Petra Governance Handbook - WP7 – Governance structures & business models
D7.3: Governance Handbook

Veeneman, Wijnand; Hirschhorn, Fabio; Klievink, Bram; Steenhuisen, Bauke; van der Voort, Haiko

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Deliverable Lead	Wijnand Veeneman, TUD
Further authors	Fabio Hirschhorn, Bram Klievink, Bauke Steenhuisen, Haiko van der Voort, TUD
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Executive Summary

This document represents the governance handbook on mobility data platforms for the PETRA project. The governance handbook provides metropolitan authorities contemplating the implementation of a mobility data platform in line with the PETRA project about governance issues and design.

The analysis has shown mobility data platforms with the reach of PETRA are not available, however a variety of solutions of both the platform and the app exist in various situations. Of those, 13 were analyses to understand how governance shapes the solutions implemented and what the solutions implemented need from governance. The results do not provide a single best solution of governance for three reasons. First, mobility data platforms will land in a variety of (governance) contexts. Assuming that authorities would be willing to fully adjust their governance for the implementation of a mobility data platform is naïve. Second, mobility data platforms can come in a variety of forms. The governance has to align with the particular implementation. Third, governance solutions consist of a great deal of element that not necessarily always act uniformly, and as such, not always act predictably in various contexts. Because of that variability the handbook highlights key mechanisms that authorities working on the governance of a mobility data platform should take in to account, rather than provide a theoretical and unrealistic single optimal governance design. The report adapts a column structure to align with this focus on specific mechanisms to take into account. It also provides specific readers with a planned route through the different columns.

The governance handbook was developed based on the analysis of 13 case studies and the three demonstrators. The provided the input to understand the relation between the specific implementation of a mobility data platform and a governance context. Desk research and interviews provided the understanding of those cases, the types of data input, the function of the platform in terms of data linking, capture, retention, storage, aggregation, and modelling, the data output and a possible mobile application. The key question in the cases was to understand organisational links of the stakeholders providing the data and using the data, and the links to the stakeholders with an interest in the various functionalities of the platform in terms of data handling. From these links we could further understand how decision-making on the platform was structured and what outcomes of that decision-making could be expected.

The report starts with an instruction on the overall project, followed by a prologue, that sets the scene. This is followed by a number of theoretical columns, highlighting understood mechanisms from organisational science and public administration that showed to be relevant in the cases and demonstrators. After these, empirical columns highlight mechanisms that were recognised in the cases studied, and that illustrate the complex and varied contexts of mobility data platforms and how to align the governance to specific goals. Finally, five syntheses are given, including a business case, a set of models, and different governance design routes.

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Part 1: Prologue

1.1 Short introduction to governance

Can a new type of travel planner, based on more real-time and multi-modal data, be an effective policy instrument? Many governments across the globe currently seem to affirm, triggered by the tremendous growth in data availability, but virtually all of them are still figuring out how. Large investments are made and many innovations are under way. The current variety of ways to organize and design for new travel planning provides a rich and urgent opportunity for us to study and improve these innovation processes from a governance point of view.

We are researchers at Delft University of Technology with a mixed scientific background of public management, economics, human geography and systems engineering. In past years, we have participated in the PETRA-project, one of a number of similar EU-funded projects, with the aim to develop a data platform for multi-modal real-time travel planning aimed at collective goals. This document is our spin-off: a handbook of governance for all who wish to contribute to the success of these projects and their collective goals.

This handbook presents, based on multiple analyses of pitfalls, helpful concepts and good practices for governmental agencies that are involved in developing data platform for multi-modal real-time travel planning. The content is based on participatory observations in three cities within the PETRA-projects, as well as 12 case studies of data platforms in the world. All studies focused on the organizational or governance side of the platforms, including their development, their procedures and their implementation. Although the handbook is targeted at travel planning platforms, it will be useful to any government involved in projects that includes the development of data platforms for public policy that requires the cooperation of multiple public and private parties.

This prologue answers four pressing questions:

- Why would government develop these mobility data platforms?
- What is governance?

- Why is governance complex?
- The handbook consists of 4 chapters! How should I read and use this handbook?

Why would government develop these mobility data platforms?
A data platform for multi-modal real-time travel planning aimed at collective goals, that is the original goal of the PETRA project. The premise is that governmental agencies can gather a lot of data, internally and from external data providers, that can be modelled upon to provide travellers with travel plans that align better with collective goals, as opposed to individual travel time optimization.

Current commercial travel planners take modal network data (a map with topological data and operational speed data of a single mode, mostly car), sometimes real-time network loading (current speed data from either the apps running the travel planner or external data on that mode) and a model of the expected operational speeds in the near future. Based on this they plan a route, optimized on minimized travel time for the single mode for the single user.

However, in the current urban environment several challenges arise that make this approach not optimal. Accordingly, three characteristics of advanced mobility data platforms may cope with these challenges.

First, congestion is high, making the single mode, mostly the car, not necessarily the best way forward. Several other modes are available, having their own trip planning, often times further fragmented between different public transport modes and operators. So, a multi-modal planning tool could help. The **multi-modal characteristic** of a mobility data platform means that network flows, modelling approach, and planner options include a variety of modes.

Second, conditions in the urban environment change constantly, and various factors can drive the performance of these various modes. Having a real-time perspective on the current state of not just road congestion, but also performance of other modes could help

the traveler in two ways: providing a better plan to start off with and providing better guidance during the trip. To achieve that, a historic and current view on all kinds of mobility related data could help more advanced modelling of future and ongoing trips. That data should include both contextual data like weather and events, and performance data like road congestion and public transport occupancy and punctuality. The **real-time characteristic** will allow for the trip and travel planning to be closer aligned tot the current state of the network.

Third, optimizing the travel plans for individual travel speed misses two key issues. The problem of the city, and thus of its inhabitants, is not necessarily arriving two minutes quicker individually. More collective reasoning could lead to optimizing travel times over the whole population and even optimizing not for travel times but for reduced emissions, greater health, lower energy use, etc. The promise of such a system is very high, both in individual as well as in collective performance improvement. The **nudging characteristic** allows for the metropolitan governments that have implemented the platform to better align the behavior of the traveler with the conditions and goals of the urban space.

What is governance?

These three changes rely on technical solutions, gathering and linking new available data sources, new ways of aggregating that raw data into a sound representation of trips made and capacity provided, new ways of modelling travel with the added complexity of making it multi-modal, new ways of modelling how contextual aspects like the weather or nudges drive travel behaviour and capacity, etc. However, they also ask for new governance models or governance blocks to help make them work.

First of all, governance has to deal with the data-in part of the platform. Part of the data comes from individuals and provides details on their locational history, their travel. Under what conditions are they willing to provide them? Is there a privacy issue? How does that align with what is needed? How detailed can we get public transport schedule data and real-time operational data? Are operators willing to provide that to a platform managing organisation, to whom they might or might not have a current relation within the governance system? All kinds of governmental agencies, even private actors, generate

data related to mobility demand and supply. Under what conditions does it make sense to make these available in the platform? Only if they can allow for better travel planning or also for more unexpected uses? Moreover, the data that is coming into the platform might very well just be a link. The platform is not a necessarily a repository of mobility related data, but rather a portal. This means that all conditions under which the data is coming in, will have consequences for the use of the data, consequences that are secured in the governance: in laws, contracts, procedures.

Second, the data is processed in the platform. Raw location data needs to be developed into individual trips and travel patterns of individuals and groups. That historic data needs to be combined with all kinds of contextual data to better understand the relation between travel patterns and the weather, events, etc. That historic data also can be combined with sensors, to better understand the effect of mobility on emissions and health. And now that understanding of context and effect of mobility can be modelled into future states of the network and translated to optimized travel plans, not optimized for the individual travel speed, but balanced for collective travel speed and reduced health risks.

Third, the platform is used to provide better predictions for travellers, that lead travellers to behaviour more in line with the collective needs of the city. The goal is to change behaviour of people travelling through the city for the better, meaning, to align with those collective needs. This asks for governance that ties the end-user to that collective. Planning a trip brings in the collective effects of that trip and lets the end-user decide from that wider context, what we call collectivization. Nudging can be used to let the end-user feel direct benefit from his more collective choice. Also that nudging needs governance. In addition, the city can be helped by the easy availability of a wide data set, either in its raw data availability or in its more processed versions, for example for public transport service planning, infrastructure planning, police service support, traffic control support, etc. Moreover, the data could be used by external parties to provide services to the inhabitants, visitors or businesses of the city. We call this third element, nudged travel planning and data distribution for collective benefits the data-out side of the platform.

Why is governance complex?

The optimal design choices on technology and governance depend highly on the perspective. When the manager of the implementation of the platform is an ICT department of a metropolitan authority, the perspective is different from that of a municipal public transport operator in the metropolitan area, is again different from a mobility policy oriented department of the largest municipality in the metropolitan area. The ICT department is probably more interested in gathering the data and allowing users to use it in a form that creates some value to the city. The operator will likely let the platform drive nudging of people towards public transport. The mobility department will probably try to align behaviour with the policy goals set in the latest white paper. In addition, regional views are probably different from local views, public and private views differ, service provider and service consumer perspectives are not the same, data contributors and data users have different perspectives, etc. As might be clear, there is no single optimal implementation. Governance will have to tie these different perspectives together, aligned with the goals set.

Main question tackled by this handbook: designing governance?

This handbook looks at the relation between the possible ways in which a mobility data platform for mobility can be realised and the governance environment of the data platform. This means we have two questions. On the one hand, how to design governance conducive to the idea and the potential of a mobility data platform? On the other hand, what governance environment will support what kind of mobility data platform?

The implementation of a mobility data platform will not start in a void. Existing stakeholders, mostly expected to be metropolitan authorities focussing on mobility, have to embrace the idea to start a decision-making process that includes decisions on funding, technology, and organisation. Those decisions are conditioned by existing institutions, internal and external rules: from the budgeting process of the metropolitan authority to national privacy laws.

In our perspective, this is the fabric that ties a great variety of actors together. From technology providers, through local politicians, to visitors of the metropolitan area, and many more. To make the mobility platform work, those actors will have to be connected in new ways, given the existing institutions and maybe dependent on new institutions. The

actions connecting these stakeholders going beyond the existing institutions is what we call governance and this is about organising for and deciding on all aspects of the mobility data platform in a context with many different actors.
The platform depends highly on the contributions of all these actors. If data providers don't provide data, the government doesn't fund the platform, travellers don't use the services coming from the platform, the platform creates no value. Governance consists of building that organisational and institutional environment that delivers an attractive mobility platform for all those (potentially) involved in the platform. It is a two-way street, understanding the stakeholders position towards the platform to align the technology of the platform accordingly, and looking for incentives for the stakeholders to change position conducive to the potential of the technology of the platform.
At the same time, the world has many different metropolitan areas, with different institutions, different mobility patterns and policies, different cultures, different economies. This means there is no single optimal way of implementing a mobility data platform with a specific governance. As a consequence, this handbook provides not a single optimal way, but a great deal of lessons drawn on the relation between context, data platforms and governance, as we have discovered in the three demonstrators and the 12 cases.

1.2 How should I read this handbook?

You will find that the structure of this handbook is not straightforward. In fact, it consists of tens of brief chapters that read like columns. This structure helps you, as a reader, to select the topics of your interest and make it a smoother read. We assume that the readers of this handbook are just as diverse as travellers. Travellers aim for diverse destinations, driven by different goals and interests. They might not want to travel the whole region, but select a route from A to B, sometimes via C. Other travellers may even just want to wander around without a clear destination in mind. By means of these short chapters, we facilitate readers to travel through the handbook in their own preferred way.

To guide you on your way, three special routes through the columns are indicated. Each route is a line-up of theme-related columns that together add up to a partial synthesis on smart mobility platforms. Each route describes how to deal with governance, but from a different angle, with a distinct theme and a distinct problem owner. A traveller route, a policy maker route and a route for platform designers are distinguished. At the end of each

route, the routes are summarized in a synthesis column drawing conclusions based on the theoretical and empirical columns along the route.

Route	Key message
The travellers' T	There are good reasons to engage travellers in the development of journey-planning platforms, but few platforms do it. Recognizing this paradox as a dilemma is a first step to change the status quo (if you want to). • 2.6. Public values: important and hard to secure • 3.6. Accounting for trade-offs • 3.7. Operationalization of public values • 3.9. User involvement • 3.10. The travellers' needs • 3.11. Mapping stakeholders • 3.21 End-users and public values • 4.1. PETRA business case • 4.4. Concluding the travellers' route
The policy route P	How can these platforms be used as policy instrument? Current practice reflects only a few of many possibilities. A conceivable explanation is that current platforms prefer to avoid complex governance challenges. What are these challenges? Can we make these challenges less off-putting? • 2.5. Wickedness of journey-planner development • 2.6. Public values: important and hard to secure • 2.8. Policy instruments: a short manual • 3.3. Gains, costs and the travellers' logic • 3.6. Accounting for trade-offs • 3.8. Nudging • 3.12 The prevalence of informational platforms • 3.13. Public and private initiative platforms • 3.16. The problem of integration and accountability • 3.23. Goals and implementations • 4.1 PETRA business case • 4.3. Concluding the policy route

The governance-by-design route G	Governance is both subject and context of platform design. Essential for a design is that it couples three core qualities: knowledge, authority and problem ownership. At the same time, governance-as-a-context may facilitate or frustrate the designability of journey-planning platforms. It may also limit the choices of designers considerably. This means strategies of designers need to be adaptive. What strategies are thinkable? And what if there is no choice? • 2.2. Three governance modes • 2.3. Information Platform Governance • 2.4. Designing institutions for smart mobility • 2.7. Multi-level governance • 3.2. Do all roads lead to Silicon Valley? • 3.4. The governability of intelligent mobility • 3.5. The implicit lock ins of governance • 3.11. Mapping stakeholders • 3.14. Organisational setting of journey planner platforms • 3.15 The centrality paradox for smart city projects • 3.18. The organization of love and dedication • 3.19. From performance to permanence • 3.20. The perpetuum mobile of intelligent mobility • 4.1 PETRA business case • 4.3 Concluding the governance-by-design route

Part 2: Theoretical columns

2.1 Our stance on governance, government and the complexities of smart platforms

"Life is really simple; but we insist on making it complicated" - Confucius
Seven theoretical columns

The exploration of mobility platforms over the world resulted in various ideas and reflections. But what was our starting point? We as social scientists had ideas about the world before we started our research. In this series of seven theoretical columns we reveal the most important aspects of our world. Reading these columns will make you understand the authors better. This facilitates us in sharing our new ideas that we will describe later, in our empirical columns.

The order of these theoretical columns is no coincidence. Column by column, we define some tricky concepts that are central in this handbook, but are so often used by so many scholars that their meanings may seem a bit ambiguous to most readers.

First we delve into the complexities of mobility data platform governance, especially from the perspective of governments. A central concept for this is 'wicked problems'. While developing policies for smart mobility governments enter a complex field of actors. Per case the role of government may differ, i.e. leading in a hierarchy or facilitating in a market. Moreover, problems and solutions tend to be 'wicked': knowledge-finding, problem formulation and solution criteria all are subject of discussion among actors, because their legitimacy differs per perspective. This creates dynamic and long-lasting interactions among actors. Any neat representation that communicates order and control – i.e. the data chain – are worth a critical reflection.

The second column (2.3) reveals our take on 'governance'. Governance is about stakeholders, not so much about technology. It focuses on transactions between different stakeholders through mechanisms of market, networks and hierarchy. The mechanisms substantially differ from each other. Hierarchical transactions are fuelled by the authority of one actor, market transactions are fuelled by perceptions of supply and demand, and

network transactions are fuelled by mutual dependencies. Although these mechanisms have clear distinct features, in real cases the mechanisms will be mixed, because of the complex, specific characteristics of the cases. In the third column (2.4) we will apply these ideas to information platforms by defining 'platform governance'.

The second tricky concept is 'institutions', which we will cover in the fourth column (2.5). Establishing and managing mobility platforms involve design choices. Designers are no neutral actors, but operate within a hierarchy, a market, a network or a mix. In other words, designers operate within a context wherein both technology *and* social interaction play an important role. They design rules that guide behaviour (institutions). At the same time, their own behaviour – i.e. their design choices – are also subject to institutions.

It is not just governments facing complexities. They take complexities with them as well. A first complexity – addressed in the fifth column (2.6) – is that they are expected to safeguard interests on behalf of a collective. These 'public values' – such as safety, privacy, sustainability, quality of life, etc. – may conflict the goals of the platform, or even conflict with each other. A second source of government complexities – as addressed in the sixth column (2.7) – is the 'multi-layered' structure of governments. There appears to be not a single government, but a variety of public institutions operating on multiple layers – including local, national and global players – also with sometimes conflicting interests.

There is more than problems and complexities, however. We finish the series of theoretical columns with capacities and all kinds of 'policy instruments' governments have. Governments are special actors, with public authority. They may use instruments that other actors lack. Altogether governments have an impressive toolkit, including laws, regulations, financial instruments and behavioural instruments. The latter are in vogue. Governments have means – i.e. budget, authority – to influence the behaviour of actors by communication. They may nudge actors to behave more in line with a public goal.

2.2 The inescapable wickedness of mobility data platform development

P

Public authorities interested in developing mobility data platforms, or broader infomobility systems, are faced with multiple challenges that go beyond the technological design of these tools. Different actors affect or are affected by these tools – the authority itself, travellers, transport operators etc. - and they all have distinct values, interests and expectations with regards to the features, functions and benefits of journey-planners. The governance dimension of journey-planning platforms is a wicked problem: tailoring adequate governance arrangements involves issues that cut across different disciplines and involve multiple and conflicting values.

Key words: wicked problems, competing values, uncertainty

In the prologue, we have identified the logic of governments getting involved in mobility data platforms. Governments often are expected to secure public values – such as safety, public health and sustainability. This isn't an easy task, because these values sometimes compete with each other (Veeneman et al. 2009). For example: a safe solution isn't always a sustainable or cheap solution. The way these values are traded off and who decides on these trade-offs is often the subject of controversy. The government's stake in mobility data platforms is subject to multiple values, and consensus on which value should prevail is not always a given.

Several questions illustrate these complex governance issues when developing a mobility data platform with a journey planner: are journey-planners a service supposed to be provided by public authorities to its citizens or should it just be left as a product to be developed by market initiative? Who are (all) stakeholders affecting and affected by the platform and hence that should/could have a say in decision processes? What is the source and flow of the information displayed in these platforms? How is this flow regulated? Are there privacy issues to be considered? How to regulate them? Should platforms be liable for the information they provide? Can a mobility data platform be a tool

for policy planning and implementation? If so, what should be the policy objectives embedded in such tool?

In sum, governments involved in mobility data platforms with a possible journey planner often face so-called ‘wicked problems’. A wicked problem (or wicked issue) is the problem associated to a policy question that poses difficulties to authorities and planners due to the fact that it normally cuts across several disciplines and involves multiple stakeholders with varied (sometimes conflicting) interests. Not only that, but also given the presence of multiple interacting players with varying views, the task of agreeing on the delimitation and definition of what constitutes the problem may not be a straight forward one (Bevir 2012; de Bruijn & ten Heuvelhof 2000).

The expression ‘wicked problem’ was coined by Horst Rittel, and later further elaborated by Rittel and Webber (1973) to distinguish between the societal problems that planners normally deal with on one side, and those problems associated to natural sciences on the other. Up to then the paradigm of efficiency guided decision-making and solutions-search but that did not seem to be enough to deal with all problems. Rittel and Webber claimed this paradigm was not representative of all multiple values sought by different affected stakeholders, especially in social matters. Moreover, the wickedness of these problems would go beyond the discussion and search for solutions, but, as indicated above, it is also is connected to the delimitation of the problem itself: “As distinguished from problems in the natural sciences, which are definable and separable and may have solutions that are findable, the problems of governmental planning -- and especially those of social or policy planning -- are ill-defined; and they rely upon elusive political judgment for resolution. (Not "solution". Social problems are never solved. At best they are only re-solved--over and over again.)” (Rittel & Webber 1973, p.160).

Still according to the authors, wicked problems have at least ten characteristics that help clarify the concept:

1. There is no definitive formulation of a wicked problem: understanding the problem requires and depends on the idea one has on how to solve it. Problem formulation and resolution are concomitant and shape each other.

2. Wicked problems have no stopping rule: the process of dealing with a wicked problem by understanding it, and attempting measures to tackle it has no clear end point. Because the process will continue until the planner decides it is enough and this may be the result of different subjective factors.

3. Solutions to wicked problems are not true-or-false, but good-or-bad: personal values affect the assessment of solutions to wicked problems. Due to this very subjective character there is no clear definition of what or how things ought to be.

4. There is no immediate and no ultimate test of a solution to a wicked problem: every solution to a wicked problem carries specific and potentially unknown consequences, that may also create new unexpected problems.

5. Every solution to a wicked problem is a "one-shot operation": since every solution is consequential there is no opportunity to learn by trial-and-error, every attempt counts and leaves marks.
6. Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan: there is no way to ascertain whether there is any and what would be possible solutions to wicked problems.

7. Every wicked problem is essentially unique: wicked problems always bring a particular feature that turns them into a unique problem and hence without previously tested responses.

8. Every wicked problem can be considered to be a symptom of another problem: the causes of a problem may be multiple. Tackling the cause of a problem may also unleash new problems.

9. The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution: explanations and reasons of existing problems are multiple and each

may call for a different approach to tackle such problem. There is no way to establish which, if any, is the 'right' one to be tackled.

10. The planner has no right to be wrong: since every attempt to improve a given wicked issue has consequences, people will be affected in some manner whilst the planner will have to bear responsibility for his or her acts.

What does this mean for public authorities interested in developing a mobility data platform or in taking any other role in it? The central argument of this Handbook is that planners must acknowledge that to develop a platform challenges go way beyond the task of collecting data and developing the technological artefact that yields trip advice based on such data. The governance dimension of mobility data platforms is crucial - appropriate governance arrangements must be tailored in order to allow the technological tool to be designed, implemented and also to deliver the expected benefits. On a high-level perspective, this entails policy efforts that coordinate and integrate measures and activities of different governmental and non-governmental entities, a 'joined-up' approach to policy planning and implementation that allows for a holistic treatment of an ample and complex problem such as the one depicted here (Christensen & Lægreid 2007; Kavanagh & Richards 2001).

This Handbook provides some insights on the governance challenges of journey-planning platforms that can be helpful to planners in tackling the wicked problem of developing such a tool. Nonetheless, due to the very nature of wicked problems, no definitive response or lesson will be found here or elsewhere. The journey to develop and regulate a journey planning platform is uncertain and tortuous – a wicked one.

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2.3 Three governance modes: hierarchy, market, network

G

Governance is a pluriform concept. Following literature, we distinguish three governance modes: hierarchy, market and network. For each mode relations between actors are shaped differently. For complex features, such as mobility data platforms, different governance modes are visible at the same time. Moreover, to be effective, governance modes should fit their context. At the same time, they may influence their context as well.

Key words: market, hierarchy, network, governance mode

Mobility data platforms can include a great variety of products and services. A recurring question is whether to make or buy a particular product or a service. This is a good example of a governance decision: when the function is carried out by the organization itself, it becomes part of the governance of that organization and it is included on the hierarchical structure of the organization. This can be the case for both permanent organizations or more temporary projects.

When the function is bought, there is no continuous hierarchy, however. The choice for a provider and the competition between providers allows the client – the buyer - of the function to have the provision of the function align with his needs. At the buying decision, the client of the function has a great deal of control, which is reduced once the decision has been made. The coordination between the client and the provider of the function is done through different forms of governance, hierarchy through a visible hand – being the contract and the buying decision – and a market via the famous invisible hand.

This in the literature leads to two main governance modes: market and hierarchy. Two important bodies of literature in economics and administrative science show the limitation of this dichotomy.

In the literature, Powell (1990) showed the dichotomy at two sides of a scale to be too simplistic. A third potential mechanism for coordination was labelled as ‘network’. Here, the coordination is shaped by mutual dependency. Power sources one may depend on are very diverse. It could be formal authority, knowledge, scarcity of resources, etcetera. Relations are ultimately reciprocal: give and take. Governance in this case can be

relatively invisible. Powell claims that networks are especially useful in those situations where “qualitative matters as know-how, technological capability, a particular approach or style of production, a spirit of innovation or experimentation, or a philosophy of zero defects are very hard to place a price tag on. (1990, pp. 304)”
As most authors in the field of economics and administrative science show, all three mechanisms for coordination between various players can coexist. A service can be procured on the market, after which is it provided for a prolonged period of time. During that a hierarchy can be used, based on the contractual obligations. In addition, normal day-to-day governance might rely more on the relations that exist between the service provider and the user of the service.

In the world of data platforms, all three, markets, hierarchies and networks, play important roles. Governments and also some companies internally could rely heavily on hierarchy, when a specific service branch is expected to deliver data to that platform and align its data protocol to the platform. Between different governmental jurisdictions, networks might be the key mode, as they are mutually dependent on participating and creating to overall value of the platform to their area and that of the neighbouring jurisdictions. Finally, data and data services can be bought and added to the value of the data platform.

The context determines the governance modes that can be used. When developing a metropolitan data platform for mobility, the existence of a jurisdiction on metropolitan level with enough agency is required to be able to rely on hierarchy. When such an entity does not exist, municipalities will have to cooperate, having to rely on cooperation in existing networks to make the platform work. When external supply and demand for certain data types exist, supply into the platform and demand out of the platform, markets can be used to acquire or sell that data under a market oriented licence. When the external supply and demand are limited, market mechanisms will play a lesser role.

That being said, this context is not just a given. The design of a platform can also trigger this context to change. For example, the lack of a network or hierarchical structures in the area will hamper the development of a government-driven data platform for mobility, because there are no incentives to start. If there are no cooperating municipalities, the

platform could trigger the need for it and let municipalities set up a cooperating governance structure responsible for the platform, moving beyond pure network governance by adding a new structure with hierarchical elements.

Governance is never singular, in that it doesn't use only one mode: only markets, hierarchies and networks. Data can be procured on the open market, by a hierarchically controlled department of a metropolitan jurisdiction that is set up to be cooperatively governed by the municipalities in the area. These hybrid forms allow for the use of strengths and weaknesses of the various governance modes when designing the governance, or evaluating it.

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2.4 Information Platform Governance: three interpretations

G

Governance is essential, however somewhat generic. We delve now into the idea of 'information platform governance'. Is there anything specific to the governance of platforms? We distinguish three important features: the decision-making structure, control mechanisms and ownership structure.

Key words: governance, information platforms, ownership, control

Platform governance refers to the solutions that organizations devise for problems of coordination (Markus & Bui, 2012). There are two generic types of governance that are relevant to understanding platforms. On the one hand, governance refers to processes, social practices and activities, performed by institutions or actors (Bevir, 2013). This form of governance is not always tangible, may be informal and in essence concerns coordination and control of a social system. When we speak of governance in this handbook, we often mean this form of governance concerning – amongst other things – the power, interests and salience of actors involved in mobility data platforms. On the other hand, governance can also refer to a more tangible, formal part of the structure, control and processes for decision making and coordination of platforms (von Tunzelmann, 2003). This second form concerns instruments and mechanisms that are employed to exercise control over platforms, both in development and operations. Tools of governance can be rather generic such as laws, but also include administrative rules, practices, decision making processes and institutional arrangements used to align the various characteristics of demand (e.g. information users) and supply (e.g. information providers and IT-service providers) (Cusumano, 2005; Lynn, Heinrich, & Hill, 2000). In this column, we explore such more tangible and formal instruments of governance that are relevant in the governance of mobility data platforms.

Governance serves to come to agreements on (technical) standards and procedures that guide the activities of the large numbers of organizations involved in a platform. Governance is important because it is believed to contribute to the efficiency and effectiveness of inter-organizational arrangements (Provan & Kenis, 2008). Specifically related to platform governance, Tiwana et al. (2010) identify three main elements: the

partitioning of decision rights, formal and informal mechanisms of control, and the ownership structure. We follow this structure and discuss each of them in turn, paying attention not only to the structural aspects of governance, but also to the process aspects.

The *decision-making structure* is about who decides, how, and on which components of the platform in terms of functionality, design and implementation. It also dictates who has control over the interfaces and thereby over the evolution of the platform (Baldwin and Woodard, 2009; Tiwana et al., 2010). There often is some degree of decentralization of authority and responsibility for different types of decisions. An important question is how and when decision rights should be shared, often a question of balancing autonomy of parties and coordination of the platform (Klievink, 2011; Tiwana, Konsynski, & Bush, 2010).

Tiwana et al. (2010) identify different formal and informal *mechanisms of control* over the platform (i.e. to encourage desirable behaviour by actors involved), including input control (where an owner decides what goes on the platform), process control (methods and procedures prescribed to parties), and informal control (e.g. values, norms, trust) (Tiwana et al., 2010). In business-to-government reporting, there typically is a formal relationship and an obligation to report to government. However, beyond that, parties are autonomous and thus the development of the platform needs to be in the interests of – indeed even driven by - the businesses, whilst at the same time offering the opportunity to government agencies to capitalize on these developments to transform the way they interact with businesses. This means that government agencies are stakeholders having their own interests and instruments (e.g. they can make it rewarding for businesses to configure and use the platform in a way that it facilitates business-to-government exchange), but without formal authority or hierarchical mechanisms to steer the platform entirely. Trying to impose constraints or incentives may remove the “luxury” of considering not to participate, but this may threaten the collaborative nature of the partnership underlying the platform (Johnston & Gudergan, 2007). Apart from the formal governance instrument (i.e. the agreed-upon decision making structure), overall a collaborative form of governance is needed, as traditional modes of governance (e.g. hierarchical, authoritative, contract-based) may be counterproductive in making the platform successful (Gawer, 2014). Balancing some kind of steering of (or control over) the overall platform with the autonomy of the actors that

participate in it is especially challenging for platforms joining-up public and private parties; the innovations have to make business-sense, and advance the agenda of government agencies.

Next to the decision-making structure and control mechanisms, a third category in platform governance is the *ownership structure* (Tiwana et al., 2010). A platform can be proprietary to a single firm (i.e. the platform leader, especially if the platform is the core business strategy of the actor), or ownership is shared between multiple actors. In case the government puts heavy requirements on the platform without ensuring that the platform offers sufficiently for businesses, control over parts (e.g. the interfaces or at least the standards) are likely to end up with government. An important element especially in proprietary solutions or shared ownership is the (perceived) neutrality of the platform, especially when it comes to data that are commercially sensitive. If the platform is meant to (partially) fulfil a public role, governments may step in by on the one hand subsidizing parts of the basic infrastructure and on the other hand pushing for open standards to ensure flexibility. Open standards reduce the dependency on a specific platform and thereby weaken the position of the platform provider. In any case, the use of technological standards is needed to facilitate adoption, as a lack of standards lead to high investments by actors without the ability to re-use them in other connections (Markus, Steinfield, Wigand, & Minton, 2006).

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2.5 Guiding behaviour: designing institutions for smart mobility

G

Erecting and managing mobility data platforms involve design choices. Designers are no neutral actors, but operate within a hierarchy, a market, a network or a mix. In other words, designers operate within a context wherein both technology and social interaction play an important role. They design rules that guide behaviour (institutions). Their own behaviour – i.e. their design choices - are also subject to institutions.

Keywords: design, socio-technical systems, institutions, embeddedness, arrangements

Getting to smarter mobility involves a creative process wherein designers play a prominent role. Designers obviously create technical elements, such as algorithms, user interfaces and hardware. Design also involves social elements, such as data delivery contracts, agreements about privacy, and platform management. These technical and social elements for design may interact, for instance when algorithms are designed to respect privacy.

In other words: smart mobility involves designing socio-technical systems. Designing a socio-technical system includes designing technical artefacts and social rules that guide behaviour. These social rules are often called ‘institutions’. To be precise: institutions are rules that guide behaviour. However, not every rule is an institution. They have to be accepted by both developers and subjects to rules, they must be used in practice and they must endure for some time (Goodin, 1996; Koppenjan and Groenewegen, 2005). For further discussion on the precise definition of institutions, we refer to Menard (1995).

Is it up to the designers to make institutions? In fact: partly. Institutions are also a context for designers. They for instance just do not have the position to design laws and regulations. As such, these laws and regulations form conditions for the design, either the ‘design space’.

This dynamic is addressed neatly by institutional economists. They have made typologies of institutions that are useful for understanding design of and in sociotechnical systems. We mainly refer to the typology of Williamson (1998), reworked by Koppenjan and Groenewegen (2005) with a focus on complex technological systems. It sketches four layers of institutions, each representing different types of institutions, and different positions of designers.

A first layer involves actors and games in socio-technical systems. This layer represents everyday transactions within the context of a market (f.i. trading), a hierarchy (f.i. obedience), or a network (f.i. tit for tat actions). Rules to be considered here are visible as practices, as volatile as they are.

A second layer represents formal and informal institutional arrangements of socio-technical systems. Formal arrangements are visible on paper, for instance in covenants, contracts, agreements, etc. Informal arrangements are less visible, but may structure behaviour as well. They are norms, routines and codes that emerge in relations between actors.

The third layer forms the formal institutional environment of socio-technical systems. These institutions are visible in laws, regulations, and constitutions. They usually cover more actors than second layer institutions and they are more durable, if it wasn't just for the simple reason that they require more effort to change them. For instance, changing laws take lots of political and bureaucratic effort and is – as a result – time consuming.

Finally, a fourth layer involves the informal institutional environment of socio-technical systems. These are again not that visible as formal institutions. They are rules of culture, of societal values. They surely guide behaviour, however it is hard to pinpoint where and how. Changing these institutions is a barely purposeful, collective effort that takes many years.

Figure 1 visualizes this typology. It also suggests that the different categories of institutions influence are not isolated rules. They rather influence each other over time.

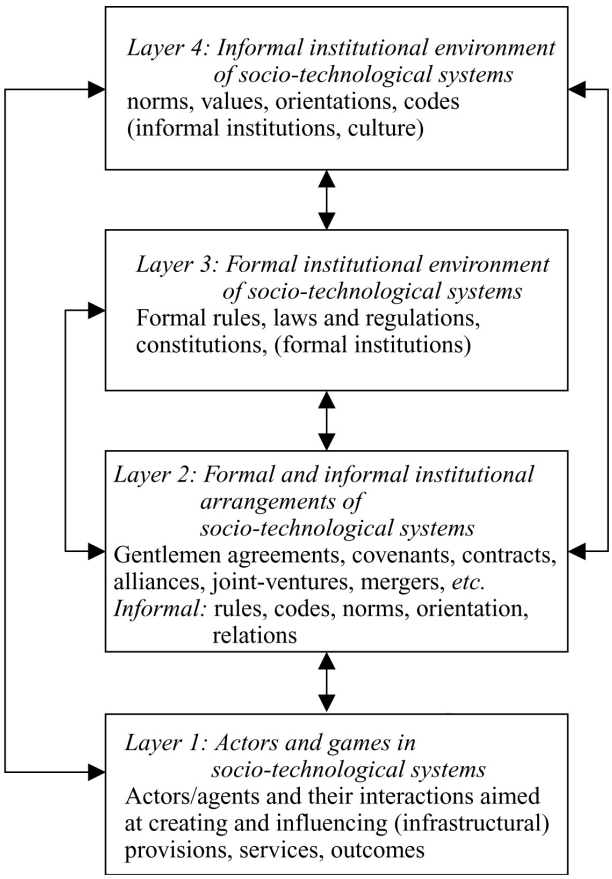

Figure 1: Four levels of institutions (source: Koppenjan and Groenewegen, 2005)

What does this mean for designers? The main dimension behind this typology of institutions is their level of embeddedness, and as a consequence the time and effort it takes to change them. This means that some institutions are more fixed than others. Some rules are a given for designers, effectively serving as prerequisites for their design. Others are subject to their design.

In other words, the designer's job is twofold: designing *of* socio-technical systems and designing *in* socio-technical systems. This duality has several very practical consequences that is worth a reflection.

First, there is no one size fits all smart mobility solution. Each city or region may have its own institutions that designer should accept as a given.

Second, there is no such thing as designing in isolation. One has to know the institutional environment wherein a design has to fit.

Third, and related, this story about institutions suggests that designers have a moving target. Institutions may be volatile, so design may create new institutions and change existing institutions, even unintended. New relations are created and new norms and behaviour emerge.

Mobility data platforms are designed in an institutional context, with a large part of that context unavailable for change to the designers of the platform. This means the governance of the platform has to be designed within this context and has to align with it. As these contexts are widely divers, from data protection to mobility policies, a single answer is largely unavailable, but a better understanding of the dependencies between mobility data solutions and the institutional context and governance options is key.

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2.6 Public values: why they are important and hard to secure

The main reason why governments get involved in mobility platforms is that they see a relation with public values. These are values that 'the public' finds important enough to be secured by governments. Platforms may either secure these values or their establishing might threaten them. Public values are highly dynamic, because they are political. As a consequence, implementation is challenging, because it involves bureaucracy, investments and points of no return, which could be at odds with the dynamics of public values.

Key words: public values, implementation, dynamics, politics

Public values are those aspects that public entities, governments, have accepted they want to secure. The public values related to data platforms for mobility can vary. Obviously, it makes sense that mobility data platforms adopt the public values of mobility policies. Mobility policies generally find their basis in economy (to reduce congestion or to strengthen an urban core), health (to reduce NOx emissions or increase fitness), sustainability (reduce CO2 emissions) or livability (improve the quality of urban space or reduce special fragmentation through infrastructure).

Public values have got growing attention after the privatizations in the late 20th century. With a growing role of private companies in the delivery of public services, interest reemerged on those aspects that were at the core of public services, the values that public services should create. Also in the field of mobility, the role of private companies grew and driving their performance in line with the public values has been a major point of concern, with various instruments available to secure public values. It is to be expected that the same mechanisms would occur.

Public values are developed in interaction between government and the public, both through representation and advocacy. In representative bodies, parliaments, public values

are often formulated in general terms: for instance “availability of transport services to all should be secured.” In bureaucracies, they often get the character of goals: for instance “in ten years everyone should have a bus stop at less than a 10-minute walk.” On the level of service delivery, they can get the character of a design rule: for example “the operator should provide a bus stop at maximum of 300 meters of each home.” So the public value is the same, the specificity varies. Obviously, in the interaction between government and the public, ideas about rights and obligations of citizens, and the principles of government play an important role (Bozeman 2007).

Public values can be secured by all kinds of means. They can be secured by means of technology, for example by realizing infrastructure to secure specific accessibility. Another way is securing public value by institutions, for example by laws that codify privacy standards, or by contract, for instance to secure service availability of a data center. All these instruments to secure public values have a different life span. Infrastructure can be there for centuries, laws for decades, contracts for years. This can be challenging, as the debate moves on and the prioritization of public values is changing continuously. After a major railway accident, safety is a key public value and often new securing instruments are demanded.

The idea sounds simple and ideal: in a political context public values are formulated and then later translated to specific actions. However, theory on public values identifies a series of dynamics that questions at least this simplicity (De Bruijn & Dicke 2006, Steenhuisen 2009).

First, as with subsidies for transport services, every instrument itself triggers new public values. For subsidies, it became clear that efficiency had to be secured. For data platforms, privacy obviously is a major public value that has to be secured. Moreover, because in the field of data, mobility platforms can align with public values in that field. Open data is an instrument that has been related to economic development and transparency. So, instruments that are implemented to secure public values trigger new policy cycles on other public values.

A second dynamic is about coordination issues from formulating public values to implementation. May and Wildavsky (1978) show how this coordination works in various policy cycles and various levels. We apply them to the issues around data platforms. Governments can use data platforms and collectivized apps to secure public values. A public data platform for mobility will be set up to secure those values that the political process has prioritized. The literature on public values shows the challenges that exist to deliver on those values. Like the need to translate the broad values coming from a political context to narrow indicators in a contractual context. This often leads to poor representation of the original values, as what is objectifiable and measurable takes priority over what is desirable. Was the original intent at considering budget for the platform better sustainability, the travel time gains might eventually be the driver at implementation.

A third dynamic is related to strategic behaviour at the bureaucracies and service providers. This may misalign the effect of the instrument, in our case the mobility data platform, with its original intent. A hypothetic example: a platform was aimed at improving the quality for pedestrians, but in the hands of the road agency, it was refocused on car traffic flow at traffic lights.

Finally, instruments and politics may develop at a different pace. Moreover, when public values are secured through an instrument, the design is often rather inflexible. This is problematic because public values are highly political and therefore dynamic. Political priorities – for instance anticipating or following elections or media attention – can change dramatically. For example, privacy has changed as a public value through the massive growth in the use of social media.

The key challenge of a data platform for mobility will be to keep align in implementation with the original public values and make its organization, governance, and institutions flexible enough to realign with future changes in the priorities in public values.

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2.7 Multi-level governance: layers of authority as problem and as solution for smart mobility

G

There is no such a thing as 'one government'. A further look into government reveals multiple layers, from local towards supranational public entities, wherein authorities are distributed. At all levels problems and solutions are framed differently and collective action might get complicated. At the same time, this complexity can be a source of solutions for smart mobility platforms.

Key words: multi-level governance, layers, jurisdictions, agency, complexity

When metropolitan authorities see value in a data platform for mobility, implementing it is a sustainable way can be a challenge, because they are not the only authority in the game. Hooghe and Marks (2001) illustrate well how governmental systems have a distinctive layered characteristic, from Europe as a supra national layer through countries, regions and municipalities, and possible other jurisdictional layers. Two distinct public qualities - the agency (power to act) and the fiscalism (power to levy tax) - are distributed amongst those layers. Furthermore, this distribution drives for a large part the way in which problems are framed and consequently which public values and instruments are prioritized into policies. For example, where a municipality is confronted with the problem of unsafety for pedestrians or limited parking at the city center, a supranational government might have a different perspective focusing on CO2 emissions and market functioning. In addition, the municipality can start redeveloping the city's crosswalks or build a car park, the supra national government would focus on emission standards and regulatory conditions.

In such a context, the way a problem reveals itself is different from different governmental levels, and this consequently will be triggering different answers. This obviously is also true for data platforms for mobility. They might align with national policies for more governmental transparency and open data. They might align with a municipal need to improve circulation of cars.

As this layered structure of government matters, a number of concepts from the literature are key. As mentioned before, ‘agency’ represents the authority a governmental body has on a certain topic. ‘Jurisdiction’ is the geographical area in which a governmental body has agency. ‘Fiscalism’ points at the way that tax revenue flows into government and is distributed over governmental layers. Unitary points at the hierarchical relations that might exist between layers, with lower levels of government expected to follow the unitary state in policy.
For the metropolitan areas we are dealing with a number of issues is key. Some mobility-related issues and solutions have clear spill-overs, scales and dependencies. A municipality hindering through-traffic is shifting the burden on surrounding municipalities, which is a negative spill-over. A metro system does only create value on the scale of the entire metropolitan area. That metro system will be dependent for full functioning on local public transport solutions: park-and-ride, bike or bus facilities, feeding travellers to the metro.

Consequently, the way that congestion is seen as problematic is different on different scales. On metropolitan level, the effect on economic development might be the first public value that is seen as under threat. On a municipal level, the high levels of NOx from stop and go traffic in a particular area might be seen as the public value under threat. On a local street, the long queues at traffic light, limiting local traffic could be seen as the public values under threat. Economic development, health and accessibility could all be aspects that could be driving the implementation, however, all in slightly different direction.
So, problems and solutions operate on different levels. At the same time, governmental layers may have different instruments that could help drive the solution. Traffic control and the related sensors could be under the control of local authorities, the contract with bus operators at a metropolitan level and the railways on a national level.

Also, authority operates in different ways. They are more fragmented or more concentrated, have a more general purpose or a more specialized purpose, are stable or fluctuating, authorize overlapping or mutually excluding territories, etcetera (Hooghe and Marks 2001).

The way in which the governance of a data platform will have to be developed is heavily dependent on these factors, and on where the platform lands. If the goals are expected to be on a metropolitan level and no organizational entity exists on that level, a principal has to be set up on a metropolitan level, for example by cooperating municipalities. And someone will have to develop and maintain the platform, for example the ICT department of one of the municipalities. If a metropolitan authority with focus on mobility exists, this entity can take up either or both of these roles. So, there is a relation between the goals of the data platform and the governance and institutions in the region. They both have scales that may align or not. This alignment in turn triggers the potential and need for a change of governance.

Finally, multi-level governance is a dynamic feature. Especially ‘agency’ and ‘fiscalism’ are shifting in the course of time. This can be illustrated for smart mobility as well. Not just the governmental problem owners of a metropolitan data platform for mobility operate on various levels. One could argue that companies like Google and MAAS are building an international data platform, also in the field of mobility with very little intervention from governments. Consequently, the potential to secure public values (like privacy) related to specific jurisdictions into those solutions can be only realized through regulation, generally realized on a national or supra national level. The more globally operating companies matter, the more a need will be felt to shift authorities towards these more centralized levels.

So far we framed multi-level governance as a source of complexities. Complexities are often seen as problems. However, the variety of layers can also be a source for smart mobility solutions. When looking at the broader picture, multi-level governance issues can drive the potential of a data platform on a metropolitan level. The to go option seems to be having a metropolitan entity, cooperative or unitary, that can drive the goals and implementation of the data platform. Four options occur when no suitable governance exists on a metropolitan level. First, the implementation can be aimed at limited goals. For example, one municipality could just start gathering the data of the various municipalities in the area have available and make in usable and useful for others. Second, a special purpose entity could be set up that sets the goals for the platform and drives it

development both financially and content wise. One could think about a new cooperative body between local municipality and potentially the national or regional government. Third, a more generic integration of mobility policy could be developed, with the platform being only one of its potential instruments. Mobility policy that encapsulates the daily urban system of the inhabitants of a metropolitan areas makes sense. Obviously, the platform plays only a minor part here. Finally, data platforms on mobility are also developed by the market parties. They have an advantage as they can develop the technologies and can easily scale and adjust to various authorities. These private platform solutions could be valuable to fragmented metropolitan authorities that are lacking the governance on a metropolitan level.

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2.8 Policy instruments: a short manual

P

Governments are special actors, with public authority. They may use instruments that other actors lack. Altogether governments have an impressive toolkit, including laws, regulations, financial instruments and a range of soft behavioural instruments.
Key words: policy, instruments, nudging, law

From the perspective of journey-planning platforms, the government's toolkit is promising. It is full of possible instruments that governments may use to influence the behaviour of actors. Many public policy scholars proposed typologies to oversee these policy instruments public authorities may use. The book 'Carrots, sticks and sermons' edited by Bemelmans-Videc, Rist and Vedung (1998), for example, discusses and critiques many attempts that try to do so. The book title quite catches the lion's share. Carrots stand for financial, sticks for legal and sermons for communicative instruments. A general problem with more advanced typologies and their terminologies is that they are often culturally biased and they easily age and get old-fashioned. Still, we can identify a few recurring and relevant dimensions or distinctions across major typologies. We will discuss them.

First dimension is the distinction between tools for *detection* and tools for *effecting* (Hood, 1983: 3). The two terms come from cybernetics. Carrots, sticks and sermons are all instruments that aim effects. Besides that, policy instruments may also aim to detect, to gather information and explore a possible problem situation.

A second often-used distinction is that between *imperative* and *voluntary*. A legal instrument is often used in a more imperative sense and communicative instruments more in a voluntary sense, but this is relative. Compliance with the law is never strictly imperative, but always goes with some kind of voluntary element and some communicative instruments can be very imperative.

A third major distinction is that between *substantive* and *procedural* policy instruments. Substantive policy instruments are more direct in the sense that they are about providing goods to people, taxing people or rewarding certain behaviour. Procedural policy

instruments are more indirect. They are about starting a reform process, creating a treaty with stakeholders, adapting the institutional landscape within a sector, etc.

This toolkit is also subject to change. Some tools are deemed old-fashioned, others are found full of promises. Especially soft behavioural instruments are in vogue currently. Governments have a variety of means – i.e. budget, authority – to influence the behaviour of actors by communication. In popular language, they may *nudge* actors to behave more in line with a public goal.

Thaler and Sunstein (2008) wrote a standard book on nudging. In theory, nudging is seen as a way to improve the world by tinkering with the choice architecture of the mass. Governments may stimulate people to make certain choices that are considered safer, healthier, cheaper or more sustainable. Thaler and Sunstein specify roughly three ways of nudging. The most obvious one is direct incentives for people to make certain choices. A second way of nudging is providing information about choice alternatives. A third way is to tailor the process of making choices, for example by implicitly offering a default or by simplifying the process of making choice in a certain way. Simply put, if you offer strawberry and banana, few people choose chocolate. Nudging is a very relevant type of policy instrument for the potential of smart mobility platforms, but certainly not the only one.

What does this variety and adaptiveness of tools mean for public authorities developing smart mobility platforms? First, smart mobility platforms themselves are promising instruments for public policy. By means of a platform public authorities may try to influence travel behaviour. Second, there are several instruments accompanying a platform. For instance, authority and communication are used to stimulate actors delivering data. Third, instruments also affect actors developing platforms. For example, they may stimulate to improve data management systems for privacy reasons. This column shows, there is a large variety in how to target and design instruments. Not only can these platforms target for a large variety of instruments. Many different types of instruments can be applied at the same time, making a ‘policy mix’.

One note about government is vital here: a full and adaptive governmental toolkit may look promising. However, this must not lead to the perception that governments can use them without any limits. Effectiveness of the tools will be a function of the power position of public authorities, among other actors. In other words: governance also matters here. For instance, communicative instruments may be very imperative if they are backed by hierarchical authority. In a networked relation, imperative communication is less likely to be effective.

The handbook serves to oversee the variety of tools in relation to governance and line up its practical implications.

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Part 3: Empirical columns

3.1 Governance problems and solutions in the real world: a collection of empirical columns

"Life is not a problem to be solved, but a reality to be experienced" – Soren Kierkegaard

Smart mobility platforms are erected anywhere at an unprecedented pace. That's even more the case for apps running on those platforms. For most cities, multiple smart apps are available. The platforms and apps are either public or private, idealistic or commercial, primitive or sophisticated, unavoidable or almost invisible. This pace and variety show that we live in an exciting time. This is the time that engineers and governors are both struggling and innovating making mobility smarter. They will be confronted with a wide range of governance problems and they will find interesting solutions to them.

In the previous section, we showed that governance thinking is grounded in theories of institutional economics and public administration. However, these theories are old and range wide. Governance problems and solutions about smart mobility platforms are found right now in very specific areas in the real world. In the following section, we want to dip in this real world.

We had the privilege to study 12 of these platforms. Most of them are developed in the EU, some farther away. We wanted to approach these initiatives open-minded. The main goal of our calls, visits and document analyses was to learn about their projects rather than check whether theory was pointing us in the right direction. We were interested in general governance issues, such as how is the development of these platforms organized? What features do the platforms have – i.e. influencing behaviour, including real-time data, involving users, including multiple modalities? What institutions do these features challenge? In what institutional context – i.e. laws, contracts, ownership structures - are the platforms born? What problems do they face and what governance solutions – i.e. transactions, strategies – have they found?

For the case studies a first long-list of possible cases was developed. These prospective cases would have to include data platforms focusing on transport processes, either

capturing passenger or goods transport, planned or realised vehicles flows or networks status. In addition, the platforms could have an element in which trips (again goods or passengers) were advised, based on the data in the platform. From this long-list of 73 possible cases, we selected 12 cases to further analyse based on variety and access to information on the cases.

An analysis framework was set up focused on governance. The framework started with establishing who was the manager of the platform, as the key stakeholder. Following the framework sought who the patron, the stakeholder(s) initiating and possibly funding the platform, was. A third set of stakeholders was based of the data flows into and out of the platform, establishing who were the producers and users of that data. Finally, the arrangements were charted between the stakeholders. In addition, more generic relevant institutions were looked for, for example on privacy the governance arrangement that was chosen with those stakeholders.

Through desk research, the key arrangements were looked at. In addition, interviews were carried out with representatives of the key stakeholder to get an overview. In some cases, also representatives of the other types of stakeholders were interviewed.

Name	**Covering**	**Key data***	**Planning functions**	**Nudging****
CarFree AtoZ	Washinton DC area, US	Network, network loads, schedules	Multimodal trip planning	Yes, informational
NLIP	NL	Customs and inspection requirements and tracking	Information provision in customs and inspection process	No
Maas	Helsinki, FI	Cost and schedules,	Multimodal trip planning and booking	No

		vehicle availability		
Optimod	Greater Lyon, FR	Network, network loads, schedules and vehicle availability	Multimodal trip planning, public transport, walking, cycling, driving	No
OV9292	NL	Network and schedules	Multimodal trip planning, public transport and walking	No
Plan a Journey	London, UK	Network and schedules	Multimodal trip planning, public transport and walking	No
PTV	Victoria, AU	Network and schedules	Multimodal public transport trip planning, walking and cycling	No
Qixxit	DE	Network, schedules and vehicle availability	Multimodal trip planning public transport, walking, cycling, driving	Yes, informational
Reittiopas	Helsinki, FI	Network and schedules	Multimodal trip planning public transport, walking, cycling	No
TIA	Vienna, AT	Network, schdules, network loads	Multimodal trip planning public transport,	Yes, informational

			walking, cycling, driving	
VSS	Stuttgart, DE	Network and schedules	Multimodal trip planning public transport, including tariff information	No
Mobidot***	NL	Travel behaviour of people	Depends on user of the app	Yes, depending on user of the app
* Data needed for trip planning, not necessarily stored on the platform. ** Informational nudging presents the options to the traveller with effects beyond travel time. *** Mobidot is not a platform, but an app that collects multimodal, door-to-door and 24x7 movement behaviour of people. The information can be used by Mobidot's clients, usually local and regional governments. It is a relevant case as one of the options of the PETRA platform is to gather information from the users of the app.				

Table 1 Overview of cases (more details on page 156)

This approach resulted in a colourful picture of very different initiatives. In the overview in in this handbook we present the platforms we have contacted. The empirical columns in this section are not case studies per se. They are reflections inspired by our findings. The majority of the columns show governance complexities that the initiatives faced. However, they all at least imply suggestions for those involved in developing a platform. They indicate governance failures and good practices, and also sheer good or bad luck. Together these empirical columns provide the bigger picture of mobility data evolving in this exciting era of smart service provision done or facilitated by governments.

3.2 Do all roads lead to Silicon Valley?

G

Innovations like mobility data platforms hold promises. A local platform has to deal with vested institutions. Vested institutions may delay innovations. The institutional void may be filled by a global player not interested in local institutions. If a local stakeholder group doesn't want this global player to set the standard; they must be able to look beyond their interests.

Key words: institutional void, digital platforms, innovation, vested institutions

Platforms seem to be the ultimate manifestation of the network society; by connecting various groups of actors and their products, needs, data, etc. to each other, everyone seems to potentially be better of. The distributed nature of the entire ecosystem, with various parties owning the physical and digital infrastructures involved, crossing boundaries between organizations and sectors, seems to ask for parties to collaborate on the platform in order to make it work.

Governments and other actors such as NGO's and trade organizations look at forms of (network) governance to make a difference in this networked world of platforms. However, digital innovations may impact social structures and practices faster than institutions and processes can keep up with. They might be disruptive as well. For example, the engines of the shared economy are global platforms facilitating local sharing of services. Mechanisms – let alone laws and regulations – that address 'sharing' for, for instance, safety and health issues are just hardly there yet. And how do local authorities get the data they need to enforce their regulation if the data are owned by global platforms? This example shows that digital innovations may question the ability, legitimacy and effectiveness of rules and institutions. In other words: digital innovations lead to an *institutional void*, in which governments and other actors that used to be involved in governance have limited capacity.

Institutional voids can also be witnessed in the case of mobility data platforms. ICT's enable us to develop tools that optimize both the individual journey of a traveller as well as the collective interests and the system as a whole. However, as our cases show, the many

stakeholders involved are often hard pressed to find common ground in which a mobility data platform is to be founded. Ministries, local governments, transport authorities, a host of transport providers, interest organizations, and many others, all have their own stakes, some of which are bound to be threatened by a new platform, at least to some extent.

But while groups of stakeholders take their time debating the design of the platforms and the rules of operating it, digital innovators are finding it far less difficult to move in this domain. Take Google for example, based on their extensive information position (e.g. maps, traffic information), they've moved into the domain of mobility data with relative ease, making use of the lack of rules and standards to set their own. As cities and metropolitan areas are each organizing their own process and design of their platforms, Google Transit's data standard is by now common, not just for Google, but also to exchange data between transport operators and governments, as some of our cases show. Consequently, increasingly Google becomes a provider of a global mobility data platform, which due to its wide coverage has become the de facto solution for many travellers. Obviously, it neither takes into account local value diversity nor specific wishes and demands from (local) authorities. It also does not optimize anything except for the individual traveller.

As long as local stakeholders each try to develop a platform that is fully in line with their current interests, momentum is lost to the likes of Google. This does not necessarily have to be the case. 9292OV shows that when a stakeholder group is able to look beyond their interests, both petty and vested, and collectively coordinate their efforts towards a platform, it is not only possible to come up with a successful platform, but also to have Google meet them at their terms. The 9292OV platform serves to exchange and open information on Dutch public transport and as such is the key data source not only for the parties involved, but also for Google. In other words: an individual traveller may choose to use Google, but in effect uses the coordinated information of 9292OV in the background.

3.3 Assessing right now: gains, costs and the traveller's logic

P

Comparing gains and costs of projects for intelligent mobility show an alarming picture. Many million euros have been spent without a clear sight of a pay-out. Moreover, it proves really hard to assess the gains of these projects.
key words: cost-benefit analysis, logic of consequences, logic of appropriateness, funding innovation

What happens if we try to draw up the balance sheet right here and now? Do these platforms actually improve society? Do the gains outweigh the costs, as envisioned? And by the way, whose gains and whose costs? When are we able to sift the wheat from the chaff? When do we know if we arrived in the promised land or created bulky public money eating machines instead?

First the costs. The costs of innovation are relatively concrete. If we only look at the EU funded projects focused on data platforms or frameworks for intelligent mobility in the past five years, this easily adds up to an investment of more than 100 million, the bulk of which is subsidy. These projects are for example SuperHub, MyWay, Petra, Modum, Sunset, Ecompass, Reduction, Peacox, MoveSmart, MoveUs, Hope, Team, Instant Mobility, Tide, Direct, WiseTrip, Enhanced WiseTrip, EUtravel, Bonvoyage, I-tour and Catch.

Then the gains. We assume that the main gain of intelligent mobility platforms lies in 'being well-informed'. Among our interviewees, there is strong consensus about the potential gains being huge. A slight change in mobility patterns, for example a few percent less cars, indeed, may be worth many millions in terms of prevented costs, health risks and environmental damage on a yearly basis. However, we should multiply its value with the frequency of use. If platforms – either developed by EU funding or not – are not being used, if there is nothing to multiply with, the actual value might be a trillion times zero users, and remain zero.

Still, if we assume that the platforms will be used, the value remains difficult to estimate, for at least three major reasons. First, being well-informed consists of a great many facets,

some subjective, others contested, and it may differ a lot per person and per region. Second, its perceived value changes over time. Third, the current quality of travel information, the benchmark in this matter, also widely differs between European cities, and even more so in the rest of the world. For some cities we visited, the available travel information already exceeded the ambitions of certain platforms in the making. But we also found transport companies involved in the process of building a fancy multi-modal platform and an app for intelligent mobility, whereas they somehow could not even print out a single static map for their daily customers to show all the lines and stops for a single transport mode. Fourth, the value of being well-informed also strongly diverges when we consider the actual goals and the actual users. Is it about the environment or the economy? Is it about individual profit or system stability? Is it meant to help business, travellers, planners, policy-makers or a mix of them? Given all these variables, estimating the value of being well-informed is quite a Herculean task.

There is a fifth more fundamental reason as well, that refers to the assumption that better information would lead in change of behaviour. This assumption – on its turn – is based on the idea that travellers, or any other mobility related stakeholder, actually make their choices on the basis of the best information about the consequences of their traveling. But do they? In other words, the traveller would have a ‘logic of consequences’. An Israeli interviewee openly doubted whether there is a market for multi-modal travel advice, because people getting into their car wouldn’t be intending to leave it halfway for public transport, at least in Israel. This would suggest that there is more than calculation of consequence. In a broader sense, when it would concern the risks of smoking, for example, being well-informed may prove ineffective for addicted smokers. Being well-informed about CO2-emissions may face a similar fate. Not only because people may not prioritize sustainability, but also because their daily decision-making may just as well be based on identity, cultural patterns and what people deem appropriate on a routine basis, instead of rationally weighing pros and cons. In other words: to behave according to a ‘logic of appropriateness’ instead of a ‘logic of consequences’. If the ‘logic of appropriateness’ is valid, and there is much reason to believe it is to a considerable extent, this would seriously affect the gains of better travel information.

If we draw up the balance sheet now for a group of EU projects, more than a hundred million have been spent in a few years to produce many more or less similar platforms and frameworks with often little users for the present, if any, and accordingly without a clear sight of a proportional pay out for users. This is not surprising per se and perhaps not even as alarming as it seems. We are dealing with a large-scale innovation process. The costs precede the gains. But if this is not the right moment to see the gains, when is?

3.4 The governability of intelligent mobility

G

There are major differences between assessing the technical feasibility and assessing the governability of intelligent mobility projects. Governance is perhaps the most critical variable of the two but also the most difficult to assess. Instead of trying to assess governability as an analytical challenge, it is perhaps more doable to focus on a 'negotiated language' to discuss governability during the project.
Key words: governability, technical feasibility, incrementalism, wickedness, negotiated language

A structural lack of means. A lack of political will. Major conflicts of interests. Leading politicians face the end of their period. Critical stakeholders remain unrepresented. The number of relevant parties seems interminable. The leading stakeholder withdraws halfway due to a completely unrelated scandal. The parties with authority don't interact with the ones with expertise. Examples of governance problems are numerous. It seems that governance is not just about willingness. The question may even rise whether proper governance of mobility data is actually possible.

In the context of our interviews many respondents challenged or questioned the 'governability' of their ambitions. How to assess the governability of these innovative projects and how to respond accordingly? We take governability, quite literally, as the ability to manage an innovative development in line with the existing interests, rules and power relations. As such, governability is a full brother of 'technical feasibility'.

There are striking differences between the way projects deal with 'technical feasibility' on the one hand and 'governability' on the other. Let us first describe these differences and then explain them. For technical feasibility, projects generally rely on expert judgment, often supported by a portfolio of previous projects and past performance. If yes, the project can move forward. From an empirical stance, also, the technological complexity of various projects in this domain of intelligent mobility is fairly constant and predictable, while the governability widely differs and may easily bring surprise. Whereas the technical feasibility

of tackling privacy issues can be considered fairly constant, the governability can be quite another story.

The governability of projects is generally much less easy to assess than technical feasibility. First of all, there are many ‘soft’ and partly ‘hidden’ aspects to take into account, e.g. interests, relations, means, institutions, dynamics. Next, there is no natural expert to rely on. The assessment is virtually always political, temporary and full of uncertainties. All in all, assessing governability almost never brings a simple yes or no. Moreover, compared to technical complexity, it is much harder to make an analogy for governance complexity with respect to the performance in past and future cases. Though questioning the governability seems very relevant – even essential – the answers are often vague, contested and impractical.

Governance is perhaps the most critical variable for the feasibility of these projects but also the most difficult to assess. What should be the leading question? Should we focus on ‘the right’ governance structure? Should we run through a long list of relevant aspects (see all columns) and try to draw a critical line somewhere for minimal governability? Both options seem plausible, but there is no scientific basis, no consensus that supports such a distinct way of assessing the governability. Basically, governance is about human behaviour, of which assumptions are generally way more contested than assumptions from natural science. As a result, governance issues are ‘wicked’. ‘Wickedness’ means that any solution requires cooperation between actors with different assumptions *and* different priorities. Neither a scientific approach nor political decision-making suffices to deal with this.

This lack of consensus about governance may trigger project teams to continuously evaluate this. Surprisingly however, another general observation is that few projects systematically assess their governability, at least not explicitly. Why is that? Perhaps it is because most projects studied are still in a rather early stage of development. A different explanation is that assessing the governability of a challenge implies integrating different views of different people with different priorities. In other words: assessing governance is a wicked challenge in itself. It requires governance again, with all its efforts. This makes

assessment of governability very unattractive for all trying to support the development of smart mobility, a laborious adventure with the certainty of disappointing outcomes.

Likewise, discussing how to assess governability seems disappointing as well. It is difficult, hardly done, at least explicitly, and ultimately not really doable. Though perhaps true, this cannot relieve us of the trouble to deal with governability. It remains highly relevant. One way to overcome this deadlock is to see the assessment of governability not as an analytical challenge, neither as a question to answer, nor a box to tick off, but as a variable, a constant uncertainty in a long and incremental process. In such a process, platform developers need to start developing a ‘negotiated language’ on governability. What makes governance complex for the specific case? What kinds of complexities are relevant? Why are these complexities considered manageable? Such a language would be a first common ground for actors developing smart mobility and a first step towards assessment. It helps to communicate about governance complexities and a first step in finding supported solutions.

3.5 Governance creep: the implicit lock ins of governance

G

Acknowledge that the choices in governance structure are more than facilitative for the development of intelligent mobility. The difficulty lies in the fact that these choices, though quite influential, are often not up to the developers to decide and may even remain variable.

Key words: path dependency, governance structures, vendor lock in, politics, design dilemma

Path dependency is a concept originally developed by economists to describe technological developments. Past choices in technology, let's say choosing a Windows-application, may prove restrictive in the future. Choices in governance likewise may prove restrictive. For example in Helsinki, we encounter a 'vendor lock in'. The transport authority HSL first bought technology developed by Reittiopas. Later, to further develop this technology, however, HSL had to invest in the technology that Reittiopas owned. This complicated and delayed the innovation process.

Path dependency basically is a concept to alert developers, as they may fix their own future development by the earlier choices they make in their technology. This also holds for choices in governance, but there are differences, at least two. First, choices in governance tend to be less fixed. Instead, they create temporary freezes. They generally are reversible. That is, in first instance. A simple example is that the involved parties participate and little by little create vested interests. Many transport authorities develop platforms focused on public transport only, such as OV9292. Walking and cycling are sometimes included, but taxis, services like Uber and car-sharing are generally not included. The general governance structure of platforms, with a central role for public transport companies, does not exclude these transport options per se, though it might boil down to the same thing. For similar reasons, platforms, like for example VSS in Stuttgart, tend to develop without much interaction with users of transport or policy-related users of the information platforms offer. This does not restrict the future development, but indirectly influences it possibly just as powerfully.

In Australia, the journey planner of PTV is a simple platform. This reflects the governance arrangement. The State has the political power and the funds, but is distant to the population, whereas the cities are close to the population's interests but have no significant means to act.

In the EU-funded project Superhub, the platform continuity suffered from a lack of funds, change in political priorities and change of politicians in power. Each of these dynamics didn't determine the future development by itself, but together they did so gradually and insidiously.

A second peculiarity of the governance type of path dependency is its pluriformity. Choices in governance tend to take place in many arenas, connecting to many other issues. They often are not up to the main developers to decide, but instead require negotiation, lobbying or simply waiting. Think of regulatory specifications, the availability of Application Programming Interfaces (APIs). Political readiness to risk privacy breaches is also a typical factor of governance that can emerge as a *Deus ex Machina* in the technological development. Do politicians in power allow for the use of cameras on the public road? Do politicians in power allow to gather information about people's travelling behaviour if there is a reasonable risk this information might be used without consent by third parties with commercial interests?

As a conclusion, the concept of 'path dependency' is relevant to the choices made for governance, but the metaphor does not seem to hold. The way choices in governance influence the future development seem to be less fixed and more accidental. 'Governance creep' is perhaps a better way to describe these dynamics at play. Besides the risk of triggering non-intended restrictions in the future development, similar to path dependency, there is also the opposite risk of non-continuity. Governance may determine a path, but may also later block it again or create a diversion. Choices in governance are double-edged. To anticipate this, developers face a fundamental design dilemma. How to include the choices in governance in the design process of a platform, given that they are less definitive and not up to the developers to decide?

Governance is often regarded as a side issue, and technological development the core of innovation. Though the relevance of governance is hardly debated, it is generally treated as a conditional issue *as if* it is sufficiently dealt with if it does not interfere or erect barriers. This popular notion of facilitative governance, however, perhaps underestimates the way governance intertwines with the technological development itself. Perhaps governance is less innocent and less instrumental. Choices in governance influence the innovative developments, although more implicit than design choices.

3.6 Pain in paradise: accounting for trade-offs

The intelligent mobility platforms involve a wide range of trade-offs, some explicitly dealt with others hardly mentioned. Though 'making well-informed trade-offs' is the key goal of these innovation projects, the developers' ideas about *who* should make which trade-offs appear rather premature.

Key words: trade-offs, accountability, utopian thinking, governance arrangements, nudging

Intelligent mobility platforms generally start as utopia, a paradisiacal new world. Thanks to these platforms, better informed customers choose the greenest, safest and cheapest transport modality and better informed governments make policies to further improve all mobility systems for all goals. But should we perceive these platforms as a paradise without pain? More likely is that they bring trade-offs, gains *and* pains, given the many competing values and interests in the mobility sector.

How do these platforms deal with the trade-offs they interfere with? What kind of trade-offs? Who makes them? Let us first try to describe the trade-offs made and save our judgment whether to consider these trade-offs good or bad for later.

Many trade-offs pop up in our studies. We encountered two major causes: transport modes and data quality. Encouraging people to use their bicycle, for example, can be positive for health and environment, but it may simultaneously increase the number of accidents, including the number of casualties. Sometimes, safety and sustainability are at the same side of the trade-off, for example in the case of train versus bus (e.g. Digitrans). But when is a safer *and* greener transport mode preferred over a cheaper and faster one? The other major cause for trade-offs is data quality. Being well-informed is the central premise of why we want these platforms, but data quality may require quite some time and investments and it is never perfect. Making data available also obliges to maintain data. When should bad data quality be a reason not to disclose the data? How should data quality be measured? Collecting data from mobile phones, furthermore, requires battery use. How to balance data quality with efficient battery use? These are the major examples of trade-offs we came across.

Also noticeable are trade-offs that we did expect, but did not really came across. For example, when is the innovation project worth its investment? Or, when is the option to stay where you are better than using any transport mode at all? Or, what if being well-informed at the system level competes with being well-informed at the individual level, like communicating vessels? These three very different trade-offs, though relevant in practice, appear undiscussed by our respondents.

We have two points of discussion with regard to how platforms deal with these trade-offs.

First, the question who should make which trade-offs is answered very differently per case, if not left implicit. Should it be the government, the market, the expert or the individual traveller? If we look at it from a theoretical perspective on governance arrangements – market, hierarchy and network – respondents generally propagate to entrust trade-offs to a single governance arrangement. ‘That is up to the market’ (market) or ‘the government should take the lead’ (hierarchy) are often heard phrases. In practice, however, trade-offs typically come about in a mix of governance arrangements. Nudging, for example, is a frequently used hybrid between the preferences of a so-called ‘choice architect’ (hierarchy) and the preferences of users (market). Yet, we hardly came across arguments how trade-offs should result from a combination of multiple governance arrangements, i.e. market, hierarchy *and* network. A network arrangement is also hardly argued for as a way to make trade-offs, despite its omnipresence in practice. Respondents tend to have a straightforward idea of how trade-offs (should) occur in the platforms they support, whereas practice remains more fuzzy and less outspoken.

Second, being well-informed is considered the key contribution of these platforms. But what does ‘being well-informed’ exactly mean if it remains implicit precisely where and when trade-offs are and should be made by whom? An answer to this complex question is generally left to the users. An obvious way to get an impression of the information needs is user involvement. A minority of platforms have invested in this. User involvement answers the question what information the users prefer for their purposes. However, for trade-offs to be known, the more advanced question *why* users use the specific platform should be

answered. We haven't found a platform that invested in this intelligence yet. As a result, the trade-offs about data quality remain somewhat implicit. And the platform that is consciously dealing with trade-offs remain utopian.

3.7 The Frankenstein-trap: proper operationalization of public values

T

The operationalization of public values for large-scale innovation processes is an intricate process with iterations and changes to be expected. In practice, the operationalization of public values appears quite a bureaucratic or technocratic endeavour without much public debate or political involvement. This is not necessarily wrong, but it brings governance risks.

Key words: public values, trade-offs, user involvement, policy process, evaluation

Public values are important drivers of the innovation in intelligent mobility. A public value, to put it simply, is 'what we want'. But what do we really want? Think of an old fashioned public value like a city's accessibility or public efficiency, or a more recent one like sustainability. It often is a mix of public values that drives major innovations. An interesting aspect of innovation is the uncertainty. Although we seem to want it, we don't yet know what we will get. Hence, in the meanwhile, until we ultimately achieve something new, we can't yet tell if that is what we really want. We could call it the Frankenstein-trap. Hence, innovations require constant or at least repetitive reflection. Is this what we really want? Public values require gradual operationalization and even radical reconsiderations should be thinkable. How does this process work and how is it facilitated? Governance is key to this.

In general, the operationalization of public values can be understood to co-exist in four interacting stages: advocacy, politics, bureaucracy and provision.[1] People advocate for certain public values. Politicians acknowledge and negotiate certain values. Bureaucracy further specifies certain values. Finally, companies may provide services that meet certain public values.

In the studied cases, we do not see a very rich process of operationalizing public values in this respect. There is often little politics, little advocacy and little provision. In the London case Plan a Journey, for example, like many other developments within transport

[1] Bachrach, Peter, and Morton S. Baratz. 1970. *Power and Poverty*. New York: Oxford University Press

authorities, the operationalization of public values seems mainly geared to the 'bureaucratic stage'. A probably related observation is that the public values driving these developments more often than not come without a clear target to actually provide services.

In the EU-funded projects, public values seem omnipresent, but their operationalization often remains neglected or hidden. The main project objectives, for example, are typically neither oriented towards nor responsive to a broad, reflective and interactive process of operationalizing public values.

The experience at Mobidot – a smart mobility software provider in the Netherlands – is that municipalities are generally reluctant to specify public values. What is the desired mobility behaviour to stimulate? What should be considered green? At the political level, the risk of reputation damage is mentioned as a main obstacle. Many specifications have a downside or a trade-off. At the bureaucratic level, the ingrained key performance indicators are mentioned as forces that keep municipalities from specifying new public values. Compartmentalization is also mentioned as a factor. It means that fractions within municipalities are used to and prefer to do their task as independent as possible, department by department. Innovations in intelligent mobility, however, typically bring together municipal departments and force them to cooperate. This often triggers explorative cooperation processes between departments that remain slow, noncommittal and nonspecific. Hence, public values often remain underspecified at the level of municipalities. Therefore, for the time being, provisional specifications are often made in a technocratic context by experts outside government. Possibly, these specifications appear controversial in five years or so, but for now few questions are asked.

To conclude, the operationalization of public values *driving* the innovation of intelligent mobility appears quite a bureaucratic or technocratic endeavour without much public debate. This is not necessarily wrong, but it has clear risks. How do we know if this is what we want? To answer this question, public values need to be contested. Little questions are asked about who 'we' should be. 'What we want' is suspiciously uncontested throughout most innovative projects studied here. This might imply two things. First, if public values are not contested, they are probably not public values. In this case it would be

questionable if governments should be initiators of these platforms. A second implication could be that ‘we’ are still asleep, until incidents happen wherein public values – such as sustainability, privacy, and public efficiency – appear to be harmed. In such a case, public values will be topic of a – generally politicized – evaluation study, where the platforms will be under public scrutiny. But in such a politicized situation it is commonly questioned if we really will learn ‘what we want’.

3.8 To nudge or not to nudge: beyond the question

Nudging is frequently plead for but rarely argued for in the development of these smart mobility platforms. Nudging has a great variety of appearances with many different nuances both in terms of morality and in term of effectiveness. Advice is to make them more explicit.

Key words: nudging, incentives, legitimacy, governance competences, dystopian thinking

Many data platforms aim to help governments in nudging for public values. If they do, this is generally considered obvious. No questions asked. But other platforms don't aim to, and some even explicitly refuse to nudge. What is nudging about in theory and in practice for intelligent mobility?

Thaler and Sunstein wrote a famous book about nudging in 2008. They provide a fruit basket of subtle ways to influence the behaviour of the crowd. Simplified, we can distinguish between providing incentives, providing information or plying the process of choice.

In practice, we also encounter a fruit basket of nudges, from simple and straightforward nudges to more subtle and invisible ones. In many cases, travellers are provided with faster trips based on historical patterns. In Venice, the PETRA demonstrator tries to secure public safety by routing people to less busy parts of the city. In Lyon, the car alternative is deliberately made more 'realistic' by adding evaluation criteria, like parking time and car ownership, that favour other modalities. In Arlington, the customer is provided information about the performance of a trip on a collective level, like CO2-emissions. In Singapore, making certain trips is rewarded with a bonus (e.g. lottery ticket?).

In the practice of these data platforms, it is notable that only few platforms nudge with direct incentives. Concrete plans to punish or reward mobility users for certain choices are generally absent, though very doable. Providing information seems the most used way of nudging. Structuring the process of making choices, the third way, is also present in the cases where mobility users are provided with advices.

Two basic but rather burning questions about nudging urge further discussion. What makes it work? And is it actually a legitimate thing to do as a government?

To start with the latter, nudging is not uncontroversial. It has a dystopian, *Brave New World* flavour. It is 'somewhat off-putting' as Thaler and Sunstein write themselves. Shouldn't governments always prioritize the freedom of choice instead of deliberately narrowing it with nudges? In practice, this question is not as rhetorical as it seems. There is disagreement. Some respondents explicitly advise against nudging. Whereas many other respondents, platform managers and their governments, are willing to nudge mobility users with advices that compromise the interests of these mobility users but contribute to public values. Often, these pro-nudging respondents implicitly assume that the goals of travellers and those of public entities are aligned. On one hand, it seems wise to acknowledge the existence of a moral quandary and to make explicit why nudging in which case is considered legitimate or not. But on the other hand, there also is a pragmatic way out. Nudging should be seen as a non-restrictive and an unavoidable way of influencing people. Non-restrictive, in the sense that nudges never block the freedom of choice. Unavoidable, in the sense that providing information always nudges people, deliberately or not, and the way choices are pre-structured always influences these choices, deliberately or not. That doesn't relieve platform managers to account for their nudging strategy, at least more than the current default to leave the moral risks of commercial exploitation and lobby infiltration implicit, but it does put nudging in a lighter perspective.

The other question also calls for further discussion. What makes it work? Nudging requires someone to nudge. A major, often implicit assumption is that there is a benevolent, higher authority able to oversee the desirable behaviour and to trade-off that desirability with the efforts and downside of nudging, if any. To cut this discussion short, we did not come across such an authority. Some data platforms do aim to contribute to the competences of government, in order to nudge, but the general observation is that governments are not yet able to operationalize and trade-off the behaviour they consider desirable. This doesn't kill the idea of nudging, but indicates there is work to do.

'To nudge or not to' is anything but a simple question with an obvious answer.

3.9 Doomed to fail? The need for user involvement

T

Involving the end user in the development of smart mobility is a design dilemma that developers seem to avoid. As a result, little is learnt about which governance arrangements may accommodate users in the development process.

Key words: user involvement, governance arrangements, learning, market-distortion, design dilemma

‘The main problem of realizing this paradigm change is not providing the service. That is simple. The main challenge is to get people want it,’ states Sampo Hietanen, director of MAAS in Helsinki. ‘Key is to look at it from a customer perspective.’ In his view, if innovative projects in this field are not directly funded by the customer, they are doomed to fail. In support of this view, we can indeed name a range of EU-funded projects that seem to have ended as soon as their funding stopped (e.g. Superhub, etc.).

This warning can be put into perspective, though, as innovation and learning doesn’t necessarily stop when projects stop. Innovation by nature comes with many trials and many errors. Failed projects inspire new projects. Innovation seldom unfolds as a straightforward success story but typically evolves serendipitous with unexpected gains. The current MAAS-initiative has also profited more and less directly from different EU-funded projects in the past (e.g. Mobinet, European MaaS Alliance). Public funds, of course, do not exclude user involvement. User involvement should not be seen as a guarantee for success. It may even slow down, fragmentize or commercialize developments in a negative way. This well-known, market-disturbing tension between user involvement and public funding pinpoints a key governance challenge: how and when to seriously involve the user in these developments of data platforms?

In the cases of VSS in Stuttgart, Superhub, Public Transport Victoria, Plan a Journey and PETRA, users were generally not involved, at least not at the time of study (April 2016), not as funders, not as stakeholders, not as experts and in many cases not even as testers. Tracking the behaviour of users was part of many platforms. This can be seen as a passive way of user involvement. In some cases, users were at least encouraged to

provide feedback to the new services, often without much response. In some cases, user involvement was expected to develop soon at the time of study.

The case of CarFreeAtoZ is somewhat more advanced, as users can create accounts to customize some of the platform services. There are plans to improve the user profile functionalities further. The MAAS-initiative is even more of an exception. Users are the intended funders in the role of customers of the new service. This case is under development.

Concluding, we have encountered projects that involve users in these innovations. But in most cases, user involvement appears extremely limited. The role of users often remains abstract, in the best case ‘expected soon’. But for now, their involvement during the innovative development remains under-articulated and not formalized.

A few possible explanations deserve mentioning. The ‘doomed to fail’ explanation by Sampo Hietanen is one. Perhaps the public funds dominating most cases *do* practically exclude active involvement of users, because the public money available may mitigate the incentives to actually involve the user. Another, perhaps more hopeful, explanation is that user involvement is under development, appeared more complex than expected, and may further evolve as these platforms mature. A source of complexity is the variety of users. There are tourists and commuters, but also public services such as police and ambulance. Their travel behaviour and information needs vary a lot. How to organize for a proper representation of users?

Is the absence of user involvement alarming? Is it a ticket to failure? This of course depends on the goals of the project. If the goal is experimenting with the application of new technology – such as in the Superhub project – user involvement may not be vital. However, if any learning goal with regard to real experience applies, then users are hard to neglect. Little can be said on the basis of real experience. Perhaps more problematic is the lack of answers to questions on a meta-level. How to tackle user involvement as a governance challenge as well as how to efficiently organize user involvement as an enrichment of the innovative process? Answers to those questions may be more vital for

commercial initiatives such as MAAS, as they have to survive in a competitive market. However, the time for free public experiments might be over soon and governance arrangements for user involvement will become a critical requirement for any smart mobility initiative.

3.10 Tell me what you need and I will (try to) give you what you want: addressing the travellers' needs

T

Addressing travellers' needs is necessary for mobility data platforms to be effective tools for implementation of public goals. These needs of these specific users may vary between the different journey stages. Clarifying the information needs of users at these journey stages helps to better tailor platforms.

key words: journey stages, users' needs, implementation of public goals

A platform for intelligent mobility should be more than just a journey planning tool. Travel information is not only relevant preceding a trip, but also during the trip at several stages, and perhaps even after the trip as well. Distinguishing the different stages of a journey and respective information needs can help identify users' expectations.

In literature, a journey is commonly divided in four stages: (i) planning stage (before the trip begins); (ii) at stop/station stage (transference points during the trip); (iii) on-board stage (also during the trip, inside a vehicle); and (iv) return trip planning stage (Grotenhuis et al. 2007; Zografos et al. 2010). We add a fifth one: after the trip. At each stage, we can identify and distinguish different types of information needs for different types of users.

- The planning stage is typically takes place at home, a hotel or work location. Users generally value the convenience of understanding all steps required to perform the desired journey. This requires a range of information regarding the entire trip in advance: routes and modes available, need for transference between modes, duration of the trip, costs etc. Therefore both static information (timetables for instance) and dynamic information (delays, disruptions) are relevant. PTV, for instance, describes the trip step by step and also provides a graphic overview of the entire journey with a map. Many platforms also add the possibility for users to purchase tickets online in advance (Qixxit or VSS, for instance). Some users may be interested in knowing in advance the trip alternative that emits less pollutants or that brings more health benefits (CarFreeAtoZ offers this information). Two important aspects that are missing in the platforms described in this Handbook: first, if the platform includes car trips as

alternatives for travellers, parking information should also be provided. Second, information regarding accessibility for people with special mobility needs – these users require details on ways to access stations and terminals as well as their surroundings.

- The stop/station stage are wayside locations comprised in the trip like bus stops, stations, park and rides, etc. The type of information required in this stage is mainly used for travel support rather than for preparation of the trip. Points of transference are of special importance as they have increased likelihood of posing challenges to travellers, both regular city commuters or tourists. Many times the need to make transferences during the trip hinders the choice of public transport modes for instance (with Plan a Journey, for instance, users can opt for planning trips defining the least number of transferences as the main selection criterion). The last travel stop can also be regarded as a wayside location and users may require advice on how to move from there to their final destination (like a map for walking as offered in 9292OV). In this stage it is relevant for users to know the time available to effectuate a transference between modes, changes in departure/arrival platform, accidents etc. Dedicated information for people with special mobility needs is also valuable in this journey stage.

- On-board information also aims at travel support rather than planning. It is the information provided during the trip and when the user is inside a vehicle. In this case information can be tailored depending on the moment in the trip: during initial or intermediary journey legs those users unfamiliar with the route may require travel alerts to indicate that it is time to get off the bus and switch to a different mode for instance. Qixxit offers dynamic information with alerts as the trip progresses. 9292OV provides static information – it lists all stops a mode makes during the planned trip (including intermediate stops) so to ensure the risk of missing the correct stop will be reduced. Stations with a connection to other modes of transportation are also points that can be informed. Tourists may also want to be informed that they are passing by a certain attraction or that a particular stop is the closest to it. Finally, availability of parking spots (either static or dynamic information) is useful during this stage.

- Return trip planning may or may not take place in all trips. Needs are similar to the initial stage and the return planning may even happen at the beginning of the trip as well. 9292OV and PTV, for example, allow users to plan the return journey by pressing a single bottom that switches starting point and end point of the trip to be planned.

- Travel information needs after the trip may seem redundant, but they can also be relevant. The platforms we studied did not focus on this stage. How far and how long did I travel? What did it cost me? How much did I pollute? How does my performance relate to the other options I had? Did the planning correspond with the journey?

Looking at the different journey stages may support authorities when designing a platform by helping them in the identification of the features needed to respond to users' interests at each stage. These interests may be multiple: they can be individual – time saving, cost saving, effort saving (all of them during the search process and also for the trip itself) – but also collective – reduced overall pollutant emissions, reduced overall traffic congestion etc. In any case, clarity on these expected benefits is needed so the platform can be designed and tailored accordingly. Attracting users is a necessary condition for authorities wishing to use their digital platforms as an effective policy tool for the implementation of public values (fostering modal shift or planning new mobility projects for instance). The success of these policies – the fulfilment of public values – depends on people making use of the tool.

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3.11 Where did all the conflicts go? The sense and nonsense of mapping stakeholders

Mapping stakeholders and their interests is a helpful but not a straightforward exercise for those dealing with the governance of mobility data platforms. Hidden agendas, shifts in stakeholder salience, and complexities varying per situation, limit the value of mapping stakeholders and have to be acknowledged to avoid attaching too much or the wrong value to the mapping.

Key words: mapping stakeholders, stakeholders' interests, wicked issue

Top-down approaches to innovations have been replaced by more inclusive approaches that respect that stakeholders matter, as Bryson (2004) puts it. And if stakeholders matter, mapping them, their positions and interdependencies seems to be a sensible thing to do for developers of smart mobility platforms. This can provide insight in potential conflicts of interests, ways to mitigate them, and ensure that a platform is aligned with key stakeholders, facilitating its adoption. Mapping stakeholders, however, is less straightforward than it may seem. For example, stakeholder mapping may not reveal some major sources of conflicts of interests. Understanding why this is the case is important when mapping stakeholders. Before we go into this, we first describe a basic mapping of stakeholders of smart mobility platforms.

'Stakeholder analysis has its roots in (corporate) management literature, but it is nowadays also applied in the field of public policy making' (Hermans 2005). A stakeholder analysis can be used in many different ways, for either analytical or strategic purposes. It can be used before, during or after a project. In this column we discuss the mapping of stakeholders with an *analytical* purpose *during* the development of a smart mobility platform.

Generally speaking, there are a number of stakeholder categories that are relevant for smart mobility platforms, such as local authorities or end users for instance. These platform related actors may, in some cases, develop more than one role (initiator, funder, owner, designer/developer, implementer, manager). A generic illustrative list could include:

- End users (i.e., city residents and tourists);
- Transportation providers and managers (i.e. transport/infrastructure provider, manager, authority, operator and user, car sharing, etc.)
- Service and/or data providers (i.e. mobile communication providers, ITS providers, tourist organizations, etc.)
- Authorities (i.e. mobility agency, local government, etc.)
- R&D actors (i.e. universities, research centres, etc.)

Our analysis of the specific stakeholder categories in our cases (those studied for this handbook), leads us to clarify the generic list proposed above. Looking at these stakeholders with a specific focus on their role, position, incentives and relative power, is useful to capture in a more comprehensive way a system's complexity examining it through its actors. This process enables the identification of challenges inherent to the wicked issue of smart urban mobility in growing urban areas in general and in particular the ones associated to governance of journey planning platforms. It thus seems to make sense to map stakeholders this way.

First, public authorities participate in digital mobility platforms in different roles (performing different tasks). They can be the owner, the (main) sponsor, a facilitator, supporter, regular participant or regulator. Impartiality and completeness of the information provided, as well as territorial coverage, are usually basic values sought by public authorities with a multimodal orientation, if their journey planning services are paid with public money. Melbourne's platform, managed by Public Transport Victoria exemplifies this perspective. The management of crisis and traffic disruptions is also an important concern for public authorities. For all these reasons, access to and accuracy of data disclosed become critical. Public Transport Victoria, for instance, is concerned with reputational issues related to providing information that is incorrect and therefore they prefer not to provide real-time data.

Second, transport service providers have a commercial interest: while the information provided must be clear and objective, it may be selected and presented with a certain bias in order to attract customers to the operator's network. The Dutch platform, 9292OV, was commissioned and is managed by private and public operators of public transport. A

further role that transport operators may have in journey planning platforms is to be the data provider. Information that is transferred to the platform's manager or developer is collected/produced by operators (either public or private). This is the case in London's Plan a Journey or Lyon's Optimod, for instance. The management of crisis situations is of great concern to operators as well and they are also cautious about publishing real-time information: aside from fearing reputational problems connected to information inaccuracy, as exemplified above, they prefer to avoid disclosing information that could highlight performance problems (delays, mechanical failures, etc.). VSS in Stuttgart, for example, jointly managed by transport authorities and private operators, makes all the data used in their platform available as open source but on certain conditions. One of these conditions is that no statistical use can be made with the data.

Third, *users* can be seen as customers of government services – authorities are expected to provide them with information on traffic conditions and public transport options as part of the public services a citizen receives. End users can also be seen in the role of consumers of services from profit-oriented platforms. In either case, it is important to acknowledge they also have multiple and varied interests and concerns. These range from the need to know how to travel from point 'a' to point 'b', how to save travel time, avoid changing modes during a journey, choose a less polluting trip etc. Having a one-stop shop to provide solutions to their interests covering all stages of the journey is ultimately the task of a journey planning platform.

Fourth, data providers are a very diverse group both in terms of their nature as in terms of their values and interests. Private companies may have straight commercial interests in selling their data, while public organizations may be strongly motivated to prevent misuse of the data in terms of privacy violation and the reputational damage accordingly. Furthermore, there are also third party providers of functionality, depending on the degree of openness of the platform. For example, in the NLIP case the basic model was that the platform would allow for third party *apps*, which would provide both value added functionality and business cases (and hence incentives) for parties to connect and contribute to the platform. However, given that the platform is partly public and partly private, some actors perceived a risk that data shared on the platform for public or

community purposes might be misused commercial apps, as it is exactly the combination of data that makes platforms so valuable.

Even though a sensible task to undertake, there are two major drawbacks to mapping stakeholders. First, any general mapping or typology sounds tempting but is in fact a simplification of the stakeholder landscape. Much of the value comes from understanding the actor landscape in a specific case, situation and context. Sometimes, a single stakeholder dominates many roles at the same time, which may absorb conflicts of interests but also instill them in the same actor. Other stakeholders may also turn out to have significant influence in some of these relevant roles but outside the core group of four in our typology, for example technology companies developing software and smartphone applications or firms providing back-office support (as described elsewhere in this Handbook for the case of Plan a Journey).

Second and perhaps most important, stakeholders are not a natural object that can be objectively observed. Stakeholders are not static and their positions and salience changes over time, which is visible in the NLIP case, where some inactivity at the side of government led to a change in the role of some of the businesses involved, shifting the salience of stakeholders from one business community (the platform infrastructure providers) to another (logistics companies). To complicate things, the higher the stakes and the more vested the interests, observable behaviour and formal strategy might differ from the real (but hidden) agenda of stakeholders and a mapping of stakeholders may offer a false sense of overview and insight here. This is to show that mapping stakeholders is very sensible, but don’t expect an easy answer…

3.12 The prevalence of informational platforms: are public authorities just too pragmatic?

P

The cases studied for this Handbook show that public authorities have two major approaches related to their objectives when they develop journey planning platforms: on one hand platforms serve as an outlet to publicise public transport information ('informational platform'), whereas on the other hand platforms can be utilised as tools for the implementation of public policy goals ('policy-rich platform').

Key words: informational platforms and policy-rich platforms

Overseeing currently existing journey planning platforms sponsored by public sector entities suggests that there are two major approaches related to the objectives associated to the design and use of these tools. On one hand, we see authorities that hold responsibilities related to public transport provision looking for platforms that serve as an outlet to publicise public transport information. On the other hand, platforms can be utilised as tools for the implementation of public policy goals. These distinct objectives – a first, more simplistic, and a second, with higher complexity – also result in differences in the features of these platforms – the type of information that is made available, the way it is displayed etc., as described below. Empirical observation shows that simple informational platforms (first type) are most common. More complex policy rich platforms (second type) are not common. We will discuss why, but also wonder: why not?

'Informational Platforms' are essentially concerned with providing comprehensive and accurate information on transportation options. Information is ideally objective and does not have any bias. They are mostly focused on providing 'door-to-door' trip advice with public transportation modes. Their core service is to provide users with public transport timetables and a reliable source of information on how to move from point A to point B. They work as transit information outlets and salient public values are time savings or trip convenience (shorter walking distances or smaller number of transferences between modes) for the *individual* user.

Public Transport Victoria and Plan a Journey illustrate cases of platforms geared to serve as a source of information to general public on how to move using public transport modes. Both also consider bike trips as an alternative (city shared bikes in London's case), though these are only included in recommendations after specific input from the platform user. In a similar vein, Stuttgart's VSS and Helsinki's Reittiopas offer commuters a planning tool that allows them to move from point A to B in the respective coverage areas using public transportation modes. These two platforms also provide bike travellers with (comprehensive) journey information and, in the case of VSS, ticketing information and purchase option is available online as well. Qixxit, a platform organised as a separate corporation but developed by the German national train company Deutsche Bahn, states advice neutrality as one of their core principles, i.e. to avoid any and all bias in the information it provides. Finally, OV9292 in The Netherlands could also be included as an example in this group. The platform provides journey advice to its users suggesting trips that may involve all public transport options (buses, trains, trams, subway, and ferry). In this case, however, two aspects are worth highlighting: first, rather than being developed by a public body like in the previous examples, OV9292 is a corporate entity owned and run by transport operators, both public and private. Second, according to accounts from users, a mild bias can be identified in the platform: when the final destination point is somewhat near to two public transport stops, the application will recommend the one that makes the trip longer (and therefore more profitable, given the Dutch kilometric fare scheme[2])

The scenario changes when the public sector envisages mobility platforms as public policy instruments instead of only an information service to be provided to citizens. In these cases the platform takes on a nudging role and influences users' behaviour. These 'policy-rich' platforms emphasize collective rather than individual optimization, evidencing public values such as general time saving through overall traffic reduction, accessibility, green mobility, and public health. Promoting collectively desired behaviours may entail increased sophistication with larger and more diversified information to users: information on more modes of transport (multi-jurisdictional public transport, private and shared bikes,

[2] Public transport fares in the Netherlands are based on two components: a fixed amount defined by the National Government and a variable kilometre-based fee defined by local transport authorities.

carpooling), information going beyond transit schedules or traffic disturbances, e.g. emissions savings, health gains etc.

Examples of policy rich platforms are less numerous amongst the cases studied. CarFreeAtoZ, in Washington DC metropolitan area, is the most illustrative. It actively incites users to adopt behaviours that are aligned with public policy goals and values such as general welfare to be achieved with traffic reduction, emission cuts, or even health related outcomes. The platform is part of Arlington County's Transport Demand Management (TDM) strategy and was commissioned by Arlington County Commuter Services – the specialised public agency in charge of TDM in the County, evidencing even more the original intent of promoting certain policy objectives through the platform. CarFreeAtoZ brings schedule information of public transport operators from multiple jurisdictions (Virginia, Washington DC, and Maryland), as well as information on the availability of shared or private bikes. Additionally, it also provides car drivers with information on routes and journey length. The platform also has attempted and is still trying to develop functionalities to facilitate carpooling schemes. Most importantly, for all of these journey options users of CarFreeAtoZ not only receive route recommendations, but also get comparative information about the potential trip choices concerning costs, emissions produced, and calories to be burnt by the traveller. These comparative data is displayed from the onset, once the departure and arrival points are selected by the user. In sum, there is a deliberate support for options that deliver collective gains.

Overseeing currently existing journey planning platforms, the prevalence of 'informational platforms' may come as a surprise. Many innovative projects have stressed the potential for journey planning as policy instrument, many have aspired to create policy rich platforms and the technical complexity of these policy rich platforms does not make out a real obstacle. Why aren't there more policy rich platforms?

A series of factors may influence and constrain the choices of public authorities between building an "Informational Platform" or a "Policy Rich Platform". Case interviews and literature (e.g. Janssen et al. 2014; Spickermann et al. 2014), indicate some of them: (i) what data is available, (ii) the quality of data, (iii) degree of interoperability of such data,

(iv) relationship amongst stakeholders and application of adequate participatory processes, (v) institutional and personnel capacity for data transference and treatment. Thus, the choice will depend on these elements. On a strictly governance perspective, this choice should bear in mind the institutional environment where the platform is landing (From performance to permanence?) and also identify and take into account salient public values it wants to implement as well as those from other relevant stakeholders (The Frankenstein-trap, or proper operationalization of public values; To nudge or not to nudge"; "Mapping stakeholders in mobility platforms and their interests)

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3.13 The black, the white and the grey: public and private initiative platforms

P

Mobility platforms can be distinguished based on the affiliation of the stakeholder(s) that has(have) the initiative to create and fund the platform – public or private sector actors. This is a simplified representation of reality and more nuanced cases exist that may not entirely fit the description, however identifying the main characteristics in these two models may help decision-makers on the development of new platforms.

Key words: public and private initiative platforms, hybrid models

Existing urban mobility platforms include examples of both publicly and privately developed projects. This division refers to the affiliation of the stakeholder(s) that has(have) the initiative to create and fund the platform – public or private sector actors. Based on this dichotomy, and to support decision-makers interested in advancing similar activities in their jurisdictions, it is possible to propose a general and simplified vision of existing platforms to help identify major characteristics of public and private projects.

The main goal of public sector initiated platforms that were researched is normally to provide users with general access to information on mobility options, especially public transport alternatives. Connected to access to information, they add value by allowing time saving choices. Therefore, travellers are mostly seen as customers that have in the public sector their service provider: users receive products such as route planning, timetables of public transport operators, news on traffic disruptions etc. There is mostly an individual focus, i.e., users have to be able to optimize their mobility choices according to their individual preferences. In very few cases there is also a concern in promoting behaviours that produce collective gains. Amongst others, *Public Transport Victoria* in Melbourne, *Reittiopass* in Helsinki, and *Plan a Journey* in London are examples here.

Privately initiated platforms in urban mobility tend to focus on the users' convenience and comfort as the main values. As with public platforms, individuals are seen as clients that will have in the platforms a service provider, however in private platforms the products are contracted in exchange for service fees. The mobility services that are offered tend to be 'auxiliary' as they do not necessarily involve trip planning or general information, but

involve mobility packages including, for instance, access to trips in different modes for a fixed price (the Finish project *MAAS*) or private (temporary) driver (e.g. *Uber* and *Lyft*). Again the individual focus is prominent, nonetheless there is an attempt for personalization in the provision of services, rather than elaborating products for a general public.

The comparison above highlights a few relevant aspects. The first of them involves funding. Public funds are used when the initiative is public, whereas users fees are expected to fund private platforms. Is there a right or at least better strategy? It is important to assess the potential risks for the continuity of the project when it relies in each of these options: public funds may dry due to changes in political preferences, political leaders may not be interested in supporting the platform, or the end of a grant. Private funds on the other hand also carry risks – the business model adopted may not be successful. The trends pointed above indicate a rationale in current arrangements: it is generally accepted and expected that 'core' mobility information - traffic, public transport options etc. - must be provided by public authorities, while private companies take care of 'auxiliary' services that involve more sophisticated or 'non-essential' tasks.

Second, and as pointed out in the specific column on this topic, user involvement in the development of these platforms is limited in both cases. Individuals are essentially customers – either of information to save time on their trips or to find their way in journeys they are not familiar with in the case of publicly initiated platforms, or of accessory services to enhance convenience and comfort in their mobility options in the case of private platforms. This is not right or wrong per se, but it probably denotes that the strategy to centralize decision-making in design of platforms is easier. On the other hand it may bring difficulties later on in connection to acceptance of the platform. *Optimod* in Lyon is an example of a very nicely developed technical solution, but at least so far it is not a widely used tool as the number of website accesses and app downloads are not high.

The dichotomy presented is a simplification of real cases to help the understanding of reality. A grey zone exists in many dimensions and several 'hybrid models' can be found: *VSS* in Stuttgart region is owned and governed by both public authorities and private operators. *9292* in the Netherlands was created by private operators and focuses

exclusively on information on public transport alternatives. *CarFreeAtoZ* in Washington DC is a publicly initiated platform designed as a tool of transport demand management envisaging collective gains. *Google Maps* offers ‘core’ mobility information services, like route planning and timetables. Additionally, although private, it does not rely on user fees and in many occasions the information used comes from public authorities (through agreements). *Waze* suggests the route to avoid traffic based on information generated by the community of users and also from public authorities. It does not charge fees.

3.14 The organisational setting of journey planning platforms

G

Four general organisational models can be identified relating to the way public sector is set-up for developing mobility data platforms: (i) the dedicated agency, (ii) the transport authority, (iii) the metropolitan authority, (iv) association with transport operators.

Key words: organisational setting, governance modes, transaction cost economics, public values

In another column, this Handbook discusses the dichotomy between private and public initiative platforms. Now we take a step further in the analysis of the latter. In particular, the question we want to discuss is two-fold: what are the governance regimes that can be used to organise journey planning platforms? How should public administration decide on which of them is more suitable? No single answer or 'one size fits all' formula exists. The existing range of alternative arrangements can serve policy-makers as an inspiration to customise their product according to their needs and objectives.

Amongst the platforms studied for the preparation of this Handbook, four general organisational models were identified:

1. The dedicated Agency

The most illustrative example of this arrangement is CarFreeAtoZ. The platform covering the Washington DC Metropolitan area was commissioned and is managed by the Arlington County Commuters Service (ACCS). Established since 1989, ACCS is the entity within the Transportation Division of the Arlington County Administration that is directly and specifically responsible for taking care of travel demand management initiatives. Therefore, local authorities believed in the need for and adequacy of a separated and dedicated agency to plan and implement specific objectives associated to mobility, such as reduce congestion by fostering carpooling and modal shift. Within this context the platform is clearly part of a policy strategy to incentivise sustainable mobility behaviours that

maximise collective gains. All data coming from different transport providers is directed to ACCS that, through the commissioned private developer, fuels the platform.

2. The Transport Authority

Examples of transport authorities managing journey planning platforms are numerous – Public Transport Victoria, Reittiopas, and Transport for London illustrate the choice for this governance structure. In the case of the latter, each mode of transport is managed by a different unit within TfL and these units collect the respective mobility data. All this information is passed to a specific unit in the entity that is in charge of Plan a Journey platform – this unit has several tasks: it keeps close link with different departments in TfL to obtain data, organise the information received, treat some of the data to improve their accuracy, and publish the information, managing and maintaining the website. As a unit within TfL, the department's role – and ultimately Plan a Journey's aim – is to provide the best information possible to users, without any specific policy objective associated to it.

3. The Overarching Metropolitan Authority

Optimod in Lyon is directly managed by the recently created Metropolitan Authority of Lyon – Lyon Métropole (in force since January 2015). The body merges responsibilities that were previously assigned either to the Rhône Department or to the 59 municipal governments that constitute the metropolitan authority. One of the main roles of this authority is to take care of the planning and investment in mobility. This task is done with the support of a transport authority – Sytral – that manages bus, subway and tram in Lyon. The mobility data is gathered by the operator of these modes (private company competitively selected in tender procedure, currently Keolis), later transferred to Sytral (as per contractual obligation), who then passes them to Lyon Métropole. Lyon Métropole also uses data from other sources with respect to modes that are not public transport – from the traffic control centre (CRITER), for instance. The metropolitan authority owns Optimod and developed the platform made available to users.

4. Dedicated association between Authority and Transport Operators

9292OV and VSS are two examples in which both public authorities and transport operators (public and private) are associated to develop a journey planning platform. In these cases, some degree of governance complexity emerges due to the varied source of funding for the platform (public and private) as well as the varied range of stakeholders involved and their multiple goals (e.g. provide accurate and objective information, promote the use of public transport etc.). In addition, these different stakeholders also accumulate different roles – in both examples the transport operators accumulate dual roles: first as platform sponsors, and second as data providers. Due to all these factors, in principle, this associative arrangement may require more sophisticated decision-making mechanisms – the more numerous and varied stakeholders and respective interests are, more complex coordination becomes, as discussed elsewhere in this Handbook (Mapping stakeholders in mobility platforms and their interests).

Overseeing the organisational models identified, we can summarize their differences in two main dimensions. On one hand, they differ in their dedication towards the platform. On the other hand, they differ in the governance complexity their model brings. Both the Metropolitan authority and the dedicated association imply significantly more governance complexity in their models. This is summarised in the figure below.

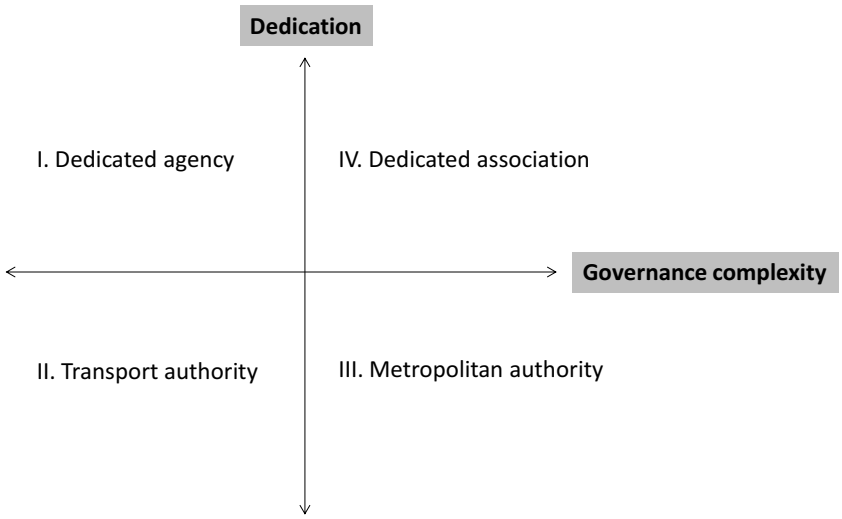

Figure 2: public organisations for information platforms: 4 models

The governance model to organise the development and management of a mobility platform within public administration may assume varied forms. More centralised and generic governance arrangements or models that pursue less integral and more dedicated structures have each their relative merits, as economic theory on governance of organisations tells us. Assessing the trade-offs involved in each governance choice requires looking at characteristics of the different tasks and stakeholders working to keep the platform up (information ownership and flows for instance). However, the most suitable alignment between governance mode and the transactions and interactions necessary to develop and maintain a mobility platform go beyond the purpose of maximising and optimising results in each trade-off. The successful choice must rely essentially on the public values that are sought and being put forward.

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3.15 Overseeing it all? The centrality paradox for smart city projects

G

In theory centrality results in integrality, but in practice integral decision making on that same central level may be harder to accomplish than on a decentral level.

Key words: centralization, funding, integrality, specialization, institutional levels

Just two questions. Who pays? Who profits? Ok, a third question. Are those who pay the ones who profit? These may be bold questions, but they are of course highly relevant for the realization of smart city projects. Motives for making cities smarter are usually problems that are perceived and experienced right there: on the streets, in the cars, in the buses, etc. Streets get congested, air gets polluted. The authorities close to the problems are looking for solutions. Many smart mobility projects are organized in the context of 'smart cities'. Rome, Haifa, Venice, Helsinki, Melbourne, Lyon are all made smarter. The cities and their residents profit.

However, these projects are funded differently. In Helsinki, Lyon and Rome, for example, local funds are important, whereas the projects in Haifa and Melbourne are mainly funded by central governments, at a much higher level than of the cities. There are many more local projects that require funds, all with good arguments. And – it's life – there are more good projects than there is funding.

This links to a classic dilemma in organization theory: should decision making, in this case about funding, be centralized or decentralized? Main arguments for decentralization is that knowledge and expertise is generally situated on a decentral level. Decentralized decision making then has the advantage that decision makers actually know what they are deciding upon. They need less reports, forms and other standards. Instead, they directly talk to the people that matter and experience the problem to be solved themselves. However, there is a downside. Decentralized organization may also lead to unfair differences between decentral units and missed economies of scale. Some cities are in more need to get smarter than others. Central authorities have that helicopter view and may facilitate a fair and efficient allocation of money.

This means that centralization serves integrality. This is much needed in smart city projects. Smart mobility systems require much integration, especially of policy fields. The policy field of transport and mobility is central, of course. But smart mobility is also about tourism, about information and communication technology, health and environment. All policy fields call for attention. A smart mobility system is able to respond to those calls and integrate their issues into a device that aims for the virtues of centralization.

However, we found that centrality also blocks integrality.

First, it may not be a coincidence that we meet the less developed and less ambitious data platforms in the centralized cases, such as Melbourne and Haifa. This is perhaps explained by the fact that central decision makers rarely taste the air of the city in question, or get caught in the traffic jam. The urgency of getting smarter is felt much less at authorities on a larger geographical scale. A second reason is an organizational issue. As stated, integration requires coordination between multiple policy sectors, such as mobility, environment, health, and tourism. The smaller an organization is, the easier this coordination gets realized. For instance, it is easier to talk to other people of other departments because of shorter distances, and people tend to know each other. For this reason coordination, sometimes doesn't need to be formalized. Authorities on a decentral level tend to be smaller than on a central level. The larger the funding and managing authority, the more likely they have to specialize their departments. They are hosted in separate buildings, have different ict-systems, and develop separate procedures. This requires much more coordination. More importantly, the separation of departments gets a segregating force. Specialized departments require smart mobility applications to get specialized as well, and they need to be labeled as 'mobility project' – for the mobility department – or 'sustainability project' – for the department of health and environment – etcetera. A project that is integral at its core will have a hard time to get funded, because it cannot be framed along the lines of organizational departments. The project is integral, the departments are not.

The centrality paradox of smart mobility is that in theory centrality results in integrality, but in practice integral decision making on that same central level may be harder to accomplish than on a decentral level. Both levels contribute to integrality, but may compromise the integrality of the other.

Another way to put this is to say ‘what’s the right level – or scale - is actually not a relevant question. Moreover, for most emerging smart mobility projects the relevant levels of decision making are a given. The reasons behind that those levels has its roots in history and serendipity. However, when people in future talk about history, they are also talking about here and now. If the levels are a given for a specific project, that doesn’t mean these levels will not change. The centrality paradox, in fact, provides a constant rationale for adapting the scale of the project on behalf of integrality, as was the case in Lyon and Vienna. Whereas these scale changes may often appear to have a conscious component seemingly as part of an endless struggle for power, the centrality paradox offers a substituent explanation why consensus on ‘the right level’ is never reached.

3.16 Contracting out smart mobility: the problem of integration and accountability

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Contracting out activities serving smart mobility is common practice. There are risks, however. How does a government keep direction if necessary expertise come from outside and is even encrypted in software? And how do governments account for their tradeoffs between values such as privacy, sustainability and efficiency?
Key words: contracting out, expertise, integrality accountability, policy rich

‘Municipalities ask for green mobility, but they do not know what green is.’ This blunt statement comes from an entrepreneurial software engineer directly working for Dutch municipalities that want to get involved in smart mobility. His company Mobidot develops track systems for mobile phones and strategies for nudging travellers’ behaviour. It is no surprise that municipalities lack the expertise to develop this software, but the potential of this software is highly relevant. We call it ‘policy rich’, as it integrates different public values, including travel efficiency and sustainability. The interviewee was surprised to hear that the municipalities he worked for were not able to provide concrete definitions of sustainability that companies like his could work with. Instead, definitions of sustainability were developed by himself, informed by the Wuppertal Institute. Is this a problem? Should municipalities as clients know what green is?

Contracting out activities serving smart mobility is common practice. CarFreeAtoZ was commissioned by Arlignton County Commuter Services – part of Virginia Transport Department – to Conveyal, a private developer. Reittiopas was initially developed by a private company and later acquired and internalised by Helsinki’s transport authority. It is of course more efficient to hire specific expertise that is lacking in the short run when it may not be necessary for eternity. Besides that, leaving innovative activities to the market is in vogue. Markets are supposed to excel in innovate services such as the software from Mobidot.

However, empirical evidence shows that the price may be high. The interviewee states that municipalities have a problem of knowledge and direction. Who is the director of smart mobility if knowledge-intensive activities are contracted out? What if vital definitions – for instance about sustainability or about privacy – are hidden in software and informed by considerations from knowledge institutes elsewhere? The Mobidot interviewee took his observation some further. For impacting travellers' behaviour, the definition of target groups is vital. The municipalities he works with also happen to have a hard time defining these target groups. They rather measure time loss at specific traffic bottlenecks. A paradigm shift from output – traffic – to input – behaviour – still has to be made in these instances. For the time being, the definitions of target groups are also developed by market parties instead of governments.

On the other side, it might be argued that the market does a very good job in developing knowledge on smart mobility, applying it to a wide range of products and selling them to public authorities that are inclined to use them. What is the problem then? We still see two problems, even at the sunny side of the street.

A first problem is about integration. Public authorities are natural actors to integrate values, such as mobility, sustainability, privacy and public efficiency. This indeed is key to their existence. However, in organizational practice this integration means hard work. Transport departments have a hard time coordinating their activities with the department that has knowledge about sustainability, and another department that tackles privacy issues, etcetera. All departments have different definitions, different aims, different histories. As the case of Plan a Journey illustrates, even within a transport authority (TfL) there are several segregated departments that need to coordinate their work for the realisation of the travel advice platform.

The Mobidot interviewee signaled that a new integrative 'smart city manager' at a municipality has been trying to define smart mobility for half a year now, without definitive success. This illustrates that the transaction costs of integration can be relatively high. Integration gets even harder, if vital knowledge-intensive activities are contracted out and

important definitions are made outside the organization of the municipality, and remain hidden in the software of products municipalities are purchasing.

A second problem is about accountability. A public authority is expected to safeguard public values, such as privacy and sustainability. Trading off these values is ideally subject of democratic considerations. This is difficult enough, if public authorities act like a well-intentioned, benevolent super power. In practice, however, these public authorities are not averse to strategic behaviour like any other actor. They, for example, have the incentive to account for as few trade-offs as possible. Governments generally try to portray policies as better for all, even if it is not the case. It is sincerely hard for governments to account for sacrifice, even if it is inevitable, without undermining one's own legitimacy. The idea of sustainability definitions developed elsewhere and encrypted in software is not only rather remote to the democratic ideal, governments will probably not raise the alarm, since it offers them a convenient position to leave trade-offs undisturbed, to let the sleeping dogs lie.

Yes, municipalities should know what green is. However, this doesn't mean that their definition should be the right one, fixed once and for all. It should be subject of continuous deliberation, trial and error, both in a political and bureaucratic arena. The main question for now is whether market parties such as Mobidot should wait for this deliberation to start. There is typical right-wing and a typical left-wing answer to this question. In any case, putting forward an untenable definition is probably a better idea than no explicit definition at all.

3.17 Data chain representations: Beyond dedication and control

Smart mobility projects involve data chains. Data chains are often represented as neat, ordered sequences of activities. Those representations communicate dedication and control, but neglects important governance aspects of data interchange. For evaluation of smart mobility a more sophisticated representation is vital.

Key words: data chains, variety, serendipity, communication, evaluation

'Everything should be made as simple as possible, but not simpler.' Einstein's aphorism also applies to data platforms for intelligent mobility. Sharing data is in the abstract simple, since programmable, generally represented as a conveniently arranged chain of activities. Arena c.s. (2012) specifies five successive activities, adopted by ISO: from data acquisition, data processing and data communication to information distribution and information utilization.

More than often, these data chains easily involve more than two actors, including providers, users and intermediaries. A simple data chain for mobility data platoforms involves data providers, the platform owner and manager, providers of related applications and users. Ideally, representations of those data chains, combined with the many actors involved, look as neat and structured as the figure below, where the blocks are actors and the arrows the data.

Figure 3: simple data chain representation

Our cases, however, suggest that this representation is fairly oversimplified and does not reflect the governance complexity in mobility data platforms. It assumes a number of stable factors that, alas, should be considered quite questionable.

A single source. Obviously, the added value of a platform is integrating different data sources. In any case, the sources are pluriform and the respective data providers are multiple and diverse. For example, bus feeds for Plan a Journey are automatically imported, while their tube data first passes the back office system that tests all data accuracy before it is included in the platform. Next to that, smaller modes have their data provided in excel files and this information is manually inserted in the platform. National railway provides blocks of data weekly. All these different sources and procedures require separate handling. CarFreeAtoZ also has an interesting example of multiple sources. Several transport operators from different jurisdictions (Virginia, DC, Maryland) provide info to be used in the platform.

Optimod in Lyon is the opposite: all information is produced/collected by a single transport operator Keolis Lyon. Nonetheless, there is an intermediary between the data producer and the platform manager: Sytral, the transit authority.
A single user. Another obvious factor is the number of targets. There are multiple end users, including tourists, commuters and various public services. Their needs and wishes vary. ITS Vienna discovered multiple functions of the platform along the way of developing their platform. The work to develop PETRA also encountered this multiplicity: the demonstrator in Venice was targeted to support tourists, essentially pedestrians in the city centre. In Haifa's demonstrator, the target audience of the planner were users of public and private transport, with the implementing entity at the municipality, the traffic control centre, having a focus on car flows through the road network. Rome, finally, brings both perspectives in two demonstrators: one aiming to provide journey advice to city dwellers and another specific for the visitors coming to the city for the Church's Jubilee celebrations.

A single goal. Most representations of data chains presume a single process that serves a single goal. Each link provides added value to a targeted end user. Each link enriches the data, at least by processing data towards the eventual user. Platforms typically consider their whole chain as dedicated to the desires of the end user. However, any platform that nudges, also presumes that there is conflict of interest between the traveller and the public

services trying to nudge travellers. In software used by Reittopas, for example, the conflict is to weigh green travel options against faster options.

A single approach. For the data chain to be as clear and streamlined as the figure above, it is interesting to see that even if we take a single user with a single goal, we still meet many different approaches to contribute to that goal. For the same type of user and for the same type of goal, we see MAAS building its business case on a perceived users' wish of purchasing mobility in one time – a *one stop shop*. Qixxit is working towards such a one stop shop as well. Other platforms consider it wise to let the user make its own choices, only presenting several consequences of a travel choice, for instance in terms of time, amount of transits and CO2-emissions.

A single sequence of activities. The figure also assumes a single sequence of activities, but this neglects the dynamics of mobility data platforms. It may be wishful thinking or a reconstruction in hindsight. In foresight, data are generally not gathered and collected for the eventual use in this platform. For example, data of telecom-providers may be useful, but they are not collected for mobility data platforms in cities. The intention of data processing may change over time. A major consequence is serendipity. Gathering and processing data becomes a group of loosely coupled, goal-searching activities.

A single platform. The simple representation suggests that there is just one platform. In reality, there are many. Qixxit first concentrated on train travel through Germany, partly because there already existed platforms for German cities. This means that data streams are not always dedicated to a single platform.

If these extra complexities are included, the picture of the data chain would look like this.

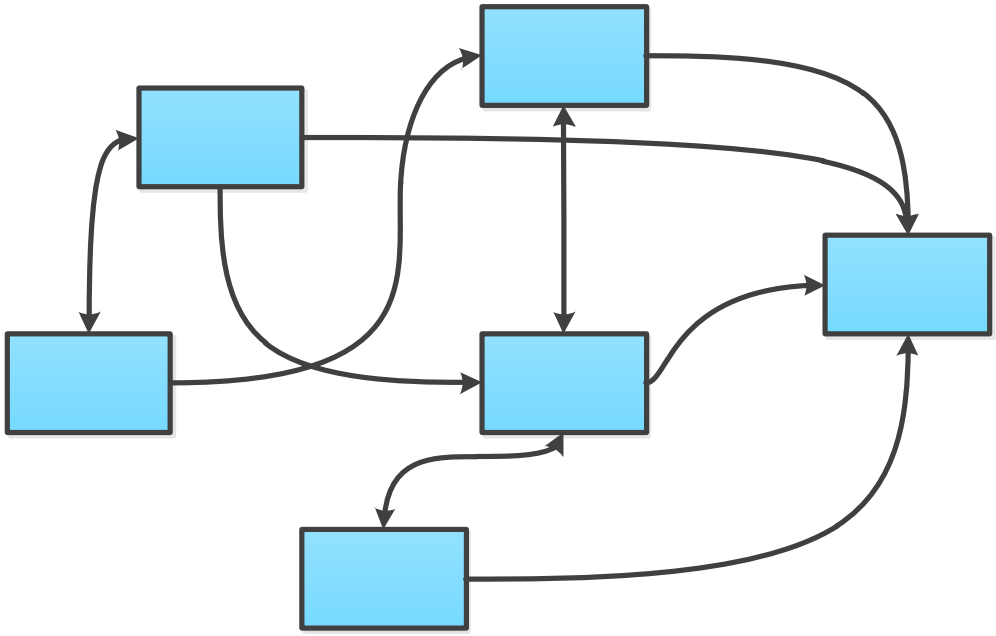

Figure 4: A real world representation of data chains

Of course, such a picture doesn't communicate what mobility data platforms initiatives want to communicate. They want to show dedication and control. However, for anyone who wants to evaluate an initiative – either ex ante or ex post – the second picture may be a better guideline.

3.18 Only for you: the organization of love and dedication

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Our cases indicate that cities with a transport authority are generally more ambitious as well as more successful in smart mobility projects. This can be explained by their functional dedication to smart mobility as well as their hierarchical position to request data.

Keywords: transport authority, integration, hierarchy, reciprocity, data requests

Anything you give attention to, grows. Flowers, food, human performance, but smart mobility? Who has the perseverance to spend huge amounts of time and attention to a thing as smart mobility? Who is so dedicated to transport, ICT *and* public space at the same time? Our studied cases clearly suggest that integral transport authorities are the most obvious, and perhaps the only, candidate. In many cities an integral transport authority is in place. Our cases indicate that cities with a transport authority are generally more ambitious as well as more successful in smart mobility projects. London, Melbourne, and Helsinki are the main cases where the transport authority has the journey planning platform. In the Netherlands and Stuttgart the platforms belongs to a consortium between authorities and operators.

The reasons for this may seem obvious. These are functional authorities, tailored to improve just transport and mobility issues. This means that they have to make little tradeoffs to other issues than mobility. They seem to be natural actors to request data and process them. They have the knowledge needed to do so. This knowledge includes both technical and institutional knowledge. They organize the transport markets and lay down the incentives to provide data and improve mobility. This is, of course, as far as their competences go. Some transport authorities are specialized in public transport – such as in Rome – others cover also private modalities – such as in the Vienna Region.

There is also a geographical aspect to it. Some authorities cover a city, others a metropolitan area, others a wider region. Transport authorities are dedicated to improving mobility. This makes them a considerable integrative force. If an urban area lacks such a

transport authority – such as Venice – integration of modalities and data gathering from several parties can be much harder.

Is it as simple as that? Is the success of smart mobility determined by this fact of having a transport authority with competences that fit the ambitions of the project? It helps, of course. But no, our cases show that even an eventual match between project and authority at the start may not endure. In Vienna the smart mobility initiative eventually extended the competences of the transport authority that stood at the cradle. In this case, the transport authority shows a willingness to cross the functional and geographical line of their competences. This is a big step for them. Crossing such a line comes at considerable transaction costs, including coordination efforts with other authorities in which they become a requesting party.

In sum, we should distinguish two forms of dedication. Transport authorities dedicate their time and attention along with their formal mandate, as defined by the functional and geographical competences and jurisdictions. There is also a behavioural dedication, based on the willingness to look beyond these competences and jurisdictions. A remaining key question is: If transport authorities are eager to support smart mobility projects even beyond their formal mandate, what is driving them?

The most notorious advantage for a transport authority to engage in smart mobility is not to improve transport, but to improve authority. What's in a name. A transport *authority* needs to be in power, like smart mobility platforms have a continuous thirst for data, i.e. from mobility providers, from telecom operators, from event organizers, from the police, etcetera. On whose behalf are these data requested? The answers to this simple question may differ per city. In Rome the transport authority RSM is able to back their request with formal authority. Venice lacks such a transport authority. The smart mobility initiative is a responsibility of AVM, a holding company for all municipal transport providers. They lack this authority and will have to explain twice why they request data and what they will do with them. In other words, they have to request data in a networked context where authority is not a given but a continuous, multifaceted game of give and take. In such a context, transactions are based on reciprocity: you do something for me, I'll do something

for you. However, what can AVM do to for instance for the police as compensation for receiving the data? This illustrates again the practicality of a transport authority. It seems some amount of hierarchy is important here.

We started off with love, but we seem to end unromantically. Yes, smart mobility grows with love and dedication. However, love and dedication sometimes is a given. And worse, it is not enough, also authority is vital. Unromantic, but real.

3.19 Survival of the fittest? From performance to permanence

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The foundation of a platform takes lots of time and effort. It would be efficient if they will function for a long time, at least survive the implementation phase. This 'permanence' is likely to correlate with performance: the better the performance, the more viable the platform. However, this relation is not that straightforward as it seems.

Key words: launch, implementation, performance, institutions, private platforms

Once, a more or less developed smart mobility platform hopes to get implemented. A critical moment and no sinecure. Platforms must convince a critical amount of people – including users spending money or time – to have added value. But launching a platform is just one moment in time. It may be an instant gratification peak after which everyone goes back to normal. The first years after takeoff are critical as well. In this period, the platform needs to institutionalize. Using it should wear down as a new routine and fit the existing culture and rules relevant in a certain area.

An often quoted design principle is to treat most of the 'institutional landscape' as a given, since it is hard to change in the short run. Many great ideas eventually strand because the world proves less makeable than thought. When we take the warning seriously, when culture, rules and habits matter and are hard to change, at least in the short run, this may have major implications for the implementation of smart mobility on the longer run. During the launch of a platform, what may look like a rather straightforward implementation process, may over many years actually prove to be a mutual adaptation process between the evolving new features of the system and the rigorous institutional landscape in which they will have to function. As a consequence, performance on the short run may neither be a guarantee nor a reliable indicator for survival.

Overseeing the studied platforms, what may indicate that eventual performance proves to be a false lead? What may cause well-performing systems to dissolve in obscurity?

As we have seen in the Superhub projects in Milano and Barcelona, for example, there is a risk that the features of the system – cutting edge and expensive as they are – will be rejected by powerful actors, such as governments funding projects, authorities managing systems, and users preferring platforms developed by competitors. This is not just about performance, but also about political priorities, ambition levels and the willingness for organizations to pay its management costs. The Superhub-initiatives in Milano and Barcelona were funded by the EU, but couldn't find enough political support in the cities they are implemented once funding stopped. As a result, they became orphans. They are now framed as 'experiments' by the engineers that developed them.

Projects developed by an institution in the regions themselves – such as in Lyon, and the Vienna Region – are less vulnerable to this risk. A dedicated problem owner – such as transport authorities, or a joint venture of transporters backed by public authorities in the Netherlands and Stuttgart - helps to overcome any time of doubt. They might continue the project if the amount of users doesn't meet expectations yet or if technical problems arise. They have already invested in the system or in the cooperation with other actors to a certain extent, making them willing to continue even if performance is not ideal.

Another example is the Dutch 9292.nl, in terms of use a very successful and long-lasting service. It is used by many people and the very name of it, based on a meanwhile old fashioned phone number, has become an institution itself. But the quality of service may neither be called bad nor outstanding. Dutch people can complain about the website being down, like they complain about the weather. Moreover, it is not at all ambitious or cutting edge – i.e. only encompassing public transport time table data. Perhaps the popularity in use is not despite but thanks to a lower ambition level.

Summing up, we meet two risks for well-performing, publicly funded platforms to dissolve in obscurity: high ambition level and lack of congruence between leading developers and dedicated problem owners.

Risks for privately funded platforms are somewhat different. Commercial parties such as MAAS and Ubigo offer a concept and a platform to their clients. In doing so, they may

reduce the transaction costs of authorities to develop smart mobility. These commercial parties spread their risks. The more clients they have, the less they have to rely on a single project. The evaluation of performance is up to the clients. Are they satisfied with the service? This may depend on the performance itself, but also the client's transaction costs compared to its – unknown – alternative. Moreover, there might be issues. The implementation of MAAS in Helsinki has been slowed down by uncertainties about the position MAAS is going to take in between the public transport providers. MAAS is a new kind of actor and transport providers perceived that they might give away customer access and relationships. Cooperation with MAAS implies uncertainties about the position of public transport and also the government promoting public transport. The amount of willingness to do this and the willingness to trust market parties such as MAAS may depend per country, region or city. And it is relatively independent from performance.

3.20 The perpetuum mobile of intelligent mobility

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Technological developments are usually accompanied by optimism. New systems would solve old problems without extra effort. A reflection on intelligent mobility learns that there is much potential for several crucial parties, however there is no such thing as a free lunch.

Key words: transportation providers, infrastructure managers, data providers, users, trust

Let's have a dream. We enter the era of intelligent mobility. This means that mobility needs of travellers become the starting point for both mobility service provision and infrastructure improvements. In theory, we think this will work as a perpetuum mobile. Some call it a 'democracy of doing'. Give it a name. We want it because we want it and because we want it, it will work.

Let us zoom in further on how this could work. Simplifying the actor complexity a little, we can distinguish four types of actors are in play: transportation providers (i.e. public transport operators, car sharing operators, etc.), infrastructure managers, service and/or data providers (i.e. mobile communication providers, ITS providers, city event organizers, tourist organizations, etc.) and end users of the mobility and information services (i.e., city residents and tourists). Intelligent mobility implies cooperation by all these four actor groups, as they incentivize each other to cooperate. We identified ten *special* incentives, special because they do not only stimulate behaviour that contributes to the platform but at the same time this behaviour brings new incentives for other actors to contribute also.

More use of travel advice and mobility services provides incentives to provide data to the platform. End users automatically provide data to the platform when using travel advice and mobility services. For some of these transactions permission is needed, either implicitly or explicitly. As a consequence, the incentives here are about both identity and interest.

More use of infrastructure provides incentives to provide data to the platform. Also infrastructure providers provide data and consider to give permissions.

An improvement of the quality of travel advice and mobility services provides incentives to provide data to the platform. The quality of travel advice and mobility services results in more (technical) possibilities to transfer data to the platform. Also end users and mobility service providers gain commitment to support the platform as a return of good service.

An improvement of the quality of infrastructure provides incentives to provide data to the platform. Also, infrastructure managers gain more insight in needs for infrastructure quality.

An increase of data provision to platforms provides incentives to improve the quality of travel advice and mobility services. The more data are provided to platforms, the more data can be processed, the more adequate the services may get. Furthermore, an increase of data legitimizes further investments in the data platform.

More use of travel advice and mobility services provides incentives to improve the quality of travel advice and mobility services. More use legitimizes (and sometimes even finances) new investments in services, which improves the quality.

More use of infrastructure provides incentives to improve the quality of infrastructure. The same holds for infrastructure use and quality.

An improvement of the quality of travel advice and mobility services provides incentives to use them.

An improvement of infrastructure provides incentives to use it.

An improvement of the quality of infrastructure provides incentives to improve the quality of travel advice and mobility services. Because infrastructure facilitates services, better infrastructures lowers the costs of service provision and makes further improvement of those services more attractive.

In the intelligent mobility data platforms under study, we see all actor groups – transportation providers, infrastructure managers, data providers, and users – feeding each other's interests by committing to action. As such, the system has self-lifting mechanisms. Are we really creating a *perpetuum mobile?* Is this dream close to real? Dreams may turn into nightmares. The incentives show that the system depends on positive feedbacks. For example, does the user experience improvements of infrastructure and services and does the user relate this to his inputs? In other words, the potential to nurture each other may also suggest a potential for decay, if the values involved are going down instead of going up. This makes the system and its governance sensitive to change and hungry for trust.

This is where the metaphor of a *perpetuum mobile* might go astray. What if positive feedback lacks, for example because funding stops, people have to choose priorities, waiting is attractive or important entrepreneurs leave? There is some fuel needed to the relations that are crucial for intelligent mobility.

3.21 End-users and identification with the public values driving the platforms

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The end-users of the platform could be various target audiences. Different audiences are tied differently to the platform, leading to different governance models around the platform. Technically, platforms can have very similar functions, but the organisational design of a platform aimed at tourists is very different from a platform aimed at the citizens of a region.

Key words: Collectivization

The PETRA platform is set a generic platform design, which is primarily set up to provide travellers with an improved trip through the network, optimized for on intermodal options and based on modelled conditions and real-time information. The traveller is seen as the end-user, for whom the experience has to be optimized, balancing between his individual goals, providing them with an attractive advice, and more collective goals, providing mobility patterns in line with public values. Introducing this last part in the end-users evaluation, we will call collectivization of the platform: end-users adopting the nudging or incentivizing of the platform to contribute in their travel to governmental goals.

Both the demonstrators as well as the cases show the variety of definitions of the end-user possible within those bounds of “the traveller”. In the demonstrators, travellers are defined very differently. In the first Rome demonstrator (as in the original Tel Aviv demonstrator), the end-user consists of variety of travellers, including commuters, very much in line with the original perspective of the PETRA platform. In the second Rome demonstrator and in Venice demonstrator, the end-user is seen as the tourist in the area. In the Haifa demonstrator also a generic set of travellers is seen as the end-user. However, the focus from the municipal partners, being the traffic control centre, seems to be more on the car driver and the flow of vehicles through the network, given the existing mobility patterns in that city.

With that variety of end-user definition, alignment with public values (collectivization) becomes an issue.

First, jurisdiction alignment now can become an issue. Romans are likely to identify themselves with the city, its governance systems, and its pubic values. As the government developing the platform operates on the metropolitan level, there is an expected link between the goals as set by a democratic (metropolitan) government and the identity and goals as set by the targeted traveller. Tying the citizens of the platform can build on that.

Several aspects can hamper this relation. First, in the Haifa demonstrator, the expected end-users are mostly car drivers in the region. In addition, the platform owner is the road traffic control centre of the city. A key value the traffic control centre is asked for is smooth flows of traffic and reduced waiting times at traffic lights. At the same time, the project also aims to provide better information to public transport passengers. The focus of the implementing entity will drive the optimization the platform provides and could be focussing on improved network flows, whit limited potential for collectivization. The potential for collectivization is limited by the alignment of the values of the implementer of the platform with the broader mobility related public values in the area.

Second, the Haifa demonstrator occurs in an area with a great deal of commuters in and out of the city. These end-users live in different jurisdictions with limited relation to the platform owner. Their identification with the policy priorities on mobility for the city will likely be limited.

Third, the second Rome demonstrator and the Venice demonstrator consider tourists the end-users. The relation between the tourists and the cities is very different. There is no long-term relation. Now the identification with the policy priorities on mobility for the city are likely even more limited.

In case of the more limited identification with the jurisdiction of the owner of the platform and the policy priorities as formulated by the governmental entity of that jurisdiction, the expectations of the end-user is likely to tend towards single end-user value: give me the quickest or more reliable trip. In such case, the platform will have to resort to providing alternative incentives to the end-user to foster more collective behaviour. If not, the

platform will be more like a traditional travel planner. Travel planners generally attract users through simple single value optimization: the planner makes the trip of the traveller quicker or more reliable and the end-user is only looking at this from the planner.

3.22 PETRA breathing: data in and data out

It is tempting to look at the platform as a data repository, with data coming in and data going out after modelling future states of the network and optimised routes. This would mean that governance would for a large part be about data ownership and storage and communication. However, the platform for a large part functions as a portal: data is linked to the platform rather then, transferred to the platform. Or even, the platform only allows for algorithms to be carried out on externa data, that never leaves the servers of the owner of the data outside the platform. Now governance of the data is about use of data that has to be linked by the platform from the data providers to the users, through licences, SLAs and APIs.
Key words: Data, Privacy

The PETRA platform works on data. For the platform to deliver value to its users, data has to come in, and has to go out, and data has to be retained, possible aggregated. And obviously, that data has to have relevance and quality, relevance for the mobility related questions users might want to answer using that data, quality in the sense that it is a sound representation of real-world situations.

The in and out flux of data is a simplification in the current world. Data coming in could very well be a managed license, managed by the platform for all users of the platform to use the data from elsewhere. Data coming out could very well be an API (application programming interface), that allows users of the platform to interact with the data the platform is moderating. These more dynamic governance models for data transactions obviously fit with the more dynamic forms of mobility data that the platform is often “handling”, like real-time GTFS and traffic counting. No governance of control or ownership of the data by the platform is needed.

Privacy

Oftentimes the platform is helped by using data that is privacy sensitive. For mobility data platforms, the locational characteristics of individual data are key examples of that. For analysis and modelling, the optimum location data of cars or phones is at the individual level. This allows for the combination of individual paths into trips or travel patterns, highly valuable for modelling future behaviour. Modelling tools in the platform are generally helped by higher granularity of data, meaning closer to identifiable individual paths.

Obviously, this raises privacy issues. We have seen several answers in the cases, affecting governance. On the one hand, aggregation into groups of travellers could be done. Individual data is not traceable after aggregation of 100 trips by various travellers (Pisa). This obfuscate the individual trip and make it non-traceable. Obviously, those individuals represented in the data in the platform should feel confident with the such a privacy securing mechanisms, governance should support that confidence.

In another form, individual location data would not be provided to the platform by those owning the data, but the platform would ask those owners of that data to perform transformations on the individual location data set for the platform, only providing the platform with aggregated outcome. This allows for use of individual data for analysis and modelling, without revealing the identities to the analyst and modelers. Again, those represented in the data should feel confident about the obfuscating effect of the transformation. The governance challenge in both is that those represented in the data not experience their provision of data, as can be easily the case with Bluetooth or Wi-Fi tracking. Or if they do willingly accept their representation in the data on the platform, they feel little control over the way in which that data is used and “scrubbed” of their identities. In several countries, privacy regulation has been set up, with watch dogs overseeing the way in which the data is used, limiting more tailor-made governance models.

So, privacy is mainly about limiting the individual traceability of people, mostly from the data from the location services in their phones (like locational coding of pictures), location-based transactions (like checking in in public transport) or locational identification of their cars or phones (like number plate recognition). Locations are a key element, as we are dealing with mobility platforms, but the same could hold true for health and financial data.

Sometimes the need for platform specific governance related to privacy is limited, as national regulation exists that providers of individual locational data feel confident about. If not, on the data input to the platform, privacy should be protected. The demonstrators showed governance models that allow for really high quality data for use in modelling within the platform, where the individual traceable data never left the owners systems outside the platform. This al works under the premise of an intricate governance model between data provider and the platform.

The cases also showed that the data on individual paths is developing rapidly. Social media posts often contain a time and location stamp, allowing the constructions of paths based on public data. This goes beyond Bluetooth, Wi-Fi and number plate tracking, as the provider of the data is explicitly and actively disclosing the data and making it public, and it does not need local trackers (camera or sensors). In addition, more and more apps are tracking more precisely the paths of individuals. This will likely make this information wider available at lower prices.

Data in

On the data coming in side of the platform, a number of governance models is apparent. First of all, we see that open data is a governance model. In Haifa, the national government is gathering the schedule data of operators in GTFS and making it available as open data. Also in the Netherlands, 9292OV is playing a role in providing schedule data to users as open data, including real-time data. Use of the open data is in principle free. However, in some cases operators are hesitant to provide real-time data, as it could be used for other purposes. We saw such limitations in Tel Aviv, London, Lyon, and Vienna. Mostly, the objections are about use of the data for performance measurement, without a proper institutional environment. The reactions varied from reluctance to provide real-time “as-operated” GTFS data, to clauses excluding the use of this data for statistical performance analysis.

Obviously, getting this data is helped when the manager of the platform is part of the organization owning the GTFS data. That can be the case if the management of the platform is performed by a public transport operator. However, this is less helpful for the

inclusion of the data from other operators. This is also the case if the management of the platform is performed by a public authority buying the transport services from operators, for example through tendering. In that case it seems to take several rounds of contract renewals to align the needs of the platform with the possibilities and willingness of the operators. Or it can be the case that the management of the platform and the operator are part of the same governmental entity. In this case hierarchy plays an important role in realizing the potential of the platform through convincing the operator.

Other important data into any mobility data platform is map data. We saw various models with various consequences for the governance. The platform AnachB in Vienna has developed its services on top of an own GIS system. This means an internal service-level agreement has to be in place to be able to secure the platform services in the long run. On the other hand, though, CarFreeAtoZ uses OpenStreetMap. In between is the broad use of google maps.

For that data to be able to be used in modelling and analysis, the data has to be stored and possibly aggregated. This means that the governance of the system should allow for data ownership and in many cases security.

Above we discussed location and flow data of individuals, schedule and real-time public transport data, and map data. This is the basic data set the platform will need to operate along its original intent: real-time integrated travel plans. The cases showed platforms that provide data for travel planners, but then go beyond. In Lyon and the Netherlands, we saw parking place availability and rent bicycle availability. In Lyon and Haifa, the goal of the platform developing beyond travel planning for end-users. The platforms gather a great deal of mobility data and makes this available for all kinds of users, from traffic control centers and infrastructure planners at government, to any commercial users of the data. The platform has developed from a purposeful combination of data, aimed at making a clever travel planner, to a broad portal for data, to be used by anyone to optimize mobility in the region.

Data out

The shift described above has clear consequences for the governance of the data out. If the aim is to develop a travel planner, this allows for simple governance model: the end-user of the travel planner has a license, which can contain both the conditions for use, as well as possible ways of using the data from the end-user back in the platform. The transaction is clear, with potential gains on both sides and controlled use of the data.

However, when the purpose of the platform is not limited to realize a (real-time) travel planner, or if the travel planner even shifts outside the scope of the platform, an alternative governance model for the use of the data is needed. If the platform is gathering all kind of public data using governmental resources and making that available for internal use within the governmental entity, this can be arranged with straightforward service level agreements. However, if the data is made available more widely, open data becomes a likely alternative. Interestingly, the Lyon case showed how in that case data can be licensed. The choice was made to stimulate the market and innovation by having paid licenses for monopolistic service providers using the data, whereas new entrants would have free licenses.

3.23 From goals to implementation: the importance of the last mile

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The platform can be developed, implemented and managed by various entities, both on the private side as well as on the pubic side. We have seen that choosing that entity very much drives the direction of operationalisation of the original goals. This is shown to have a very substantial impact. An ICT department drives it different from a mobility department, a public transport operator different from a traffic management department, a metropolitan authority different from a national and local authority.

Key words: policy goals

A platform like PETRA would be established to support the realization of policy goals, as the main funding and initiative lies with public entities. The demonstrators and the cases show that the link between these goals and the platform are more intricate than one would expect.

First, the goals that are set by government, for example as the official policy goals as posted in white papers, are generally high level. We see that what those goals eventually are depends highly on the entity within government that is implementing the platform. In the demonstrator in Venice, AVM, the local public transport operator, implements the platform. As a result, there is a focus on service of the waterbuses, related to and crowding in the old city center. In Haifa, the traffic control center plays a major role in implementing the platform, which could trigger a focus on flows of road traffic at traffic lights despite a broader policy focus on pedestrian safety. In Rome, the metropolitan transport agency implements the platform, triggering a broader focus, both on genera mobility as well as on dealing with the influx of travellers during the Jubilee.

In the cases we see similar mechanisms. In Lyon the ICT department plays an important role in realizing the platform. As a result, the implementation is relatively loosely related to policy goals in mobility, even though it is in fact a mobility platform. The focus is on providing mobility information to the outside world, with the expected result being a useful

application of that data; useful from a public perspective, but in the broadest sense. In Arlington the implementation is done by a private entity for the various transport authorities in the region.

This aligns with understanding of policy processes and goal setting. Mobility goals at a metropolitan level are generally formulated at a high level. For an instrument to be developed those goals will have to be operationalized. That operationalization can and will change the focus of the goal setting. As this process is in the hand of the main implementer, they will put their stamp on it. This is further supported by the versatility of the platform, which allows implementation in many different ways.

As a result, the choice of the implementer and manager of such a platform is essential for those driving the purpose of the platform. For a focus on explicit general policy goals the implementation by a generic transport authority on metropolitan level seems best. When the goal is wide use of the information, not restricted by specificity of governmental goal setting on mobility, a ICT department makes sense as the implementer. For a focus on general informational support of choices of travellers, optimizing to their needs, an ICT department in one of the regional public entities seems to work best. This can work when individual traveller and government goals align, for example in battling congestion for faster and more reliable travel times. In that case, the governance model does not need to support collectivization and nudges of the traveller. Also, one of the cases showed how private parties can also integrate information for the goals of the traveller, as long as there is a business case.

3.24 Governance problems and solutions in the real world: concluding the empirical columns

The empirical columns revealed governance complexity for a variety of smart mobility platforms. Besides only trying to understand this complexity, we also displayed some practical wisdom, how our insights could be made to use. As discussed before, we do not aspire to a Grand Theory on how to deal with governance complexity. Instead, we give advises how to deal with the many fragmented governance issues we encountered. Our handbook structure of 'columns' reflects this *en passant* approach, dealing with governance issues as they come along.

To conclude, summarizing the practical wisdom we displayed, reading through all the empirical columns and looking for the advises we gave, two patterns emerge.

One, we time and again advised parties involved in the development of smart mobility platforms to develop a 'negotiated language' on governance issues. We experience that our respondents find it hard to be concrete and concise about these issues. Partly this is typical for governance issues. They can be woolly and unbridled. Developing negotiated language may help here. Though respondents generally acknowledge that certain governance questions should be answered, they tend not to answer them, at least not explicitly, perhaps because it is hard to find assumptions and arguments with sufficient authority. An alternative approach is to develop negotiated language on governance issues. The idea is that at least the parties involved agree on how to answer certain governance questions, and if they cannot agree, explicit disagreement can be preferred above implicit (pseudo)agreement. Negotiated language on governance issues is not set in stone like scientific definitions. It may change under the influence of using it. In the empirical columns, we observed and argued that the parties involved could use some more 'negotiated language' on the following items:

- *The economics of the platform*. Is the platform viable? We suggest adding two topics here. First, what is the cost-benefit analysis per actor, not just for the platform owner? Second, what is the cost-benefit analysis along the way, not just in future when the platform might be ready and functioning?

- *The game of decision-making*. Given the variety of cost-benefit ratios in the course of time one can expect a dynamic development process wherein parties will be confronted with each other. By what rules do the parties want to play? A survival of the fittest? A friendly competition? Full cooperation?
- *The history of rules*. Some rules are not subject to design, but are given. They origin from culture, path dependencies and higher administrations. These rules are not always rational or stimulating innovations. What rules are relevant here? And who solves the problems caused by these rules?

A second pattern in the advises we gave is that we encourage developers of smart mobility platforms to open up for a multiplicity of actors. A rather closed, mono-actor, technocratic environment is currently the default to develop platforms in the cases we studied. This is apparently convenient, at least on the short term, and not necessarily wrong, but it is risky. Particularly as the platforms develop, it becomes more and more relevant to include the voice of many actors in the development of these platforms. The involvement of multiple actors of course has its costs. And gains and costs can be optimized. But we stress that the involvement of multiple actors should not only be seen as instrumental to the platform. Their involvement is also essential to the public values served by these platforms, not only to scrutinize, criticize and reinterpret them, but also to align them with the individual values of actors. As such, the process of developing a platform will have learning and trust-building as bycatch, which may get as valuable as the platform itself.

Three synthesis columns will follow up on these advises. But first, below we listed the key messages of our empirical columns, as the main summary of our findings.

Empirical column	Key message
3.2. Do all roads lead to Silicon Valley?	Innovations like infomobility platforms hold promises. A local platform has to deal with vested institutions. Vested institutions may delay innovations. The institutional void may be filled by a global player not interested in local institutions. If a local stakeholder group doesn't want this global player to set the

	standard, they must be able to look beyond their interests.
3.3. Assessing right now: gains, costs and the traveller's logic	Comparing gains and costs of projects for intelligent mobility show an alarming picture. Many million euros have been spent without a clear sight of a pay-out. Moreover, it proves really hard to assess the gains of these projects.
3.4. The governability of intelligent mobility	There are major differences between assessing the technical feasibility and assessing the governability of intelligent mobility projects. Governance is perhaps the most critical variable of the two but also the most difficult to assess. Instead of trying to assess governability as an analytical challenge, it is perhaps more doable to focus on a 'negotiated language' to discuss governability during the project.
3.5. Governance creep: the implicit lock ins of governance	Acknowledge that the choices in governance structure are more than facilitative for the development of intelligent mobility. The difficulty lies in the fact that these choices, though quite influential, are often not up to the developers to decide and may even remain variable.
3.6. Pain in paradise: accounting for trade-offs	The intelligent mobility platforms involve a wide range of trade-offs, some explicitly dealt with others hardly mentioned. Though 'making well-informed trade-offs' is the key goal of these innovation projects, the developers' ideas about *who* should make which trade-offs appear rather premature.
3.7. The Frankenstein-trap: proper operationalization of public values	The operationalization of public values for large-scale innovation processes is an intricate process with iterations and changes to be expected. In practice, the operationalization of public values appears quite a

	bureaucratic or technocratic endeavour without much public debate or political involvement. This is not necessarily wrong, but it brings governance risks.
3.8. To nudge or not to nudge: beyond the question	Nudging is frequently plead for but rarely argued for in the development of these smart mobility platforms. Nudging has a great variety of appearances with many different nuances both in terms of morality and in term of effectiveness. Advice is to make them more explicit.
3.9. Doomed to fail? The need for user involvement	Involving the end user in the development of smart mobility is a design dilemma that developers seem to avoid. As a result, little is learnt about which governance arrangements may accommodate users in the development process.
3.10. Tell me what you need and I will (try to) give you what you want: addressing the travellers' needs	Addressing users' needs is necessary for journey planning platforms to be effective tools for implementation of public goals. These needs of users may vary between the different journey stages. Clarifying the information needs of users at these journey stages helps to better tailor platforms.
3.11. Where did all the conflicts go? The sense and nonsense of mapping stakeholders	Mapping stakeholders and their interests is a helpful but not a straightforward exercise for those dealing with the governance of journey planning platforms. Hidden agendas, shifts in stakeholder salience, and complexities varying per situation, limit the value of mapping stakeholders and have to be acknowledged to avoid attaching too much or the wrong value to the mapping.
3.12. The prevalence of informational platforms: are public authorities just too pragmatic?	The cases studied for this Handbook show that public authorities have two major approaches related to their objectives when they develop journey planning platforms: on one hand platforms serve as an outlet to

	publicise public transport information ('informational platform'), whereas on the other hand platforms can be utilised as tools for the implementation of public policy goals ('policy-rich platform').
3.13. The black, the white and the grey: public and private initiative platforms	Mobility platforms can be distinguished based on the affiliation of the stakeholder(s) that has(have) the initiative to create and fund the platform – public or private sector actors. This is a simplified representation of reality and more nuanced cases exist that may not entirely fit the description, however identifying the main characteristics in these two models may help decision-makers on the development of new platforms.
3.14. The organisational setting of journey planning platforms	Four general organisational models can be identified relating to the way public sector is set-up for developing journey planning platforms : (i) the dedicated agency, (ii) the transport authority, (iii) the metropolitan authority, (iv) association with transport operators.
3.15. Overseeing it all? The centrality paradox for smart city projects	In theory centrality results in integrality, but in practice integral decision making on that same central level may be harder to accomplish than on a decentral level.
3.16. Contracting out smart mobility: the problem of integration and accountability	Contracting out activities serving smart mobility is common practice. There are risks, however. How does a government keep direction if necessary expertise come from outside and is even encrypted in software? And how do governments account for their tradeoffs between values such as privacy, sustainability and efficiency?
3.17. Data chain representations: Beyond dedication and control	Smart mobility projects involve data chains. Data chains are often represented as neat, ordered sequences of activities. Those representations communicate dedication and control, but neglects

	important governance aspects of data interchange. For evaluation of smart mobility a more sophisticated representation is vital.
3.18. Only for you: the organization of love and dedication	Our cases indicate that cities with a transport authority are generally more ambitious as well as more successful in smart mobility projects. This can be explained by their functional dedication to smart mobility as well as their hierarchical position to request data.
3.19. Survival of the fittest? From performance to permanence	The foundation of a platform takes lots of time and effort. It would be efficient if they will function for a long time, at least survive the implementation phase. This 'permanence' is likely to correlate with performance: the better the performance, the more viable the platform. However, this relation is not that straightforward as it seems.
3.20. The perpetuum mobile of intelligent mobility	Technological developments are usually accompanied by optimism. New systems would solve old problems without extra effort. A reflection on intelligent mobility learns that there is much potential for several crucial parties, however there is no such thing as a free lunch.
3.21. End-users and identification with the public values driving the platforms	The end-users of the platform could be various target audiences. Different audiences are tied differently to the platform, leading to different governance models around the platform. Technically, platforms can have very similar functions, but the organisational design of a platform aimed at tourists is very different from a platform aimed at the citizens of a region.
3.22. PETRA breathing: data in and data out	It is tempting to look at the platform as a data repository, with data coming in and data going out after modelling future states of the network and optimised

	routes. This would mean that governance would for a large part be about data ownership and storage and communication. However, the platform for a large part functions as a portal: data is linked to the platform rather then, transferred to the platform. Or even, the platform only allows for algorithms to be carried out on externa data, that never leaves the servers of the owner of the data outside the platform. Now governance of the data is about use of data that has to be linked by the platform from the data providers to the users, through licences, SLAs and APIs.
3.23. From goals to implementation: the importance of the last mile	The platform can be developed, implemented and managed by various entities, both on the private side as well as on the pubic side. We have seen that choosing that entity very much drives the direction of operationalisation of the original goals. This is shown to have a very substantial impact. An ICT department drives it different from a mobility department, a public transport operator different from a traffic management department, a metropolitan authority different from a national and local authority.

Part 4: Synthesis

4.1 PETRA business case

PETRA main characteristics

PETRA is a system that adds value to mobility data platforms with travel planning on three specific characteristics. These characteristics are real-time (data, modelling and planning of trips), multi-model (trip plans), and nudging (of travellers towards public goals). The **real-time characteristic** will allow for the trip and travel planning to be closer aligned to the current state of the network. In addition, it will allow for real-time changes of advice. In addition, the data will be broader than traditional trip planners, focussing on network flow. Adding other data like weather, events, allows for predictive modelling using historical patterns and real-time data. The real-time characteristic could be further supported by the fact that the trip planner app supports the platform to have a real-time status of network flows, by anonymously contributing the location data of the various apps to the platform. The **multi-modal characteristic** means that networks flows and planner options include a variety of modes. This allows network managers and traffic controllers to widen their analysis and solution set when considering options from network or flow interventions. In addition, it provides the trip planner to optimise the travellers trip using a wider variety of options. In addition, this variety of modes forms the basis of the third characteristic, as the app can present the traveller various modal options that are attractive from various perspectives, from healthy to quick, from cheap to comfortable, from clean to reliable. The **nudging characteristic** allows for the metropolitan governments that have implemented the platform to better align the behaviour of the traveller with the conditions and goals of the urban space. Travellers are used to optimise their trips for travel time. This optimisation is often putting a strain on the network and the city, by its negative externalities. Travel can be polluting, congesting, unhealthy, etc. The platform allows the government to assess the network and provide the traveller with alternatives through the planner that are less polluting or shifting pollution to less vulnerable areas. They could nudge people in taking different routes, optimised for collective travel time optimisation, rather than individual travel time optimisation. They could show people the health effects of their choice for a different mode, for themselves and for those residing in or visiting the city. The platform with its real-time data and multi-modal modelling abilities would allow for estimating the effects and nudging users in more collectivised choices.

PETRA business model

A mobility data platform like PETRA has to be developed and maintained in an organizational context that is conducive to realising its potential. This context will consist of a variety of actors, for example data providers, platform managers, and planner users. Whether these actors have the propensity to contribute to the successful development and maintenance of the platform depends on the incentives that the platform's organizational context is providing them and how sensitive these actors are for the incentives provided. A large part of these incentives will be monetary; whether they will they get paid drives their behaviour. For understanding the monetary basis of the platform it is important to understand the financial basis for the platform, both on the cost side as well as on the revenue side. This business case provides a first overview of the potential costs and revenues of a mobility data platform like PETRA.
Below an estimation of the costs and methods for analysing the benefits is provided.

Suppliers	Activities	Value propositions	Relationships	Customers
• Data suppliers • App developer • Cloud service provider • Model / algorithm suppliers • Dashboard developer • Payment service provider	• Data gathering • Data storage • Data enrichment • App development • Dashboard development **Resources** • Data related to mobility • App building capacity • Dashboard building capacity • Cloud capacity • Payment service	• Optimised urban mobility with reduced negative effects • Optimised individual travel times, robustness and reduced negative impact of trip • Easy availability of and access to mobility data	• Patron • App user • Data user • Cloud capacity user **Channels** • App for trip or travel planning • Licences for data use • Contract for cloud capacity use	• Metropolitan authorities • Travellers / app users • Raw data users • Enriched data users • Cloud users

Cost structure		Revenue streams	
Computing level: direct costs of upholding the platform		Computing level: direct revenue of upholding the platform	
- Cloud storage and computing capacity	€12.000 pa	- Cloud capacity	pm
- Communication capacity, T1 line	€10.000 pa	- Modelling capacity	pm
- Data licences			
○ Mobile streaming data real-time	€400.000 pa		
○ Mobile streaming data historic	€40.000 pa		
○ GTFS/AVL/WIFI/BT/CCTV/PT-RFID in ownership	€0 pa		
○ GTFS/AVL/WIFI/BT/CCTV/PT-RFID in licence	pm		
○ GTFS/AVL/WIFI/BT/CCTV/PT-RFID in open data	€0 pa		
- Algorithm and model development	€80.000 pu		
- App development	€100.000 pu		
- App maintenance	€10.000 pa		

- Dashboard development
- Dashboard maintenance
- Sensor procurement and deployment
  ○ Camera
  ○ Bluetooth and Wi-Fi
	€120.000 pu
	€10.000 pa
	
	€1500 pu
	€2000 pu		

Platform level: operational costs of the platform
- Platform development and maintenance
  ○ Staff, 3 fte
  ○ Facilities
- Nudges as part of the platform[3]
	
	€180.000 pa
	€12.000 pa
		Platform level: transactional revenues of making the platform
		- Funding from government
		- Data licences from other data users
			
			pm[5]
			pm[6]
			but advisable to relate price of data to the cost of acquiring the data
			pm

[3] Nudges are transactions that incentives app-users to make choices more in line with collective needs. Think about free public transport miles if an app-user makes trips more aligned with collective goals, like slower but cleaner. The transactions can pass through the platform manager, but generally are paid for by others.

[5] The platform will need a steady revenue stream, expected to be provided by a government subsidy. Obviously, that subsidy should be in line with the expected gains on a metropolitan or societal level, with government having to decide which goals they want to realize and what effects they expect from the platform and what funding they have available for realizing those effects. Obviously, this means that all revenues in the right columns cannot be added. The revenues on a metropolitan and societal level should reflect the expected benefits, which the governmental actors can decide to invest in by funding the platform on platform level.

[6] It is advisable to relate price of data to the cost of acquiring the data.

		- Nudges as part of the platform[4]	
Total over 5 years	€3.670.000 estimated costs excluding sensors €3.800.000 estimated costs	**Total over 5 years**	**Highly dependent on local situation.**
Metropolitan level and societal: societal costs on the level of the metropolitan jurisdictions and beyond	none	Metropolitan level: societal revenue on the level of the metropolitan jurisdictions and beyond[7] - Value of time saving and reliability for travellers - Willingness to pay for service providers	Value of time savings (Mackie, Diaz and Fowkes, 2001) Willingness to pay (Foelkner, 2006)

[4] Here we do not provide estimated revenues or outcomes, as they are highly dependent on the metropolitan environment, existing travel patterns, and expected effects of the platform and app. The modelling ability of the platform should help in accessing the effects. Here we provide pointers to approaches on how to calculate the effects. Some generic numbers to support calculation:

- Value of time savings in travel is often seen as between €10 and €20 per person per hour (Warfemius et al, 2013, Meunier and Quinet, 2015),

Value of emission reduction is €30 per tonne CO2 (Mandell, 2010) and an estimated €4500 per million car km (at 150 gr/km)

[7] Here we do not provide estimated revenues or outcomes, as they are highly dependent on the metropolitan environment, existing travel patterns, and expected effects of the platform and app. The modelling ability of the platform should help in accessing the effects. Here we provide pointers to approaches on how to calculate the effects. Some generic numbers to support calculation:

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Value of emission reduction is €30 per tonne CO2 (Mandell, 2010) and an estimated €4500 per million car km (at 150 gr/km)

		- Societal gains in terms of health, reduced CO2 emissions, etc.	Societal cost benefit analysis (Hanley and Spash, 1993)

Legend: pa (per annual), pm (no data available), pu (per unit)

Assumptions

The business model has several assumptions

- Costs on resources will be similar as experienced in the demonstrators and cases
- Both real-time and historic mobile phone streaming data are needed
- The platform will have its own sensor network
- Data licences are possible for the data needed and can possibly be transferred

Cash Flow Statement (NPV)

- The characteristics of the revenue stream do not allow for a detailed estimation of the revenue stream, without the context of a real metropolitan area and a real implementation of which the effects can be estimated. In the context of this broad analysis, these are not available. Here, instead, some high-level numbers are provided as well as references to methods to calculate the potential effects of the platform.

PETRA main risks

The effect of the platform has several key risks.

The first key risk is the **lack of users** of the app. The app is a key element in the changing the behaviour of the travellers in the region. If the app does not gain a substantial user base, the platform cannot realise its potential. Key factors might be the quality of travel planning by competing app providers, like Google, Moovit and Waze, or the visibility of the app compared to these competing providers. Another factor might be apprehension in the potential user base to share data, due to privacy concerns. Several mitigating factors are available. First, privacy should be secured in the platform, for which excellent algorithms are available that can be built into the platform. Second, metropolitan areas might already have an app with an existing user base. This helps kick-start the platform and extends the potential for nudging.

A second key risk is the **quality of data**. The platform's performance relies heavily on the quality of the data it takes in. In addition, the modelling approach is tuned to a specific set of data. With the landscape of mobility data rapidly changing, this could be under pressure. For example, privacy laws could now or in the future limit the possibility to use specific

data types. Or providers of specific types of data might withdraw from the market, without comparable alternatives available.

A third risk is the **inability to nudge**. It might be that the platform is working fine, based on good quality data and that the user base is substantial. However, users are not willing to change their mobility behaviour. In this case the only societal benefit the platform could provide is the increased reliability of travel advice, beyond existing trip planners. That is a limited societal benefit.

Strategic Options

Beyond its key use, there is a number of potential strategic options for the platform. First, infrastructure managers in the metropolitan area can have a much more **accurate understanding of the current and upcoming network status**. This would allow them to manage road and rail network more effectively, even without influencing the travel behaviour through the app**.** Traffic control rooms of rail and road networks could be supported by the predictions of network status based on real-time data and prepare for specific situations later in the day or on specific types of days.
Second, infrastructure planners in the metropolitan area can also have a much more **detailed understanding of historic traffic flows and network speeds**, allowing them to optimise infrastructure network planning. Infrastructure planning, looking for weak spots and bottlenecks in the network could be simplified. Would infrastructure planners before the platform have to buy their own data sets and analyse these, the platform provides a ready to use set of mobility data that they can use in evaluation and analysis tools.
Third, **providers of transport services could use the platform to better plan and operate services**. Public transport and taxi operators could obtain a more detailed and accurate view on the current and historic network speeds and direct traffic or plan services in accordance to that more effectively and robustly.
Finally, the platform could provide local and global app developers **easy access to mobility data for the metropolitan area**, making it attractive for them to come up with new services to governments, businesses, and travellers in the area.

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4.2 Five data platform models and their consequences for governance

A metropolitan mobility data platform can be implemented in several levels of functionality. Obviously, these various levels have consequences for the governance that the specific implementation requires. Here we discuss various models a data platform could take. Each next model will rank higher in terms of maturity. For each model we will consider possible consequences for the governance choices that would have to be taken.

First model: Open data policy

One of the key features of the data mobility platform is the wide availability of mobility related data. Data is the key prerequisite for the functionality and much of that data is in the hands of municipal or metropolitan governmental actors. In various cases, value was created in terms of improved travel pattern, transport operations or infrastructure planning due to available data, with other using that data for their own modelling, controlling, and planning.

The governance of this model is straightforward. Data is simply provided as open data, with data streams available. That open data policy can keep less control, with just open data streams, to stronger control, with licenses that are conditioned as for the types of use, types of users or data conversions allowed. So, the governance main characteristic is the license conditions under which the data is provided.

A second element of the governance is whether the licensing conditions are centralized or localized. We see examples where local or metropolitan governments are choosing and organizing their own open data licenses. In other cases, national governments force an open data policy with standardized licenses for most types of information generated with public money.

A third governance element of this model is whether the data type is standardized. Open data can be made available; however, the usefulness and potential uptake of that data is

dependent on whether the data type is a recognized standard. This can be illustrated well by scheduling data. Transport for London has its own data format, whereas scheduling data mostly is presented in the GTFS format. Open data that is only about access is more limited than an open data policy that also standardizes the format of the data. Standardizing the data format is a clear step towards mobilizing the potential of mobility data.

A fourth element is further structuring the interaction between the data streams and other applications through API's. The attractive side of this is that this allows for a more controlled interaction between the data sources and the data users.

So, key governance issues for the most basic for of mobilizing data for better mobility are: data availability, for example through an open data policy, data licenses, data standardization, and facilitation of interaction with the data through API's. These are key decisions that can support more effective metropolitan mobility through the use of data. The management of this basic form could be limited. Open standardized data with standard licenses could

Second model: A data oriented platform

A major step beyond open data policy is the development of a data platform, as a single point of entry for the mobility data in the metropolitan area. That single point of entry is not necessarily of technical characteristics, as current level of connectedness of most data systems makes access ubiquitous. And indeed, such a single point of entry could very well operate as a pass through of data. The role of the platform in this context is mainly in the field of governance: it serves as a single point of access for licensing and the API's mentioned above.

A second role the platform could add is quality control. The data that is accessed through the platform is considered to be of sufficient quality. For this, obviously, the manager of the platform will have to have quality control in place and a selection process that adds only data sources of a sufficient level of quality. That quality control will make it more interesting for users of the data.

A third element the platform could add is data retention and aggregation. Data streams can add value because they are real-time, however, they are also transient. This means that when data users would want or need more historical data, the platform could provide for that. Hardly ever, this is feasible or efficient by storing the direct output of the data streams. Consequently, aggregation of data for storage is needed.
Technically, this most basic form of the platform could be run on a cloud platform and as such, it is not relying on hardware of a possible metropolitan mobility platform manager. However, the need for a clear metropolitan organizational unit with the role of platform manager is substantially higher than in an open data model. The role of such a manager can be limited to both selecting and curing the data (streams) into the platform and licensing and facilitating the use of the data (streams) out of the platform. This would probably best be carried out by a department focused on data and technology.
When retention and aggregation become added functionalities, that retention and aggregation needs to be purposeful, aligned with the goals of the metropolitan authority that is funding and possibly hosting the platform, staff and facilities. This means that governance has to be set up to keep that alignment; the platform is more mobility policy driven, meaning that also a department focusing on mobility has to at least be involved in setting up and directing the platform's retention and aggregation strategies.
In addition, with the retention and aggregation, privacy and data retention legislation play a more significant role in regulating the platform. Governance has to be in place, driving the technical choices of retention and aggregation, in line with the regulatory frameworks on these issues.

Third model: A network status modelling platform

Building on the model above, a data platform with data retention and aggregation, another functionality could be added. This would further mature the model. Building on the data, the platform could provide for the modelling of trip chains based on the raw data streams, to get a better perspective of the real-time network status. For example, GPS measuring points can be translated into paths and speeds, which can be amalgamated into current network status.

In addition, the modelling could be aimed at getting a predictive network status. Based on the historic data, maybe in conjunction with the real-time data, the platform could provide predictions on the network status in the upcoming hours or on a specific day, like an event. This could help operators prepare for the upcoming status with changes in vehicle and personnel capacity.

Finally, the platform could be used to evaluate the effect on the network status of specific policy interventions. Specific policies might drive people to use more public transport, new investments in infrastructures might be considered, increased parking possibilities might attract more car drivers to the city center. The platform, with a variety of historic multi-modal data on network status and trips could help make the right decisions and choose the, from a policy perspective, most effective options.

For the governance, the fact that the platform now has added focus is relevant. New actors come into view that might want to demand functionality from the platform and drive its development in a certain direction. The cases showed us that in this state of maturity, it becomes very relevant for the development of the platform who is taking the role as platform manager. For example, when the manager is the road traffic control center of the metropolitan area, road network status aimed at aiding car flow becomes the focus. When the manager is a public transport operator, the public transport trip planning and operational control of the bus fleet become the focus of the modelling. Technically, both functions could exist together on the platform. However, the governance is driving the solution and the governance generally takes focus. Consequently, the focus in the governance (a specific department taking ownership of the role of platform manager) seems to be driving the focus in the technological solution, even if that technological solution could be broader. This is the risk of appropriation: the wider potential of the platform is thwarted because the implementing department drives it towards its own preferred application.

Fourth model: A trip modelling platform

Again, building on the model above, the captured and modelled status of the networks, both historically and real-time, allow for the predictive modelling that provides travellers

with an optimized multi-model trip advice. This come close to traditional trip planners. However, the variety of data in the platform and the quality of the network status, as they were captured, would allow for more sophisticated plans, in terms of the conditions of the network. For example, traditional trip planners for cars have to create an idea of the network status based the earlier trips of their users and the current users of their system in that network. The platform could have a much more detailed view of both the historic and real-time network status. Likely, the plans that are modelled on that better data are also more accurate predictors of the upcoming trip.

A second element that can be added beyond the optimized trip planning is making the plan multimodal. We have seen two ways in which this can be done. On the one hand, most trip planners are able to calculate different options using different modalities. The prospective traveller can choose between travelling by car, public transport, bike, or walk. The more mature trip planner would build trip chains from these different modalities, in line with the possibilities of the traveller, to further optimize the trip plan to the conditions the traveller is going to encounter on the network. The platform can probably distinguish more easily between modes than current trip planners, which would allow for more sophisticated planning of intermodal trips.

Another element that can be added is to go beyond traditional optimization of trip options for the least travel time. Because of the increased quality and variety of the data, other trip characteristics can be included or selected for optimization. For example, the trip can be optimized for reliability of the plan, for environmentally friendliness, for current weather conditions, for events, etc. Any data that can be added to the platform, like pollution data, can enrich the model and can be used to help travellers plan their trips, optimized for that data.

A further element that can be added is the coordination between influencing the travellers through the trips they plan, and other interventions in the transport system, like managing traffic flows traffic lights, information panels, etc. The platform would also allow for the evaluation of various interventions.

For governance, the modelling for trip planning and adding specific goals, further increases how mobility policy the platform is set up. It increases the need for the departments focusing on mobility to be involved in the decision-making on the development of the platform. In addition, the platform now has become a service to the travellers in the metropolitan area, to external users. In the governance, this means that the platform is entering a new market, with new clients and new competitors. The success of the platform now is less easily managed by internally selling the strengths of the platform to metropolitan authorities and allowing them to harvest the benefits. The competitions for trip planners is fierce and the function will only be successful if the uptake with travellers is substantial.

The multi-modal approach also means that more stakeholders are now have an interest, with different demands towards their metropolitan government on how to develop the trip planning service. Public transport operators, road network managers, mobility policy administrators, travellers, they all could have a different perspective on how to optimize the planning, and at the same time they all can help make the platform successful, for which their commitment is needed. The risk here is that a planner focused on the most environmentally friendly option would not be used by travellers, a planner focused on fasted travel time not (financially) supported by policy makers, a planner with a stronger car orientation hindered by public transport operators on which data the platform is relying, a planner with a stronger public transport orientation not supported by the road network manager. The governance will have to be able to deal with the dependence of this model of the platform on these stakeholders with possible conflicting interests.

Fifth model: A trip planning app connected to the platform

And again, building on the model above, the data platform, with modelling and trip planning could use a proprietary app that could further mature the platform. A first element this app could add is an additional data stream of real-time travellers flows over the networks of the various modalities. If the number of users of the app in a metropolitan area is high enough, this could further enhance the real-time understanding of the status of those networks.

A second element this would allow for is quality improvement of the planning model. If a substantial part of travellers is using the trip planning tool and allows the platform to follow their real trip, this allows for a constant revaluation of the quality of the trip plans and the model providing them against the real trip.

A third element is that the app would allow the governmental actors managing the platform to award travellers for choices that optimize for more collective values, like emissions and pollution, and less for individual values, like minimized travel time. This nudging would align the choices of the traveller more with the collective goals in the metropolitan area. A traveller could receive free public transport kilometres, when he follows a trip plan that is more environmentally friendly. Or another traveller could receive points for free coffee if she takes a route that alleviates congestion in more densely used areas of the network.

A fourth element the app could add is a dashboard to dynamically prioritize the values that they deem important and nudge the travellers. For example, in the morning rush hour, the collective travel time might be the key value. On warm days, the reduction of the emission of NOx in busy areas could be a key challenge, to which the trip planner could contribute by nudging travellers using the car away from these areas. On very congested days, travellers could be nudged to use public transport more. The dashboard could help governmental actors dynamically align the behaviour of the travellers more to the goals of mobility policies.

This trip planner app adds two key elements to the governance challenge of the data platform. First, privacy and trust become an even more important aspect of the relation with the data user. That relation will have to be set up to let travellers trust the app, as they allow for the app to track them. This also is generally highly conditioned by privacy legislation. Second, the nudging element is something that should be used carefully, balancing individual and collective losses and gains and focusing on the primary mobility challenges in the area. Nudging is a powerful and vulnerable approach for which decision-making on how to apply it should be carefully embedded in the wider governmental

organization.

4.3 Governance-by-design route

G

…from the dynamics of governance to the governance of dynamics

Governance may frustrate the designability of journey-planning platforms. Essential for a design team is to couple three core qualities: knowledge, authority and problem ownership. Dynamics may frustrate the design team in doing so. Different complex-adaptive strategies can be chosen to deal with this.

From a design perspective, journey-planning platforms are developed by a design team on the basis of a fixed program of requirements and implemented accordingly. From a governance perspective, it is less simple, since it involves not one design team but multiple stakeholders. Accordingly, governance is not only the subject of design, but the design process is also subject to governance. The dynamics of governance, as described in this handbook, therefore may challenge the design-ability of journey-planning platforms.

Governance is about the interaction between those providing information, those integrating it, those using information, and all others that have desires concerning the platform. For PETRA – just as many other platforms – government is involved, because they feel public values are at stake. This means that governance must bring together different positions and interests and will also cross the public and private divide. This complicates the transactions between the actors involved. Will government's will prevail, like in a hierarchy? Are relations better described as market transactions? Or is platform development and management better understood by the broader concept of networks, involving multiple actors that are mutually dependent? The obvious answer is that governance in practice show a mixture.

The design team is confronted with this governance mix and has to find a position in this socio-technical world of intelligent mobility. It involves designing a technological feature that has to satisfy these actors, and at the same time a context that facilitates actors to organize themselves – for instance by contracts or organizational structures. Designing also involves adjusting the design in a socio-technical context, for instance the culture, habits, and the regulations of the place where the platform has to function. It is easy to end up in despair. If platforms are subject to diverging interests, if objective knowledge is scarce and even norms of what is right diverge, is intelligent mobility governable at all?

True, it is easy to ask questions with no easy answers, but after all, this is exactly what makes designing such a complex activity. Despite these governance difficulties, our empirical work shows some starting points for design.

We found three qualities of actors vital for the governance of intelligent mobility platforms. We believe that each of these qualities can manifest themselves as necessary condition for success:

- *Knowledge*. What actors have scarce information and knowledge that is critical to developing the platform? These actors have vital ‘can do’ qualities.
- *Authority*. Another obvious ‘can do’- quality is the ability to impose their definitions and procedures on others.
- *Problem ownership*. Where the former two factors represent power qualities, a third factor is about ‘will do’. What actors have the drive to solve problems as they emerge, for instance by taking the lead in mediation among actors or connecting knowledge fields?

These three qualities are usually distributed over more actors. In this context we defined four models for mobility platforms. The models are based on the extent to which a platform owner is dedicated to infomobility and the organizational complexity of the platform owners. The governance of mobility platforms seems to be powerful if the three qualities are unified in one actor – such as in a dedicated transport authority – or coupled in a strong arrangement among multiple actors to overcome the organizational complexity.

This surely doesn’t mean that there is a perfect model. Development and management of platforms seems to be too dynamic for a perfect model. We found a range of different dynamics relevant to the success of keeping these three qualities together.

- A first dynamic is about authority. Although many platforms are developed on a decentralized level, close to the knowledge of the region and the problems experienced, at times authority or funding is needed from a central level, invoking centralizing forces.
- Second, it seems hard to pinpoint a perfect geographical scale. Problems – such as congestion – may manifest across administrative borders. The more borders

crossed, the more entities needed for coordination, the more compromises an administration has to make.

- Third, a good platform may attract interested parties outside the region, adding desires and complexities.
- Fourth, because platforms require diverse disciplines that are usually organized in specialized departments – i.e. ICT, environment, safety, mobility – the emphasis of the platform may change, largely depending on what department is in charge of the project.
- Fifth, and related, the platform's life path from cradle to grave doesn't go straight. Implementation and management are vital processes that may deviate significantly from the designer's plans.

These dynamics make perfection just a temporary delight. Indeed, a perfect choice now may be a curse in future because of path dependencies. As an alternative we would call designers to find a way to deal with the dynamics of infomobility platforms. Instead of perfect, a governance model should be adaptive. Roughly, two directions of thought on adaptive governance can be distinguished.

A first direction is anticipation. The need for authority, need for funding, possible spinning wheel effect, implementation issues, specialization, implementation issues, they all should be considered beforehand while designing a platform. This is of course a huge task, however this handbook provides a broad agenda for issues to be tackled.

A second direction is resilience. This assumes the occurrence of unexpected dynamics. If uncertainty is taken as a given, anticipation will by definition fall short. Recommendations then will target the organizations and transaction devices to be flexible enough to cope with dynamics. For instance, arrangements for entry and exit, feedback and conflict resolution mechanisms should be in place. However, these arrangements are just paper. Basically, the ultimate resilience mechanism is trust. Trust is hard to design for. It is a prerequisite for overcoming differences in times of technological and social turbulence.

4.4 The travellers' route

T

There are good reasons to engage travellers in the development of journey-planning platforms, but few platforms do it. Recognizing this paradox as a dilemma is a first step to change the status quo (if you want to).

Ask someone about what is necessary for the development of a journey-planning platform. The majority of answers will name three essential roles.

- a platform owner
- a technology developer
- a data provider

As we have seen, these three roles can be filled in by a variety of actors. The platform owner can be a governmental entity or a private player. The technology developer can be a separate tech company holding technical expertise necessary to build the artefact, but it might also be done inside the same organization that owns the platform or provides transport. The providers of data may involve many different actors. It might again be the same player taking the owner role or a third party, like a transport operator or a telecommunications company for instance.

Although this group of roles and actors may look comprehensive, a fundamental aspect is missing: the user. This 'route' is about the traveller and the different roles he or she may take. Another 'route' on policy instruments will focus on the government as user of these platforms.

The interviews conducted for the preparation of this Handbook confirm this gap: travellers are only thought of as the platforms end-users, and their role as part of the development process is not recognised. Stating adamantly that this approach is inadequate is too daring – in public policy there are no universal recipes for success. Nonetheless, at least three reasons justify to re-consider this predominant view and to acknowledge the importance of involving travellers in the development process of journey-planning platforms.

- Allowing all stakeholders, including travellers, to have a say in decision-making processes is conducive to a more legitimate outcome, therefore enhancing the

possibilities of successful – or at least less controversial – design and implementation choices.

- Travellers hold local knowledge – this knowledge, associated to the expected technical and strategic expertise of the platform owner and developer, allows for an improved final product, a better platform.
- As the end-users, travellers are the ultimate target of journey-planning platforms. Whatever the purpose of developing the platform is – be it public policy implementation or profit for the owner – it depends on attracting travellers and making sure they use the platform. Travellers' expectations and values must be embedded in the product.

Hence, this makes engaging travellers in the 'development team' a potentially beneficial strategy.

Throughout this Handbook, a route through the empirical columns discussed evidence encountered in existing platforms in relation to travellers, the roles they assume (or do not assume) in journey-planning tools, as well as reflections on some of the reasons and repercussions of these choices, including consequences for the operationalization of public values through the platform. A possible route to follow this discussion starts with the identification of stakeholders that are involved with journey-planning platforms and some reflections on the usefulness of trying to map them. "Where did all the conflicts go? The sense and nonsense of mapping stakeholders" discusses what is apparently a simple task (identifying stakeholders) and how it unfolds complexities involved in the development of journey-planning platforms: the network of stakeholders, roles and relationships and dependencies between them, their interests, resources as well as potential conflicts of interests that will have to be dealt with.

With this overview as a starting point, the trip continues with a discussion of the potential need for the involvement of travellers in the development process and some of the reflexes of this choice. "Doomed to fail? The need for user involvement" reflects on levels of potential or existing examples of travellers' participation or use of these platforms. This reflection will lead readers to the next journey leg, with two columns discussing a relevant

issue that lays in the background of the choice around what travellers' involvement ought to be: the value(s) sought with the creation of a journey-planning tool. Whose values will be sought? How important are travellers' values? And finally, how are these values operationalized? Some of the answers to these dilemmas are examined in "End-users and identification with the public values driving the platform" and "The Frankenstein-trap: proper operationalization of public values". The same discussion can be approached from an even more practical point of view. What kind of information does a traveller require when planning the trip? How does the information need change during the trip when the traveller is already on-board a vehicle? What kind of features should a platform offer in these cases? By considering the different journey stages a traveller goes through during his/her trip, the next column in the Travellers' Route – "Tell me what you need and I will (try to) give you what you want: addressing the travellers' needs" – offers a different perspective on ways to identify the values expected by travellers and also the ways by which these values are put in practice.

7 tips to involve travellers in the development of journey-planning platforms
• Start experimenting with it, in a minimal way at least. There are many options available. Organize for continuous feedback by travellers. Give travellers a say in the design team. Learning from such experience would be very welcome for current platforms in the making. • Think in terms of journey stages. The users' interests are more diverse than often thought. It is not only about travel planning, but also about changing plans or improvising during a trip or even afterwards, to evaluate the trip and the planning experience. • Align the users' interests with the public values driving the platform. The more alignment, the more travellers may identify with the platform goals. Travellers' involvement is driven by this identification and sense of problem ownership. • Organize for feedback on the operationalization of public values. Organize for dialogue and publicness to test and scrutinize the choices made during platform development. Allow the driving ideas about public values to change. Travellers can be of added value in this process. Use travellers as indicators for success. The costs and gains of journey-planning platforms are hard to

assess during their development. Involving travellers can be of added value in this.

- Address travellers with a variety of incentives. Don't treat travellers merely as 'guinea pigs' or 'rational calculators'. The behavioural logic of travellers is anything but simple and consistent.
- Draw on creative incentives based on a sense of community and loyalty schemes. Particularly if the public transport provider is the main platform owner, many relatively free bonuses are thinkable, such as extra kilometres or discounts for trips in off-peak hours.

There are reasons enough as well as options enough to involve the traveller. But why is it not done? It is somewhat of a paradox. Of course, there is no such thing as a free lunch. Involving travellers means transaction costs, imagine for example if a worldwide journey-planner is concerned. Involving travellers may also make the development more complex. These costs are not only and directly financial, but involve for instance, all the work and time spent to reach-out to a wide number of people and to collect their inputs or to develop a comprehensive decision process. Overall, the option not to involve travellers may represent a less complex and more manageable path. The advantages of involving travellers are less concrete and come later than the costs. Indeed, it is important to assess trade-offs and costs involved in the context of journey-planning platforms. Travellers, public authorities, developers, transport operators all have different interests, different needs and conciliating these sometimes conflicting perspectives implies trade-offs. Important questions emerge: What kind of choices and trade-offs are made? Who is supposed to decide on these? How are travellers being benefited? At the end of the Travellers' Route, "Pain in paradise: accounting for trade-offs; assessing right now: gains, costs and the traveller's logic" addresses these matters.

Involving travellers imposes a dilemma for the developers of journey-planning platforms with short term costs whilst gains are less concrete and come in the longer term. A schematic dilemma box below shows it.

	+	-
Involving travellers	• More insight in users' interests • More alignment between public values and user's interests	• More complex • More transaction costs
Not involving travellers	• More manageable • Less transaction costs	• Less insight in users' interests • Less alignment between public values and user's interests

4.5 The policy route: smart mobility platforms as policy instrument

P

How can these platforms be used as policy instrument? Current practice reflects only a few of many possibilities. A conceivable explanation is that current platforms prefer to avoid complex governance challenges. What are these challenges? Can we make these challenges less off-putting?

The word 'smart' in smart mobility needs unpacking. Somewhat ironically, the word has two meanings, both 'intelligent' and 'pain'. People tend to mean the first and ignore the latter. To some extent, smart mobility platforms may be a nice gadget for everyone, but to some other extent the platforms require value trade-offs, settling conflicts of interests against the will of some. In the current innovation rush, it is a bit sour to bring it up, but for the legitimacy of these platforms as policy instruments on the longer term, it is an underdeveloped aspect that needs our attention.

We read through the columns most related to the theme of policy instruments and reach a practical synthesis.

Theory promises a large variety in how to target and design a policy instrument. We call to mind three types (legal, financial, communicative), three dimensions (detection, effecting; imperative, voluntary; substantive, procedural) and three ways of nudging (incentives, information, choice architecture). Empirically, by contrast, we meet hardly any smart mobility platforms explicitly designed as advanced policy instrument. That is to say, few platforms are designed as a direct tool for specific policy makers to influence the mobility in a desired way. Instead, the general emphasis is to provide travellers with information on transport issues, but what's the innovation? Where's the policy interest?

Taking a closer look, however, we see a range of attempts to nudge the mass in new ways, particularly with communication, emphasizing some information and pushing other information to the back. This nudging is mainly treated as a collateral benefit and not as a trade-off. Financial incentives are somehow not used in all the platforms we studied. And

what about detection? What about the procedural side of policy instruments? All these dimensions seem unexplored in current initiatives.

We encounter a paradox. The smart mobility platforms promise a new era of policy instruments in mobility. The stakes are high. Mobility is critical to billions, as well as to our economies in general. Many governments invest a great many millions in these platforms already. But hardly any smart mobility platform maximizes, and often even stresses, its potential as policy instrument at implementation. As if it is a side-issue.

This route through the empirical columns does not only show but also partly explains this paradox. This becomes more insightful when comparing and combining the rationales of two perspectives for one of the core dilemmas, ‘ambition versus attainability’. On one hand, the journey-planning platform can be taken as a technological design challenge. On the other hand, it can be treated as a policy-making endeavour, a governance challenge. From a design perspective, this dilemma can generally be tackled in a rather straightforward way. Ambition reduces attainability, but more efforts compensates for that. Technical feasibility is not a fundamental or very unpredictable problem in the case of journey-planning platforms. From a governance or policy-making perspective, however, the dilemma ‘ambition versus attainability’ is more difficult to deal with, less linear and less predictable. More ambition is not directly less attainable. It really depends. Leading in the policy-making process is the argument ‘who wants what and why’, i.e. which policy makers aim to change which kind of (system) behaviour in light of which public values. Hardly any platform has been found with an explicit argument for policy making who wants what and why, let alone whether this argument is also accepted or not.

So, what may explain the paradox mentioned above is that making such an argument from a policy-making perspective gets the genie out of the bottle. Conceiving journey-planning platforms as policy instruments, requires publicness, political consent, stakeholder interaction and concrete risk taking, and this creates much more complex governance challenges and transaction costs. Conceiving journey-planning platforms as design challenges within a technocratic sphere offers a much more predictable and safer context. The latter, design-oriented perspective seems a convenient starting point as it offers the

best governability on the short term, but it may obscure the more problematic governability on the longer term when things change and eventually a switch is made to a policy-making perspective.

The rub is how these two perspectives come together in the process of developing journey-planning platforms. Common practice is a sequential approach. To start developing platforms from a design perspective in the political sidelines, in a safe technocratic context. If the platform eventually works, policy makers may step in as they get interested to use it. A major risk of this approach is that it may simply not happen that policy-makers seriously start using the new devices and the technological development stops when the project rans out of subsidy.

In most cases, it is not a reasonable option to treat both perspectives separated and sequential. From a policy perspective, the legitimacy of policy instruments is based on transparent and accepted trade-offs. A point of attention is the main authority, or authorities, using the policy instrument. Who these authorities are and how they publicly account for the trade-offs they may induce through this platform, may have many subtle implications for how to develop journey-planning platforms in a technical sense. A second point of attention, is the evaluation and adaptation of this policy instrument. Many technical design choices are not immune to this policy context.

It is unlikely that these platforms will spontaneously grow into ‘smart’ mobility platforms in the good sense of the word. When journey-planning platforms are first designed and then exposed to policy-making, the governance complexity may increase very abruptly and easily disrupt the continuity of developing. An alternative, more gradual approach would emerge when conceiving journey-planning platforms as policy instruments from the start of development.

Case overview

A prelude to the case descriptions

"One can state, without exaggeration, that the observation of and the search for similarities and differences are the basis of all human knowledge."

The quote with which we start this section is attributed to Alfred Nobel. The same way as for the Swedish chemist, it was also PETRA's team conviction that the empirical research of existing cases could provide PETRA's team with invaluable insights and knowledge for the development of a new platform. In particular in this Handbook, this interest in case studies meant observation of experiences from other platforms when encountering and tackling (or not) governance challenges. Studying other platforms was planned from the outset of the project and constituted a central element for the preparation of this Handbook.

While developing our work plan, a detailed case protocol was elaborated. This protocol established our priorities and set guidelines for the team to execute two tasks: on a first moment, identify potential cases and select those that could be part of our study. On a second moment, the protocol defined the most relevant information to be obtained from stakeholders connected to selected cases, serving, therefore, as an interview route.

The initial plan established the importance of unveiling interactions among stakeholders in those platforms that presented six key key-features. These key-features, summarized below, were in line with the characteristics being developed for PETRA:

a) *Platform*: a data repository or pass-through should be in place, providing a single point of access to users to a variety of data from multiple sources. The platform has to concentrate the data, integrate the data for the function of the platform, and interpret the data through modeling to expected outcomes.

b) *Multi-modality*: the platform aim is to advice on various services that have mutual dependencies but can be seen as separate, for example by the use of different

technologies or markets and are delivered by distinct providers of those services. For example, the platform is aimed at various energy providers (wind, PV, gas, oil, coal).

c) *Situational information*: next to data on the services, the platform gathers situational information that influence demand for and performance of the different services. It stores that data and makes them available for future reference and analysis. For example, weather information, driving the provision of alternative energy sources.

d) *Real-time planning*: the platform provides planning support to users. That planning is per definition aimed to optimize the future use of the services. The planning is real-time, in that it uses current situational information in its planning algorithms. Users can be the users of the services, but also coordinative actors on the services. For example, the platform helps control rooms of energy networks switch between various energy sources or helps power consumers to actively switch between greener and grayer power sources.

e) *Collective optimization*: the planning support is not just aimed at optimizing the goals of the individual user, but, at least partly, has a collective focus. That can be done by official policy goals included in the planning heuristics, or by heuristics that optimize the collective, rather than the individual performance. For example, the heuristics optimize the use of green energy, under the premise of reliable energy delivery, rather than the optimized power output of a single service provider.

f) *Jurisdictions*: the sources of data, the governmental goals, the planning demands, all might have various jurisdictions. A multi-level governance element is valuable. For example, the platform might advise the disconnection from the energy grid of a specific region to maintain functionality in the remainder of the grid.

Throughout the research process, it became clear that platforms that show all these features were extremely rare. Because of this, the team also included platforms that did not showcase the entire list of features as they may offer interesting lessons. As a result, a first rough longlist of potential cases including nearly 80 platforms was established. This was eventually narrowed down to the current list of 13 cases presented below and that

were interviewed either *in loco* or by telephone. This process to reduce the scope of analysis from 80 to 13 cases involved the subjective judgement of team members in selecting more interesting examples (based on the mentioned criteria), but also resulted from the actual availability from platform representatives to participate in interviews (the team reached out to several cases that unfortunately did not get back to our contact requests). These interviews were conducted with varied stakeholders fulfilling different roles in these platforms: technology developers, transit authorities, transport operators, travellers etc.

The main lessons and most insightful evidence gathered after researching cases are described in the empirical columns of this Handbook. The case descriptions in this sections come close to our 'raw data' and show the most important facts in a nutshell. Apart from the requirements we just discussed they list the type of information that is most relevant for the governance dimension of these platforms e.g. identification of the main stakeholders, their potential tasks and responsibilities; trade-offs involved in the development of the platform (including financial); level of embeddedness of the platform etc. Not all the information was found or disclosed by the platforms' representatives for all our cases, and this is the reason for some gaps in the list. Ultimately, though, this list serves as a practical reference guide for those interested in finding more about different platforms, helping the identification of those platforms that can be of greater interest according to one needs.

CarFreeAtoZ

Platform: CarFreeAtoZ

Coverage area: Washington DC metropolitan area

Stakeholders:

- Arlington County Commuter Services (ACCS): the transport demand management agency of the Arlington County, a bureau of Arlington County's Transportation Division
- Transport operators from multiple jurisdictions (Washington DC, Virginia, Maryland): ART, DASH, DC Circulator, Fairfax Connector, MTA, PRTC, Ride-On, VRE, and WMATA.
- Developer: Conveyal

Organisation and management: Platform was commissioned to private developer by the ACCS as part of the Mobility Lab of Arlington County. ACCS' mission involves reducing traffic congestion, decreasing parking demand, promoting maximum use of High Occupancy Vehicle (HOV) infrastructure, and improving air quality and mobility in and around Arlington.

Source of funding: Mobility Lab's Transit Tech Initiative is funded through a Demonstration grant by the Virginia Department of Rail and Public Transportation. The programme is part of the Mobility Lab which encompasses a series of Transport Demand Management initiatives and is funded by Arlington County (Virginia) Commuter Services, the U.S. Department of Transportation, the Virginia Department of Transportation, and the Virginia Department of Rail and Public Transportation.

Initial Investment: CarFreeAtoZ was created out of a partnership with Virginia's Department of Rail and Public Transportation. The county allocated $100,000 for development of the website in fiscal year 2013, while the state paid $400,000 via a "demonstration grant". In 2015 Arlington county has moved to "phase two" for CarFreeAtoZ that was expected to cost USD1 million, also coming through a grant from the Department of Rail and Transportation.

Development history: CarFreeAtoZ's history coincides with the emergence and growth of their developer Conveyal in 2011. In that year, ACCS's research arm Mobility Lab announced a fellowship program for aspiring transit techies. Conveyal's fellowship

produced promising results, leading to a grant for the project, awarded from the Virginia Department of Rail and Public Transportation. ACCS matched the DRPT funds.

Modes of transport included: metro, bus, private car, carpooling (formal and 'slugging'), private bike, shared bike.

Service Features: (i) **multi-modal** journey planner, including option to register for carpooling schemes, private bike and shared biked (ii) **trip duration** estimate, (iii) **carbon footprint** of the trip options, (iv) comparison of **trip costs**; (v) information on **calories burned**. Therefore it is a platform that serves both **individual and collective optimization** purposes.

The platform does not provide real-time information – it is essentially aimed at serving as a general planner for defining a daily commuting plan. ACCS has other services that offer this functionality though (Car-free Near Me).

Source of data:

- OpenTripPlanner (http://www.opentripplanner.org/)
- OpenStreetMap (http://www.openstreetmap.org)
- GTFS (Transit data feeds from the following providers: ART, DASH, DC Circulator, Fairfax Connector, MTA, PRTC, Ride-On, VRE, and WMATA)

Data flow: Operators providing GTFS data are in different jurisdictions. There is no formal agreements or legal obligation regulating the transfer of data from these operators to ACCS and/or the developer. Conveyal receives and treats the information for later publication. Two main issues faced to obtain data: (i) technical difficulties due to non-standardized data format; (ii) lack of institutional capacity and workforce in these operators to collect, treat and transfer data – especially in the smaller ones.

Open data policy: Information is only shared with entities who are contractually acting upon behalf of CarFreeAtoZ.

Continuity: The current work is partly being done on the basis of the initial grant, and on state funds for marketing.

Miscellaneous: CarFreeAtoZ is part of a broader Transport Demand Management programme led by ACCS Initiative: it is connected to multiple other service and/or platforms related to Travel Demand Management: CommuterPage.com; CommuterDirect.com; Arlington Transit — ART; WalkArlington; BikeArlington; Arlington

Transportation Partners; The Commuter Store; Arlington's Car-Free Diet; Mobility Lab; Car-Free Near Me; Capital Bikeshare; Arlington DOT.

Neutral Logistics Information Platform

Platform: NLIP

Coverage area: Netherlands, including incoming and outcoming goods

Stakeholders: Branch organisation for air cargo (ACN), port community system organisations in the Dutch mainports (Cargonaut, Portbase), shipper's association (EVO), Dutch Government (represented by the ministry of Economic Affairs, but also the ministries of Finance and Infrastructure are stakeholders, as are the Tax and Customs Administration and other organisations), port authorities of Rotterdam and Amsterdam and their shareholders, Schiphol airport, business association for transport and logistics (TLN), branch oragnisations for forwarders and logistics (FENEX), the association for Rotterdam ship brokers (VLC) and terminal operators (VRTO). Later, also some members of the branch associations were involved directly, as were other parties such as FloraHolland.

Organisation and management: The platform was commissioned by the Topsector Logistics, as part of the Dutch Topsector policy. A covenant was signed between the parties involved, securing commitment to the overall vision. Formal governance consists of a steering group and a sounding board. There is a programme manager and a secretariat ('NLIP team') for day-to-day management.

Source of funding: The central government pays for the programme, often in the form of subsidies for specific projects or developments (such as certain functionality on the platform). Co-funding by the private sector is also common. Recently, the programme manager changed awarding funding from subsidies to contracts, allowing for more direct control over the various activities in the NLIP programme.

Initial investment: Unknown. The total budget made available by government and businesses for the entire topsector was initially €155M, but this was allocated to six programmes (NLIP being one of them).

Development history: This programme started in 2010, with the idea of creating one information platform (building on existing platforms), based on a process aimed at agreeing on (technical) standards, functionality and governance. The NLIP is not a platform itself, but a set of standards, guidelines and agreements used for joining up existing information platforms and message brokers, such as the existing port community systems and the government's e-message portal. The programme supported the

development of specific use- and business cases, resolving legal and governance issues that came up with specific implementations, and the adding of new value-added functionality. The success of the overall development as a platform is mixed at best.

Modes of transport included: cargo, including containers over sea, airfreight, truck, barge, rail.

Service Features: one-stop-shop reporting, data re-use, reduction of administrative burden, chain optimisation, digitisation of forms, support government inspections.

Source of data: the business community (primarily carriers, terminals, freight forwarders, or their respective agents), through the community systems. The supply of information from government to the business community (e.g. inspections or container release) were also in scope, but ran into legal hurdles.

Data flow: the main source of the information is the data involved in business-to-government reporting, whether supplied to government directly, or via port community systems. Especially the flow through community systems led to discussions about data ownership, re-use of data for new functionality and services, and various data rights and (perceived) vulnerabilities related to data sharing.

Open data policy: none, data is not open, the commercial stakes are too high. Furthermore, cargo-related information may not always be shared due to reasons of security, confidentiality and data protection legislation.

Continuity: once the financial support of government ends (currently not foreseen), continuity will depend on business cases for data sharing, and on business models for components of the platform (as a system-of-systems). The underlying vision would upset the business models of quite a number of parties in the supply chain, which leads to resistance. Should the programme end now, the lasting impact is likely to be limited.

Miscellaneous: this is an a-typical case for the PETRA project, as it does not concern personal mobility but is focused on cargo. Yet, it is a very rich case in which a diverse business community and a government community (also quite diverse) collaboratively work on a data platform. The actor complexity is high and a number of legal, organisational and governance issues come up that are relevant to infomobility platforms. Given that we are able to study close to 6 years of this case, it offers valuable insights that are relevant to the broader topic.

MaaS Global

Platform: MaaS Global

Coverage area: 'Whim', the platform's mobile app will be launched in Helsinki in 2016. The owners intend to expand the use of the platform to other areas and countries in the near future.

Stakeholders:

- Company owners: the biggest single owners in MaaS Global with a 20 per cent interest are Transdev, a French transportation giant offering land, rail and passenger transport services and Karsan Otomotiv Sanayii and Ticaret AS, a leading car-industry family of Turkey. Sampo Hietanen holds a ten percent stake in the company. Other shareholders include InMob Holdings of Cyprus; Neocard; Korsisaari; GoSwift; MaaS Australia; Goodsign; IQ Payments; and Delta Capital Force.
- Local Transport providers
- Service providers (restaurants, grocery shops etc.)

Organisation and management: Privately owned company.

Source of funding: Private investors, Finish Funding Agency for Technology and Innovation. Eventually funding will rely on user-fees.

Initial investment: MaaS commenced operations on 1 February 2016 raising a total of EUR 2.2 million in its first call for funding from private investors and the Finnish Funding Agency for Technology and Innovation Tekes.

Development history: The company started to be operational in February 2016. The mobile application that offers MaaS services is to be launched in Helsinki in 2016.

Modes of transport included: taxi, bus, train, bike and car, all rented or shared

Service Features: MaaS concept relies on the idea that 'the money lies on the freedom of mobility allowed by cars' – that is something people are willing to pay for. MaaS intends to serve users as an alternative to owning a car however providing them with the freedom of movement offered by a private vehicle. It will work as a one-stop-shop combining options from different transport providers into a single mobile service that will offer users different

mobility packages with monthly fees. The company's business model involves providing services to clients rather than providing them with means to service themselves like journey planning platforms do. This assistance takes place with respect to 2 main components: ticket purchase and offering the transport option through mobility packages

Source of data: Transport providers
Data flow: Information supplied by transport providers is used to feed the MaaS platform creating trip options to users. The mobility packages are built through agreements between MAAS and transport providers: these providers grant access to their data/mobility services and MAAS buys these services to later resell to end users. Transport providers accept to grant MAAS access to their clients and services mainly because the company does not act as a regular intermediary taking a percentage of the ticket revenues, but simply buys them to resell to end user.
Open data policy: N/A
Continuity: Depends on the success of the business model
Miscellaneous: Transport providers understand that this way they lose contact with clients however they see that people are looking for one-stop shop options.
MaaS has a very critical view on governments participation on the development of mobility platforms. They see a great risky of non-continuity – platforms are created but not well kept or upgraded – public sector as entrepreneur is bad and should not be involved in this type of initiatives.

Optimod

Platform: Optimod

Coverage area: Lyon Metropolitan Area

Stakeholders:

- Lyon Métropole (Metropolitan authority)
- Sytral (transit authority)
- Keolis Lyon (transport operator)

Organisation and management: Since January 2015 Lyon Métropole (La Grand Lyon) assumed roles that previously were held by the Rhône Department and the Municipality of Lyon. Grand Lyon manages public transport policy for its 59 members. Grand Lyon owns Optimod.

Source of funding: La Grande Lyon + EU funds

Initial investment: 7 million Euro

Development history: The platform was developed in three years (2012-2014) by thirteen partners from public and private sectors: Le Grand Lyon, City of Lyon, Renault Trucks, IBM, Orange, CityWay, Phoenix ISI, Parkeon, Autoroutes Trafic, Geoloc Systems, Le laboratoire d'Économie des Transports (LET – Lyon II), le Centre d'Études Techniques de l'Équipement (CETE) de l'Est et le laboratoire LIRIS (INSA).

Modes of transport included: private car, train, metro, bus, bike (private and shared), airplane.

Service Features: the platform envisages three major services (i) 1 hour traffic prediction; (ii) an urban navigator on mobile phone; (iii) a navigator for urban freight & an optimisation tool for delivery rounds in the city. The navigator service, app developed by Cityway, is the main feature and involves. This service offers (i) **multi-modal public transport** or **private car** or **bike (private or shared)** or **walking** journey planner, (ii) **trip duration** estimate , (iii) **real-time planning and situational info**, including availability of public bikes and bike parking places in stations; (iv) incentivizes carpooling and car sharing. Therefore Optimod promotes **individual and collective optimization**.

Source of data: All data on public transport modes is gathered by Keolis Lyon.

Data flow: Keolis transfers all its data to Sytral (contractual obligation). The data is owned by Sytral. This data is used by Sytral in their own platforms providing information to

travellers – travel plan and schedule but is also provided to the Grande Lyon. Data format is NETEX and GTFS.

Open data policy: The platform supports open data. The move to open data led to improvement in data quality. However a licensing agreement was devised and is used to ensure business secrecy, know-how, and contact with clients.

Continuity:

Miscellaneous:

OV9292

Platform: 9292

Coverage area: The Netherlands

Stakeholders:

REISinformatiegroep B.V. owns the platform. The company's shareholders are (--)

Organisation and management: 9292 was founded in 1991 as the central source of information for public transport in Holland. Besides the travel planner the REISinformatiegroep B.V., manages the NDOV point, which is a central platform where all the public transport information is publicly shared. This information point contains planned and real-time travel information, prices, and other information.

Source of funding: the REISinformatiegroep is self-funded with income from; (i) advertisement on their services; (ii) their telephone travel information services; (iii) the reisinformatiegroep sells there travel information API; (iv) the reisinformatiegroep develops dynamic travel information systems.

Initial investment: N/A

Development history:

In 1991 the Dutch public transport companies decided to work together on a central travel information system. In 1992, 9292 started as a telephone number that travellers could call to obtain trip information. From 1998 the company launched the possibility to plan your travel from address to address on their website.

Modes of transport included: bus, train, metro, tram and ferryboat

Service Features: The platform's core components are information on bus, metro, ferryboat, tram and railway stops/stations. In general it provides (i) **multi-modal public transport** or **walking** journey planner, (ii) **trip duration** estimate , (iii) **real-time planning and situational info**, (iv) **price** information (v) **personalised needs** – users with special accessibility requirements.

Source of data: each transport provider supplies their data to the NDOV (open) data platform.

Data flow: 9292 uses the data from NDOV for their journey planning services.

Open data policy: The reisinformatiegroep sells, from 2013, the 9292 API for use within companies own systems.

Continuity: 9292 is a well-established system, embedded in habits of most Dutch. 9292 gives 450 million journey advices each year, divided over 5.3 million single customers.

Miscellaneous:

Plan a Journey

Platform: Plan a Journey

Coverage area: London metropolitan area

Stakeholders:

- Transport for London (TfL) - transport authority: Plan a Journey department
- Transport operators: bus (private companies), metro (TfL), National Rail (national government), Overground, DLR, river bus, shared bike (TfL)
- TfL's departments responsible for each mode of transport
- MDV in Germany ('data system')

Organisation and management: TfL is responsible for all transport strategy, going beyond public transport and including all surface transport, including urban planning, traffic management strategies, congestion charges, taxis etc. TfL has a department dedicated to the gathering, treatment and publication of all data collected from the different transport modes included in the platform. This department manages Plan a Journey.
Platform is not part of TDM initiative at TfL – Plan a Journey is not within TDM department.

Source of funding: TfL - Mayor of London

Initial investment: N/A

Development history: the journey planner became available in the early 2000s.

Modes of transport included: National Rail, Bus, London Overground, metro, River Bus, Emirates Air Line, DLR, TfL rail, tram, coach

Service Features: The platform's core components are information on bus and railway stops/stations. In general it provides (i) **multi-modal public transport** or **bike** or **walking** journey planner, (ii) **trip duration** estimate, (iii) **real-time planning and situational info**, (iv) **personalised preferences** – option amongst fastest route, route with least walking, route with least transferences, (iii) **personalised needs** – users with special accessibility requirements.

Source of data: each transport provider supplies the Plan a Journey department with the respective data.

Data flow: (i) bus feeds are automatically imported to the platform; (ii) metro data goes to the back office system (MDV) that tests all data accuracy before they are included in the platform; (iii) smaller modes have their data provided in excel files and these information

are manually inserted in the platform; (iv) national railway provides blocks of data weekly (TfL does not run the process in this case). This requires that the department responsible for Plan a Journey keeps in close and constant contact with all TfL departments in order to obtain information to be able to publish notifications on services related to stops, disturbances and schedule.

Open data policy: Plan a Journey has a unified API and that single API is also provided to developers interested in creating apps.

Continuity:

Miscellaneous:

Public Transport Victoria

Platform: Public Transport Victoria

Coverage area: Victoria

Stakeholders:

- Public Transport Victoria (Transit Authority)
- Transport operators (rail and tram services are franchised while bus services are contracted out or franchised)

Organisation and management: PTV is the system authority for public transport. Amongst other functions, PTV functions as a single contact point for information on public transport services, fares, tickets and initiatives. The travel planning platform is an element of these services.

Source of funding: Public Transport Victoria (Victoria Government)

Initial investment: N/A

Development history: PTV's travel planner was initially developed outside the entity, however it was internalised and is now managed by the authority.

Modes of transport included: train, tram and bus services.

Service Features: PTV's travel planner provides route information based on static timetable information – it does not provide real time information, just indicates general status of lines (colour alerts). The justification for not providing real time information is the concern authority and operators have in relation to quality of data

Source of data: transport operators

Data flow: PTV determines the data to be provided by the operators. Trams and trains have also their specific journey planning platforms. The information may not be exactly the same as the one provided by PTV.

Open data policy: all modes, except for buses, have their information available at Google Transit

Continuity:

Miscellaneous: States in Australia play major role in transport –Victoria government governs the State and the main city - Melbourne. PTV's journey planner is a simple platform and that is also a reflection of this governance arrangement: The State manages

the transport authority and developed platform as it has the political power and funds. However it sits ‘distant’ to the population. People are closer to city government but the cities have no significant means to act.

Qixxit

Platform: Qixxit

Coverage area: Germany

Stakeholders:

- Qixxit: corporation owned by Deutsche Bahn.
- Transport providers that celebrated partnership agreements: DB, Flixbus, Bla Bla Car, Call a Bike, Konrad Bike, Opodo, Matzes Minibus, StadRAD Hamburg, StadRAD Luneburg, Citybus, Busandfly, Avis, Better Taxi, Sixt, Flinc acr sharing, HKX.
- User involvement has always been significant. Active feedback and frequent researches are used since the development of the platform. Users' input is steered by Qixxit as they develop their questionnaires based on their algorithms.

Organisation and management: Qixxit is a corporation owned by DB however acting autonomously as a business unit. Qixxit is an outside sales channel through which DB aims to gain new customers. It's open to any mobility service and no preference is given to any mode (neutral advice).

Source of funding: DB

Initial investment: N/A

Development history: Qixxit was developed within DB to offer journey advice for users in Germany. It was launched in 2013.

Modes of transport included: Train, Tram, Bus, private car, taxi, shared car, bike.

Service Features: The trip advice provided is door-to-door, however Qixxit's main focus is the long leg of the journey given that for most trips within cities already have specific platforms. Travel advice is multi-modal including public transport options, private car, taxi, car-rental, car-sharing options, bike, and bike-sharing. Besides offering trips in different modes, Qixxit also has different options of providers within the same mode. Qixxit indicates the cheapest option as well as the option that emits less CO2. Users are able to create personal profile indicating trip preferences so as to personalise the search/planning tool. Users are not nudged to make specific choices. One of Qixxit's principle since its inception, even though being owned by DB, is to provide **neutral advice**. At the moment users can purchase DB tickets through Qixxit, but purchase options for other modes are

still not integrated. The information and advice are real-time. Updated with disruptions or delays. The app also follows the trip indicating the remaining time and alerting for transferences.

Source of data: The information available at the platform is supplied by DB as well as all other partner transport providers.
Data flow: The information flow is regulated by formal partnership agreements that specify the transfer of information as well as the manner in which it is displayed by Qixxit. The company does not reveal whether these agreements are remunerated.
Open data policy: Qixxit does offer open access to its data. At the moment all effort is dedicated to improve the tool and develop more functionalities. There is no interest in providing an open API.
Continuity: Qixxit plans to integrate purchase options for all services available at the platform so as to become a one-stop-shop. Currently trips cover German territory however in the near future Qixxit wants to provide advice for international trips – from and back to Germany. Being a fully international platform with advice on trips within different countries is a possible long-run objective.
Miscellaneous:

Reittiopas

Platform: Reittiopas

Coverage area: seven municipalities of Helsinki Metropolitan Area

Stakeholders:

- HSL (Helsinki Regional Transport Authority)
- Transport operators

Organisation and management: HSL now owns the platform – it acquired it from a private vendor - however the technological development of Reittiopas depends on the vendor.

Source of funding: Funding for the projects comes from HSL. The authority's budget is composed by funds from the seven member municipalities (50%) and from user tariffs (50%)

Initial investment: N/A

Development history: Reittiopas was developed by a start-up company (made up of 3 students) in 2001. Currently the company is CGI. HSL, Public Transit Authority for Helsinki Metropolitan Region (7 communities), bought the services of this tech company. This beginning caused some problems to HSL (vendor lock-in).

Modes of transport included: Public transport modes – bus, tram, metro, commuter train, ferry. A separate link offers advice for walking and cycling.

Service Features: Reittiopas offers itinerary information including different modes of transport within HSL member municipalities, however it is essentially a service to provide info on how to move from point A to point B. There is no real-time information and the data uploaded to the platform is merely based on 'static data', i.e. the transit timetables defined by HSL. It was identified that 65% of users are accessing Reittiopas from mobile devices, however the platform is not optimal for mobile devices as it was developed for desktop use.

Source of data: transport operators API.

Data flow: data originated from transport operators is used to feed the platform

Open data policy: HSL offers access right to Reittiopas interface for applications and services that support public transport usage and transport information availability. The use of these interfaces is free of charge. Access to the downloads and interfaces is granted an

account registration form. HSL has the right to inspect applications and services before granting access to the interface and may revoke access rights whenever necessary, for example in case of excessive traffic to the interface or misuse of the service.

Continuity: Current Reittiopas service has high satisfaction rates with users however the platform is already technologically obsolete Digitransit is the newer initiative from HSL in the field of travel demand management through digital journey planning platforms. Digitransit is already active and coexists with Reittiopas. There are still considerable more people using Reittiopas (160.000 users per day), but one expects that this will change by the end of 2016. By then it is expected that Reittiopas will no longer be online. Digitransit will be fully owned by HSL. This solves the 'vendor lock in' that marked the Reittiopas-arrangement. HSL had to invest in something a private party owned and developed.
Miscellaneous: Digitransit brings important changes in relation to Reittiopas:

- HSL ownership
- Real-time information where available
- Mobile devices friendly platform
- User responsive / user oriented
- Easier to use open data
- Covers all Finland and not only Helsinki metropolitan area

Digitransit will go beyond public transport modes and offer information on bikes (including city bikes), private cars and also provide information on availability of parking spaces in case one wants to switch modalities. Digitransit will have more nudges to direct users towards public values: for environmentally friendly options as well as cost-efficiency goals. Two examples. 1. Digitransit prefers the train over the bus and will advise users to take the train if the travel time would be comparable (not equal; it even advises the train if the bus would be slightly faster). 2. The app advises central places to change rather than more peripheral, because it is safer to change there

Traffic Information Austria (VAO)

Platform: Traffic Information Austria (VAO)

Coverage area: Austria - The VAO traffic information is used in journey planners by a variety of platforms, among them; AnachB.at, the motorway operator ASFINAG and 9 other institutions. VAO is offered as a stand-alone traffic information platform, but also serves as the basis for the respective traffic information provided by its partners.

Stakeholders: VAO is a collaborative project of ASFINAG (coordinator), the working group of Austrian transport association organisers (ARGE ÖVV), ITS Vienna Region, Ö3 traffic editorial staff, ÖAMTC, the City of Graz as well as the federal provinces of Burgenland, Carinthia, Lower Austria, Salzburg, Styria, Tyrol and Vienna. Co-opted partners are Austro Control, the Austrian Association for Rehabilitation (ÖAR), the Austrian Federal Ministry of the Interior and the Federal Province of Upper Austria.

Organisation and management:

Source of funding: 50% are subsided by the Climate and Energy Fund. The other 50% are paid by the stakeholders involved in the project, such as the provinces and the cities. For example, the state of Upper Austria funds the project to develop a real-time traffic overview of the states of Upper Austria and Salzburg.

Initial investment: The VAO project has a total financing volume of EUR 4.700.000. and was made possible by the Climate and Energy Fund, receiving a 50% subsidy under the framework programme “Public Transport”. The VAO II - a second phase to improve the project by use of additional data, optimisation of detection of traffic data and real time data, and integration of new mobility services (sharing concepts). Also, improving usability and performance of end-user services was targeted - project has a total financing volume of EUR 9.800.000, and also receives a 50% subsidy of the Climate and Energy Fund under the framework programme “Public Transport”.

Development history: The VAO is a project that started September 2009, with the launch of the journey planner in the summer of 2014. The VAO II project had the goal to further improve the services. The VAO II project started in 2012 and finished in mid-2015.

Modes of transport included: bike, foot, car, bus, train, metro, tram and airplane.

Service Features: The journey planner provides: (i) intermodal Austrian-wide door-to-door routing; (ii) comparison of travel times and environmental aspects of the trip.; (iii) public

transport timetables; (iv) real-time and forecast of traffic situation;(v) information on Park&ride and Kiss&ride facilities, parking areas; (vi) map information and alerts related to roadworks, detours and traffic problems. The platform's advice is neutral - there is no preference or discrimination of individual transport companies.

Source of data: VAO is based upon: (i) GIP.at and GIP.gv.at are the source for digital map for routing – authorized by federal states, ASFINAG, ÖBB Infrastructure; (ii) Basemap.at for background map tiles – source: GIP and geographical data; (iii) all data from its partners.

Data flow: The core component is a public database: the Graph Integration Platform (GIP) which enables the different partners to maintain and share content in partial networks.

Open data policy: N/A

Continuity: N/A

Miscellaneous:

VSS

Platform: Verkehrs- und Tarifverbund Stuttgart (VVS)

Coverage area: The network area includes the city of Stuttgart and four neighbouring counties - Böblingen, Esslingen, Ludwigsburg and Rems-Murr-Kreis - with a total of just over 3,000 square kilometers and 2.4 million inhabitants.

Stakeholders:

- Public transit authorities: Land Baden-Württemberg, Landkreis Böblingen, Verband Region Stuttgart, Landkreis Ludwigsburg, Landkreis Esslingen, Landeshauptstadt Stuttgart, Landkreis Rems-Murr-Kreis
- Over 40 transport operators

Organisation and management: VSS is an association owned by: (i) Stuttgart Local Authority and authorities of 4 districts around Stuttgart (50%) and (ii) bus and train operators in the area (50%). VSS main roles: (i) organise common fare system; (ii) design public transport schedule; (iii) manage the journey planning platform.

Source of funding:

Initial investment:

Development history:

Modes of transport included: subway, commuter trains, bus

Service Features: Static timetable of public transport. Real-time data on commuter trains. Tariff information is also integrated into the platform. VSS recently developed a separate platform for bike journey planning.

Source of data: VSS is directly responsible for the static timetable of public transport and hence includes this data directly into its platform. Real-time data on commuter trains comes from operators.

Data flow:

Open data policy: Data is currently open to third parties only through a contractual agreement that imposes two main conditions to data receivers: request must come from a real person and no statistic use of the data can be made. MOOVEL, owned by Daimler (https://www.moovel.com/en/NL), for instance, uses VSS database. Tendency is that the use of these contracts will be discontinued – VSS is moving towards fully open data.

Continuity:

Miscellaneous: Currently VSS does not make any other use of the data gathered for the journey planning platform. VSS does not nudge users to any behaviour – platform simply provides travel information for public transport users. At the moment users have no role nor provide policy rich feedback. There will be news in relation to users participation in the coming months.

Mobidot

Platform: N/A

Coverage area: The Netherlands

Stakeholders: N/A

Organisation and management: Mobidot is a Dutch Start-up established in 2013. Mobidot collects personal travel information by using an application on smartphones. The app collects multimodal, door-to-door and 24x7 movement behaviour of people. The information can be used by the owner of the app and with permission it is used by Mobidot and partners.

Mobidot works for governments, transport companies, service providers and employers. With the information gathered via the Mobidot app on smartphones, clients can use the knowledge of travel behaviour and travel motivation to influence movement behaviour of people and provides capabilities to influence travel behaviour in a personalised way.

Source of funding: The start-up is funded through their partners assignments.

And Mobidot received a EU- stimulation price in 2014

Initial investment: N/A

Development history: Mobidot is established in 2013. Mobidot is a Dutch spin-off and start-up company of former technological institute Novay and European commission funded R&D project Sunset. Sunset is part of the European commission's Seventh Framework programme Smart Cities & Sustainability under DG Connect.

Modes of transport included: depending on the wishes of the customer using the Mobidot services. The software can distinguish train, bus, bicycle automatically with accelerometer. Other modes of transport can be distinguished surveys integrated in the application.

Service Features: Mobidot offers their services in two ways: via a turn-key model or via an integration model with the clients own application.

In the Turn-key model the client uses the Sesamo app (mobidot own app), the client will be able to allow certain people to access the app, collecting the information about their target group via the Sesamo app.

In the integration model the services are integrated in the application of the client.

In both options the client is in charge and in control of the respondents.

Source of data: Personal travel information is gathered by the sesame application developed by Mobidot, but also via the integration of the Mobidot services in clients applications.

Data flow: the data is processed by the Mobidot data processing platform called MoveSmarter. MoveSmarter is a modular platform with 5 different modules; MoveSmarter Library; MoveSmarter Tracking Module; MoveSmarter Information Management Module; MoveSmarter Incentive Management Module and the MoveSmarter Sampeling Module. The modules are supported by an Identity Management module and a web-based MoveSmarter Management cockpit. The MoveSmarter Identity Management software provides domain and user registration and identification, authentication for data exchange and role-based authorization to MoveSmarter functionality. This creates a secure, manageable environment. The web-based management cockpit provides a user interface for administrators for user management, configuration of the functional modules, monitoring and tuning, data anonymization and data visualisation and reporting.
For explanation about the different modules see: source.

Open data policy: The API is available in consultation with Mobidot.

Continuity: Mobidot is a private company providing services to governments and transport companies. It will continue to do so if there is enough demand for their services.

Miscellaneous:

Information source

Glossary

App	Application on a (usually) mobile device allowing for the planning of a trip or travel by app-users
App-user	Individual travellers that plan their trips or travel using an app
Platform	Computer facility consisting of hardware and software providing the storage or pass-through of (mobility related) data, data enrichment, data access management, and trip or travel planning services
Platform manager	Organizational entity that manages the development, maintenance, and control of the platform
Governance	The way platforms and all their features are governed by all stakeholders, both public and private.
Institutions	Rules that affect behaviour, including formalized, written rules and informal, more invisible rules.
Stakeholders	Actors that have an interest in mobility platforms. Most notably users, data providers, transport service providers, infrastructure managers and governments
Cloud	Virtualized computer hardware and software capacity available through connections to the internet
Trip modelling	Modelling single trips from one location to another to propose trip options optimized for specific parameters, mostly trip time minimization
Travel modelling	Modelling more complex travel over multiple trips to propose travel options, optimized for specific parameters, mostly aimed at landmark access
Trip planning	A supported evaluation, mostly through an app, of different options for a trip against a set of parameters by an app-user
Travel planning	A supported evaluation, mostly through an app, of different options

	for a travel plan against a set of parameters by an app-user
Real-time data	Data about a current situation
Mobility data	Data representing travel and transport or relevant to travel and transport
GTFS	General Transit Feed Specification, data format for schedule of planned or real-time public transport services
AVL	Automated Vehicle Location, technology that allows for tracking of the location of vehicles, often used in public transport, allowing for the generalized analysis of travel paths and speeds on a network
BT tracking	Bluetooth tracking, temporary (anonymized) storage of timestamps of the location of bluetooth enabled phones or computers through sensors, allowing for the generalized analysis of travel paths and speeds on a network
Wifi tracking	Wireless network tracking, temporary (anonymized) storage of timestamps of the location of Wi-Fi enabled phones or computers through sensors, allowing for the generalized analysis of travel paths and speeds on a network
Camera tracking	Video based tracking, temporary (anonymized) storage of timestamps of the location of recognized features (faces, number plates) through cameras, allowing for the generalized analysis of travel paths and speeds on a network
RFID tracking	Radio Frequency Identification tracking, temporary (anonymized) storage of timestamps of the location of RFID cards, allowing for the generalized analysis of travel paths and speeds on a network
GPS tracking	Global Positioning System tracking, temporary (anonymized) storage of travel paths from the GPS system of participating app-users, allowing for the generalized analysis of travel paths and speeds on a network

Nudges	Incentives provided to an app-user to optimize his trip or travel for other parameters than time minimization, that are more aligned with the collective needs of the city, for example policy goals like safer of more sustainable transport
Dashboard	The hardware and software available to the platform manager to influence the trip and travel planning along collectivized parameters

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