_____

_____

Q16 **In your opinion, how should Urban Data Platforms be financed?**

_____

Page Break

Q17 **2. Platform Purpose**
 In our study we use the following definition of an Urban Data Platform:
  "An Urban Data Platform exploits modern digital technologies to bring together (integrate) data flows within and across city systems and make data (re)sources accessible to participants in the cities' ecosystem"

Q18 **To what extent do you agree with our definition of an Urban Data Platform?**
 Please indicate to which extent you agree with the definition

○ Strongly agree (1)

○ Somewhat agree (2)

○ Neither agree nor disagree (3)

○ Somewhat disagree (4)

○ Strongly disagree (5)

Q19 **What would you like to add or change about our definition of an Urban Data Platform?**

_____

Q20 **In your vision, what should be the purpose of an Urban Data Platform?**

_____

Page Break ───

Q21 **3. Platform Value Creation**
 The figure below shows a Business Model Canvas for an Urban Data Platform. The triple bottom line consisting of financial, social and environmental costs and benefits is envisioned as a key characteristic of an Urban Data Platform business model, emphasizing the societal value that an Urban Data Platform should aim to create. Is this indeed the kind of value we are trying to create with Urban Data Platforms and what is the private and public sector response?

Q22 **The business model of an Urban Data Platform must facilitate a triple bottom line.**
Please indicate to which extent you agree with the statement

○ Strongly disagree (1)

○ Somewhat disagree (2)

○ Neither agree nor disagree (3)

○ Somewhat agree (4)

○ Strongly agree (5)

Q23 **Within the context of Urban Data Platforms, in the future, the private sector...**
Please select one answer

○ will always have a single bottom line because shareholder value maximization is the primary purpose (1)

○ will move towards a triple bottom line, to fulfill the responsibility to society at large (5)

○ other (6)

Display This Question:

*   If Within the context of Urban Data Platforms, in the future, the private sector... Please select on... = will always have a single bottom line because shareholder value maximization is the primary purpose*

*   Or Within the context of Urban Data Platforms, in the future, the private sector... Please select on... = will move towards a triple bottom line, to fulfill the responsibility to society at large*

*   Or Within the context of Urban Data Platforms, in the future, the private sector... Please select on... = other*

Q24 **Cloud you please clarify your answer?**

_____

Q25 **Within the context of Urban Data Platforms**, **in the future, the government will...**
Please select one answer

○ stick to the primary role of creating market conditions and leave innovation to the market (16)

○ use financial surplus generated from the Urban Data Platform to fund innovations that the private sector considers too risky (17)

○ other (18)

Display This Question:

*   If Within the context of Urban Data Platforms, in the future, the government will... Please select o... = stick to the primary role of creating market conditions and leave innovation to the market*

*   Or Within the context of Urban Data Platforms, in the future, the government will... Please select o... = use financial surplus generated from the Urban Data Platform to fund innovations that the private sector considers too risky*

*   Or Within the context of Urban Data Platforms, in the future, the government will... Please select o... = other*

Q26 **Cloud you please clarify your answer?**

_____

Q27 **In your opinion, what are the main incentives for private sectors to connect to an Urban Data Platform?**

Please rank the incentives by relevance. Drag and drop an item to the respective rank position you want to assign.

_____ Financial (1)

_____ Social (2)

_____ Environmental (3)

_____ Other (4)

_____ Other (6)

Q28 In your opinion, what are the main incentives for the government to connect to an Urban Data Platform?

Please rank the incentives by relevance. Drag and drop an item to the respective rank position you want to assign.

_____ Financial (1)

_____ Social (2)

_____ Environmental (3)

_____ Other (4)

_____ Other (8)

Q29 Are there any comments you have to clarify your answers on the topic of value creation?

_____

_____

_____

_____

_____

Page Break

Q30 **4. Scaling**

Smart City initiatives e.g. Smart Grids (energy solution) or Smart Mobility (mobility solution) have been around for more than a decade, but many of these initiatives fail to scale. Can an UDP be seen as a mechanism to connect sector-specific smart city initiatives and allow them to share data and users within cities? Should we go one step further and connect UDPs across cities requiring the platforms to be interoperable?

Q31 **Smart City initiatives will best flourish if they...**

Please click and drag the button to the respective position you want to assign.

	...remain focused and sector specific	...increase their scope and reach through an Urban Data Platform
	0 1 2 3 4	
1 ()	▬▬▬▮▬▬▬	
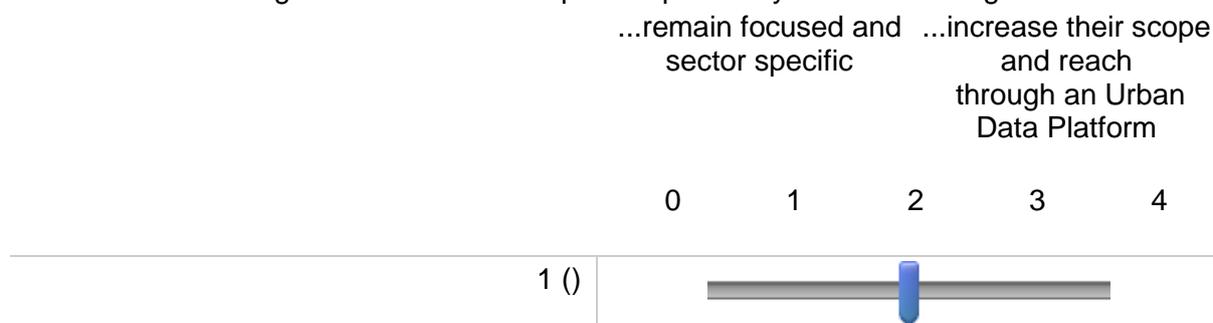
Q32 **At which level should an Urban Data Platform best be developed?**

Please select one answer

○ Local (Municipality/City) (2)

○ Regional (State/Province) (1)

○ National (Country) (3)

○ Multinational (across Countries) (4)

Display This Question:

> *If At which level should an Urban Data Platform best be developed? Please select one answer = Local (Municipality/City)*

> *Or At which level should an Urban Data Platform best be developed? Please select one answer = Regional (State/Province)*

> *Or At which level should an Urban Data Platform best be developed? Please select one answer = National (Country)*

> *Or At which level should an Urban Data Platform best be developed? Please select one answer = Multinational (across Countries)*

Q33 **Cloud you please clarify your answer?**

_____

Q34 **Cities need to collaborate and make Urban Data Platforms interoperable to be attractive for private sector actors to connect to.**
Please indicate to which extent you agree with the statement

○ Strongly disagree (25)

○ Somewhat disagree (26)

○ Neither agree nor disagree (27)

○ Somewhat agree (28)

○ Strongly agree (29)

Display This Question:

> *If Cities need to collaborate and make Urban Data Platforms interoperable to be attractive for priva... = Strongly disagree*

> *Or Cities need to collaborate and make Urban Data Platforms interoperable to be attractive for priva... = Somewhat disagree*

> *Or Cities need to collaborate and make Urban Data Platforms interoperable to be attractive for priva... = Neither agree nor disagree*

> *Or Cities need to collaborate and make Urban Data Platforms interoperable to be attractive for priva... = Somewhat agree*

> *Or Cities need to collaborate and make Urban Data Platforms interoperable to be attractive for priva... = Strongly agree*

Q35 **Cloud you please clarify your answer?**

_____

_____

_____

_____

_____

Q36 Another reason to make Urban Data Platforms interoperable is to share data between cities.

 Please indicate to which extent you agree with the statement

○ Strongly agree (1)

○ Somewhat agree (2)

○ Neither agree nor disagree (3)

○ Somewhat disagree (4)

○ Strongly disagree (5)

Display This Question:

If Another reason to make Urban Data Platforms interoperable is to share data between cities. Please... = Strongly agree

Or Another reason to make Urban Data Platforms interoperable is to share data between cities. Please... = Somewhat agree

Or Another reason to make Urban Data Platforms interoperable is to share data between cities. Please... = Neither agree nor disagree

Or Another reason to make Urban Data Platforms interoperable is to share data between cities. Please... = Somewhat disagree

Or Another reason to make Urban Data Platforms interoperable is to share data between cities. Please... = Strongly disagree

Q37 Cloud you please clarify your answer?

_____

Q38 Citizen Engagement is needed for Urban Data Platforms to become successful.
Please indicate to which degree you agree with the statement

○ Strongly agree (1)

○ Somewhat agree (2)

○ Neither agree nor disagree (3)

○ Somewhat disagree (4)

○ Strongly disagree (5)

Display This Question:

If Citizen Engagement is needed for Urban Data Platforms to become successful. Please indicate to wh... = Strongly agree

Or Citizen Engagement is needed for Urban Data Platforms to become successful. Please indicate to wh... = Somewhat agree

Or Citizen Engagement is needed for Urban Data Platforms to become successful. Please indicate to wh... = Neither agree nor disagree

Or Citizen Engagement is needed for Urban Data Platforms to become successful. Please indicate to wh... = Somewhat disagree

Or Citizen Engagement is needed for Urban Data Platforms to become successful. Please indicate to wh... = Strongly disagree

Q39 Could you please clarify your answer?

_____

Q40 Have you personally observed any of these strategies for developing UDPs in practice?
Please select all that apply

☐ **Inside-Out**: starting with the municipality and moving outwards (1)

☐ **Outside-In**: starting in the Market and later adding municipal data (2)

☐ **Bottom-Up**: starting with one Smart City sector and later adding other segments (3)

☐ **Top-Down**: starting with a sector agnostics platform and add sectors later (4)

Q41 According to your experience, how successful is the Inside-Out approach in developing the UDP?

○ Very successful (11)

○ Somewhat successful (12)

○ Not sure (13)

○ Somewhat unsuccessful (14)

○ Not successful at all (15)

Q42 According to your experience, how successful is the Outside-In approach in developing the UDP?

○ Very successful (1)

○ Somewhat successful (2)

○ Not sure (3)

○ Somewhat unsuccessful (4)

○ Not successful at all (5)

Q43 According to your experience, how successful is the Bottom-Up approach in developing the UDP?

○ Very successful (1)

○ Somewhat successful (2)

○ Not sure (3)

○ Somewhat unsuccessful (4)

○ Not successful at all (5)

Display This Question:

If Have you personally observed any of these strategies for developing UDPs in practice? Please sele... = Top-Down: starting with a sector agnostics platform and add sectors later

Q44 According to your experience, how successful is the Top-Down approach in developing the UDP?

○ Very successful (1)

○ Somewhat successful (2)

○ Not sure (3)

○ Somewhat unsuccessful (4)

○ Not successful at all (5)

Q45 How do you rate the importance of triple helix collaboration (Government-Industry-Academia) in the development of Urban Data Platforms along different

development stages?
Please check the applicable level of importance for each stage

|	Not at all important (1)	Slightly important (2)	Moderately important (3)	Very important (4)	Extremely important (5)
Exploring & Planning: Investigating possibilities and getting stakeholders on board and designing the UDP (1)	○	○	○	○	○
Building & Implementing: Actual construction of the digital manifestation of the platform is ongoing and making the platform available for use to participants (4)	○	○	○	○	○
Operational: First wave of participants on board (and further developments started) (6)	○	○	○	○	○

Page Break

Q46 **5. Trust**
 Trust is crucial to the functioning of society in general and our previous work has shown that it seems to play a crucial role in the functioning of an Urban Data Platform as well. How can trust be fostered and who needs to be trusted? What are other Urban Data Platform design choices that influencing the level of trust ?

Q47
From a citizen's perspective, who is more trustworthy to take the lead in Urban Platform Development?
 Please click and drag the button to the respective position you want to assign.

	the public sector		the private sector
	0 1 2	3	4
1 ()			
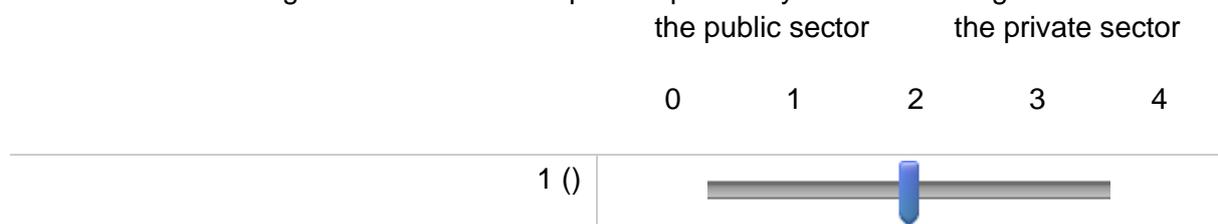
Q48 **In the context of Urban Data Platforms, how would you rate the trust of the <u>public sector </u>in the <u>private sector</u>?**
Please rate

○ High degree of trust (16)

○ Some degree of trust (17)

○ Neither trust nor distrust (18)

○ Some distrust (19)

○ Complete (20)

Q49 **In the context of Urban Data Platforms, how would you rate the trust of the <u>private sector</u> in the <u>public sector</u>?**

Please rate

○ High degree of trust (1)

○ Some degree of trust (6)

○ Neither trust nor distrust (7)

○ Some distrust (8)

○ Complete distrust (2)

Display This Question:

    If In the context of Urban Data Platforms, how would you rate the trust of the public sector in the... = High degree of trust

    Or In the context of Urban Data Platforms, how would you rate the trust of the public sector in the... = Some degree of trust

    Or In the context of Urban Data Platforms, how would you rate the trust of the public sector in the... = Neither trust nor distrust

    Or In the context of Urban Data Platforms, how would you rate the trust of the public sector in the... = Some distrust

    Or In the context of Urban Data Platforms, how would you rate the trust of the public sector in the... = Complete

    Or In the context of Urban Data Platforms, how would you rate the trust of the private sector in the... = High degree of trust

    Or In the context of Urban Data Platforms, how would you rate the trust of the private sector in the... = Some degree of trust

    Or In the context of Urban Data Platforms, how would you rate the trust of the private sector in the... = Neither trust nor distrust

    Or In the context of Urban Data Platforms, how would you rate the trust of the private sector in the... = Some distrust

    Or In the context of Urban Data Platforms, how would you rate the trust of the private sector in the... = Complete distrust

---

Q50 Could you please clarify your answer?

_____

Q51 **To what extend do you believe the following factors contribute to trust in the Urban Data Platform?**

Please check the applicable level of importance for each factor

	Strongly reduces trust (18)	Slightly reduces trust (19)	Neutral (20)	Slightly reinforces trust (21)	Strongly reinforces trust (22)
Platform openness the extent to which citizens and organizations can join the platform without prior selection by the platform manager (5)	◯	◯	◯	◯	◯
Platform analytics sophistication the extent to which analytics tools are leveraged by the platform manager to analyze platform activity (8)	◯	◯	◯	◯	◯

Display This Question:

If To what extend do you believe the following factors contribute to trust in the Urban Data Platfor... = Strongly reduces trust

Or To what extend do you believe the following factors contribute to trust in the Urban Data Platfor... = Slightly reduces trust

Or To what extend do you believe the following factors contribute to trust in the Urban Data Platfor... = Neutral

Or To what extend do you believe the following factors contribute to trust in the Urban Data Platfor... = Slightly reinforces trust

Or To what extend do you believe the following factors contribute to trust in the Urban Data Platfor... = Strongly reinforces trust

Q52 Could you please clarify your answer?

_____

_____

Page Break

Q53 This is the end of the questionnaire. Just two more final questions. May we disclose your affiliation in the reporting of the study.

○ *Yes (1)

○ *No (2)

Q54 How would you rate your overall confidence in your answers?

○ Strong (63)

○ Moderately strong (64)

○ Slightly strong (65)

○ Neutral (66)

○ Slightly weak (67)

○ Moderately weak (68)

○ Weak (69)

Q55 Please note that by clicking the right arrow button below, you will submit your answers irrevocably

○ *I consent to submit my responses (1)

End of Block: Default Question Block

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D6.6 – Governance, trust and smart city business models: the path to maturity for Urban Data Platforms - Addendum

Public (PU)

Delphi Round 2

Delphi Study Round 2

Q1 Browser Meta Info
Browser (1)
Version (2)
Operating System (3)
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Flash Version (5)
Java Support (6)
User Agent (7)

Q2
Delphi Study round 2 on Urban Data Platform & Data Management
 A European-wide study conducted by Erasmus University Rotterdam

Dear Panel Member,
 This questionnaire consists of only 5 questions and is deliberately designed to "force your mind". There is no room for nuance through topic-specific free text. Only at the end of the questionnaire, there is an option to enter free text for anything you may want to share with us as a research team.

◯ I consent that my data will be processed in accordance to the above mentioned statement* (1)

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Q3 **Details about respondent**

○ Name* first and last name (1)

_____

○ Email* (2) _____

○ Position* (3) _____

○ Organization* (4) _____

Q4 **Which sector do you associate with?**

○ Governmental Institution (1)

○ Company (2)

○ Non-Governmental Organization (3)

○ Academic Institution (4)

○ Other (5)

Display This Question:

If Which sector do you associate with? = Other

Q5 **Which other sector do you associate with?**

☐ _____

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Q6

1. Purpose

 We are in the early days of development for Urban Data Platforms. Suppose that we move 10 years into the future to the year 2030: in your vision of the future, what should the ambition of an UDP be? Please allocate 100 points to reflect the importance of the following effects of a mature UDP.

Please allocate 100 points to reflect the importance of the following effects of a mature UDP. The more important an option, the more points you allocate to it. You can allocate points to any number of options.

City Services, Policies and Decision Making : _____ (4)

Economic Innovation & Entrepreneurship : _____ (5)

More Resilience & Environmental Sustainability : _____ (6)

Social Innovation & More Democracy : _____ (7)

Total : _____

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Q7 **2. Governance** That government should take the lead is agreed to by most panel members, predominantly for reasons related to data ethics. However many panelists, including those from the government, say that the government lacks the ability (skills, leadership) to build and run Urban Data Platforms on their own. The majority view is that UDP governance (a combination of ownership and day-to-day management) should be some kind of joint public-private endeavor. We would like to understand your Point of View on which participant in a joint public-private setup is most suited to control the following components of governance. You can only select one option.
 Please select one party per factor.

	Public (1)	**Private** (2)
Setting data privacy norms (7)	○	○
Determining platform access rules (8)	○	○
Selecting the (data) standards (10)	○	○
Assuring quality of data (11)	○	○
Determining data ownership rules (12)	○	○
Pricing of in-platform services (13)	○	○
Generating and capturing in-platform data (14)	○	○
Nurturing the UDP ecosystem (15)	○	○
Innovating platform tools and services (16)	○	○
Branding and building platform audience (17)	○	○
Adapting the platform purpose, impacting governance (18)	○	○

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Q8 **3. Financing**

There is more or less consensus among panel members that an UDP is vital public infrastructure. There is also a majority view that the best way to govern an UDP is some kind of joint public-private set up. However, the panel is split on how to initially finance the UDP. Please allocate 100 points to your preferred financing option(s).

Policy-driven top-down approach at a **National or EU level.** Critical infrastructure like an UDP should be financed **with tax money**. National or EU budgets come with incentives to adopt e.g. **ethical-, data- and interoperability standards.** : _____ (1)

Policy-driven top-down approach at a **Local (Municipal or Regional) government** level. Critical infrastructure like an UPD should be financed with **taxpayer money**. : _____ (2)

A more management science approac**h** applied at the **Local government level.** Even if an UDP is a critical infrastructure, it must have a positive **business case with the platform paying** for its own operation and maintenance. : _____ (4)

Joint public-private investment approach. The government alone **will not have the market discipline** of making a proper value case and delivering on the case. : _____ (5)

Pure market logic approach with **private investment**. The **government pays for the use of the UDP**, which operates within certain **guidelines** set by the government (privacy, security, standards). : _____ (6)

Total : _____

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Q9 **4. Trust**

The jury is out on the matter of trust. The panel is more or less equally split in their perception of the amounts of mutual trust and mutual distrust between the government and the private sector. How can the mutual trust between the government and the private sector be increased?

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Q10 **Trust in the government by the private sector can be increased by...**
Please allocate 100 points.
Improving **government's capabilities**, i.e. the skills, competencies and leadership characteristics in the domain of Urban Data Platforms : _____ (1)
Improving **government's integrity,** i.e. the perception that the government has principles (e.g. transparency, fairness) that are acceptable to the private sector : _____ (2)
Increasing the **benevolence of government**, i.e. the desire to do good to others, including companies : _____ (3)
Creating **collaborative experiences** with the government, e.g. collaborating in pilots, proofs of concepts : _____ (5)
Total : _____

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Q11 **Trust in the private sector by the government can be increased by...**
Please allocate 100 points.
Improving **capabilities of companies**, i.e. the skills, competencies and leadership characteristics in the domain of Urban Data Platforms : _____ (1)
Improving the **integrity of companies**, i.e. the perception that companies have principles (e.g. accountability, inclusion) that are acceptable to the government : _____ (2)
Reducing the **self-centredness of companies**, i.e. contributing to society beyond the own profit motive : _____ (3)
Creating **collaborative experiences** with the private sector, e.g. collaborating in pilots, proofs of concepts : _____ (4)
Total : _____

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Q12 **5. Citizen Engagement**

The predominant position of the panel is that citizen engagement is important. Governments tend to value this more than companies, some of which think this is a matter of later concern. From our previous work (a survey about UDPs in 80 European cities, January 2020) we know that very few cities have actually involved citizens. How can this apparent paradox be explained? Perhaps because decision-makers don't agree on the "what" of citizen engagement. As a panel, you gave us a wide variety of topics that citizens can engage in. Please rank these categories of citizen engagement from the most valuable on top to least valuable at the bottom. Drag and drop an item to the respective rank position you want to assign.

_____ Engage Citizen in the **design of the platform** itself (7)

_____ Engage Citizen in the **co-design of the services** and **apps** that use the platform (2)

_____ Engage Citizens to **contribute personal and/or sensor data** to the platform (3)

_____ Engage Citizens in **policy making** and **urban planning** (8)

_____ Engage Citizens to **self-improve** their **quality of living/lif**e using data from the platform (9)

_____ Engage Citizens to help **manage their data privacy** and data ownership (10)

_____ Engage Citizens as **entrepreneurs** and/or help them to **monetize** their personal data (11)

_____ Engage Citizens to make their **voices heard** and thus **strengthen the democratic society** (12)

_____ Engage citizens to help **manage their social communities** (13)

Q13 **Is there anything you would like to share with the research team?**

Any feedback to the research team about the content, process, relevance or related work, is welcome

_____

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Q14 This is the end of the questionnaire. Just two more final questions. May we disclose your affiliation in the reporting of the study.

○ *Yes (1)

○ *No (2)

Q15 How would you rate your overall confidence in your answers?

○ Strong (63)

○ Moderately strong (64)

○ Slightly strong (65)

○ Neutral (66)

○ Slightly weak (67)

○ Moderately weak (68)

○ Weak (69)

Q16 Please note that by clicking the right arrow button below, you will submit your answers irrevocably

○ *I consent to submit my responses (1)

End of Block: Default Question Block