Public policy framework supporting "Mobility-as-a-Service" implementation

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ABSTRACT

World population forecasted growth, ageing population, rising urbanization and congestion levels carry several challenges inside urban mobility systems. The digitalization megatrend is reshaping lives worldwide while at the same time "Usership" is thriving along collaborative consumption. "Mobility-as-a-Service" ("MaaS") emerges as a potential mobility disruption, in this new mobility ecosystem.

Inspired in Finland's "MaaS" ecosystem, this paper aims to propose a "Mobility as a Service Public Policy Framework" with a two-stage approach. First structuring the "MaaS" concept, looking for the core features, its relations, that leads to its reconceptualization and a topology proposal. Secondly, a public policy framework is proposed, considering the policy instruments, indicative group of stakeholders responsible and the different urban mobility management decision levels.

The authors argue that is fundamental to understand the nature of decisions which are intimately connected with the Urban Mobility system, to design and implement a coherent and effective policy framework, where the policy tools chosen to materialize policy decisions regarding "MaaS" should first consider the identification of the founding pillars of the "MaaS" concept, guiding the process of policy design accordingly.

If "MaaS" is considered a Mobility Management tool, it can constitute an opportunity to redefine public transport and its financing.

1. Introduction

With the continuous growth of the world population and rising urbanization, urban sprawl is taking up the scene of human settlements and several challenges arise consequently inside the urban mobility system. Increasing levels of congestion and its related cost, in economic, social and environmental dimensions, affect greatly the quality of life. At the same time, in a hyper-connected world, the Digitalization megatrend is reshaping lives worldwide. Accelerated advancements of Information and Communications Technologies (ICT), that already changed Industrial processes and led us to Industry 4.0, are democratizing data, which is seen as the new "oil" of the XXI century. Enabled by digitalization, consumption attitudes are also shifting from "Ownership" to "Usership" where within this environment and based on the existent diversity of transport services, Mobility-as-a-Service ("MaaS") emerges as a potential mobility disruption.

"MaaS" recently became a trendy word, sometimes used as a voguish slogan, others as a "buzzword" that resonates with the "FOMO" ("*Fear of missing out"*) attitude by central and local

governments along with transport operators. In brief, MaaS is commonly defined as a one-stop-shop for mobility, where different transport services are available seamlessly and accessed and purchased through one single digital user account.This paper dedicates its first part to the clarification of what is the "MaaS" concept avoiding the recurrent non-definition pitfall, as it is shown in the old adage cited in Klijn (2008): *"if a concept is everything, it is nothing".*

Within the structuring of the concept comes a deeper understanding of its core features, their relations and a "MaaS" topology proposal is designed, where it is possible to differentiate degrees of maturity and estimate its disrupting potential.

To successfully implement "MaaS", the authors argue that a policy framework must guide decisions in different urban mobility management levels, comprehending the identification of policy instruments and indicative group of stakeholders responsible, according to each topological level envisaged (intimately related with its core features).

2. Methodology

The proposed work was developed first using an inductive logic followed by a deductive logic methodology. The work begins with an inductive logic approach, with *"data collection from which theoretical ideas and concepts emerge"*(Robson & McCartan, 2016), since it was needed to conduct a systematic literature review of the concept of "MaaS" and its fundamental questions. To analyse 121 documents found, "MAXQDA" software (developed by "Verbi") was used, that facilitated its content analysis (qualitative analysis) and was determinant to process around 5000 pages of information.

The emergence of a "MaaS System" in Helsinki (Finland) was considered the inspirational case-study for the development of the Policy Framework proposal envisioned in this work. Besides official documents (laws) and websites, that constituted the initial base for the characterization of the case study, three semi-structured interviews with Finnish stakeholders (Central Government, Local Government and MaaS Provider) were conducted between August and September 2018 to validate and gather more information on the case-study.

Afterwards, a deductive logic methodology was conducted in order to structure the "MaaS Public Policy Framework", divided in two moments: i) the structure of the "MaaS" concept and design of the "MaaS topology proposal", that relied on Multicriteria Decision Analysis model, and ii) the proposal of a Public policy framework, with the identification of implementation tools (policy instruments) and indicative group of stakeholders responsible for its implementation by each urban management decision level and "MaaS" core feature. The policy framework was anchored in the literature review of the theoretical framework on Public Policy and policy instruments, Urban Mobility Decision levels and Stakeholders identification.

3. Theoretical Framework

3.1 The Universe of MaaS questions – literature review

The definition of the emergent concept of mobility consumption "MaaS" is scattered throughout numerous channels of information: in its early days (2014-2017) it can be seen a high concentration of conference papers where innovation dissemination is key; from 2016 on an increment of peer-reviewed scientific articles begin; and also a wide range of publications from news-based companies to consulting companies dedicated their attention to "MaaS" under a disruption perspective since the beginning. The literature review for this paper was conducted using only the word "Mobility as a Service (Google Scholar, Scopus database and ISI Web of Science database from February to April of 2018), which returned only 37 peer-reviewed

articles and 45 conference papers for this period. Besides conference papers and peer-reviewed articles, it was possible to add 39 documents that matched the search criteria, like: 16 policy and position papers from international organizations, 13 MSc. and PhD. thesis, 4 working papers and 6 book chapters, which totals 121 documents. Almost 100 authors wrote about this topic, and despite this number there is no particular journal that can be recognized as being the sole influencer on “MaaS”. The universe of relations and perspectives wrote about this concept vary from urban mobility; smart cities; urban planning; business models; innovation; IT or governance and policy.

Numerous “MaaS” definitions were analysed and three clusters were found, that correspond to different perspectives in complexity levels:

i) **“MaaS” exists when a specific action occurs** (and is defined by it) (Transport Systems Catapult, 2016; Y. Li & Voege, 2017). This perspective is focused on the access to mobility services through specific actions (e.g. “purchasing ability”, “means of access”);

ii) **“MaaS” is what happens when some conditions exist** (no direct action needed for “MaaS” to exist) (Leviäkangas, 2016, Eckardt, Aapaoja, & Sochor, 2017; Sprei, 2018). This perspective bases the existence of “MaaS” in conditions, that can be understood as the necessary relations between systems (transport, information, payment, data infrastructure, etc) and stakeholders (public and private transport providers, authorities, etc).;

iii) **“MaaS” understood as a Mobility Distribution Model** (a model that enables a set of conditions that allow afterwards the occurrence of specific actions within the mobility system) (Matyas & Kamargianni, 2017b). This perspective aims to encompass the whole ecosystem of relations and conditions, stating that “MaaS” exists when there is a coordinated scheme of relations, where different actions (functions) and their enabling conditions can take place matching supply and demand through one single interface, hence the distributional character.

After the structuring of the “MaaS” concept conducted in this paper, a definition of “MaaS” will be stated and will anchor the public policy framework proposal

3.2 Public Policy and Policy Instruments

Policy can be understood as the science or art of governing what is public in a society ecosystem and the questions that are addressed are directly related with **public policy**. Anything a government chooses to do or not to do is one of the most concise definitions of public policy (Dye, 2013), that entails two main ideas: 1) the government is considered a determinant for the enactment of policies and 2) governing implies “choice”, and each choice is directly related with the promotion of the well-being of citizens and the protection of public value. Complementing this definition, Lasswell (1958) adds that besides government decisions, public policy is a composition of two elements: *policy goals* and *policy means* (cited *in* Howlett, 2011). Following the logic of “principal components of public policies” (Howlet & Cashore, 2009), Howlett (2011) also emphasizes that policies are based on policy goals and means that range from strategical level (answering “Why” question); Tactic level (first level of operationalization answering the “How to” question); to operational level (answering the “What” question, or “what has to be done for the monitorization of the implementation of “goals” and “means” in terms of public policy)

Identify the policy process is fundamental to understand the different stages and decisions and choices of policy making. Depicting **policy making as a process** underpins *“a set of*

interrelated stages through which policy issues and deliberations flow in a more or less sequential fashion from 'inputs' (problems) to 'outputs' (policies)" (Lasswell, 1958 cited by Howlett, 2011). The policy process can be perceived as a cycle, which has its roots in *"systems theory and the pioneering work by David Easton on political systems (Easton 1965, 1966)"*. From the five policy process stages defined by Howlett (2011), this paper will look at the Helsinki case study under the focus of the first two and indicate the necessary policy instruments for the Public Policy Framework proposed, which corresponds to the fourth stage: 1) Agenda-Setting; 2) Policy Formulation; 3) Decision-Making; 4) Policy Implementation; 5) Policy Evaluation.

The relation between policy formulation and policy implementation is of high importance for the proposal of an effective and coherent policy framework, therefore the choice of the policy instruments is very relevant to produce the intended effects and attain the proposed policy goals. **Policy means or instruments** are relevant for the enactment of policies and can be described as "*technical mechanisms used to attain policy goals and as existing only in the stages of 'policy formulation' – when policy means are proposed - and 'policy implementation' – when they are put into effect"* (Howlett, 2011).

As it is revealed by Rist, Vedung, & Bemelmans-Videc (1998) there is a wide variety of classifications types of policy instruments (Doern,1981 cited in Howlett & Ramesh, 1993; Rist, Vedung, & Bemelmans-Videc, 1998; Howlett, 2011; Macário, 2011), and it is recognized that *"nowhere in the international literature (…) is to be found a uniform, generally embraced classification of policy instruments".* For the development of the policy framework proposed it was used the **taxonomy of policy instruments** proposed by Howlett (2011), where it is taken into consideration that despite the complexity of the reasons behind government's policy instrument choices *"the set of possible choices is limited in nature, bound as they are to the limited number of types of different governing resources they have at their disposal".*

Howlett (2011) organizes instruments according to four categories of governing resources, dividing them in two types of instruments (Figure 1): i) substantive – *"those directly providing goods and services to members of the public or governments"* and ii) procedural – *"rather than affect the delivery of goods and services, their principle intent is to modify or alter the nature of policy processes at work in the implementation process"*.

		Governing resource			
		Information	*Authority*	*Treasure*	*Organization*
Purpose of tool	Substantive	Public Information Campaigns	Independent regulatory agencies	Subsidies and grants	Public enterprises
	Procedural	Official secret acts	Administrative advisory committees	Interest-group funding	Government reorganizations

Figure 1 - Taxonomy of substantive and procedural implementation tools according to governing resource (source: Author, adapted from Howlett, 2011)

3.3 Urban Mobility System, levels of decision and stakeholders

Mobility by itself can be seen as a process-oriented system that *"results from a sort of productive chain where several agents (authorities, operators, and users) intervene at different stages of the mobility chain (and also at different decision levels) to pursue the final objective that is to access a number of urban functions"* (Macário, 2011).

Understanding the nature of decisions which are intimately connected with policy making within the Urban Mobility System, is of extreme importance to have a coherent and effective policy framework, leading to a consistent policy process with the highest efficiency potential. Moreover, matching the nature of decisions (decision levels) with the stakeholders responsible for its implementation according to their mission and role, is also of outmost importance. In fact, after defining “Why” and “How”, only with this matchmaking practise is possible to understand “Who” has the responsibility to do “What” and “When”, resulting in a clear roadmap to policy implementation and evaluation.

According to Macário (2011), the allocation of responsibilities within each decision level cannot be object of generalization because of its highly contextual dependency, especially at the political and administrative organization (as well as culture). Although, among the several principles of good practices to establish a management model for Urban Mobility Systems, the author reinforces that there is a need to *“ensure clear distinction between the three levels of planning and control (strategic, tactical, and operational), or decision levels, with different organizational requirements and functional roles and a clear allocation of these roles to different institutions, whenever possible”* (citing *Anthony, 1989; EC, TIS.PT, 1997*). A clear separation between these levels provides higher consistency to the distinct phases of policy-making and implementation, resulting in a *“network of institutions (i.e., authorities, operators, and third parties) linked by varying degrees and forms of interaction”* (Macário, 2011).

The three levels of planning and control, or decision levels adapted to this work, are defined as follows:

- **Strategic** - the level that corresponds to policy formulation phase, where the rationale behind the policy is established answering **the “Why” question;**
- **Tactic** - this level corresponds to the policy implementation phase, where strategies, goals and visions (the Why) are matched with the necessary package of policy tools (means) to its operationalization, answering in this way **the “How” question;**
- **Operational** – this level relates to “evaluation and monitoring”, where it is decided specifically **“What”** to do in order to ensure the compliance with the strategical goals (Why) and the correlated and enabling policy means (How) that frame activities for final consumption of users.

In what concerns Stakeholders, which can be described as *“any group or individual who can affect or is affected by the achievement of the organization’s objectives”*(Freeman, 1984), their responsibilities when acting in mobility systems are also dependent on the Political and administration organization context of a country as well as its whole ecosystem of agents.

Indeed, by understanding within the universe of stakeholders, their roles, missions, contributions, expectations, power and strategy, a contextual adapted management strategy can be implemented throughout the entire policy process.

A high-level approach to stakeholder identification was conducted recurring to literature review, being the final categories inspired in the work of Macário (2011), and represented by the following group of Stakeholders: i) Politcal authorities; ii) Regulating authorities; iii) Technical authorities and agencies; iv) Operators; v)Suppliers; vi) Clients; vii) Other interest parties (e.g. NGO; Academia).

4. “MaaS” implementation case-study: Finland

Numerous authors reference Helsinki’s “MaaS” experience and Finland as being at the forefront of “MaaS” design and implementation (Casey & Valovirta, 2016), even the first one

to initiate it worldwide (Y. Li & Voege, 2017). Declared as one of the most famous (Nikitas, Kougias, Alyavina, & Njoya Tchouamou, 2017) or as the best example of "MaaS" (EPOMM, 2017), Finland is seen as the country where "MaaS" was born (Dotter, 2016) with higher consistency and that lasts since its first appearance (2016). Studying the chronology of the "MaaS" policy process in Finland, considered as an "inspirational" case study, paved the way for the comprehension of the policy process, the reasons behind determinant choices, and the effects on the emergence of "MaaS".

All the process dates to 2009 with the **1st Intelligent Transport Strategy** driven by the Finish Ministry of Transports and Communications (LVM), which mission is to *"ensure that people have access to well-functioning, safe and reasonably priced transport and communications networks".* This strategy was considered *"the world's first national ITS strategy covering all modes of transport"* (Ministry of Transport and Communications, 2009), and triggered the development of the policy process until today. With this strategy it was proposed an **"administration reform"** (performed in 2010) where the focus of transport administration would expand from individual transport modes to an organization focused on the transport as a whole reflected also in the transport information structure. This shift in transport policy was of foremost importance since it fostered *"a customer-oriented view of the entire transport system".*

The background for the implementation of a renewed transport policy in Finland was in place with this administration reform and at the same time, during 2010 began what is called the **"Transport Revolution programme"**, that aimed at "*developing a new mind-set for urban and transport planning and policies and policy implementation"* (Tuominen & Kanner, 2011).

The **second Intelligent Transport Strategy** is published in 2013, and advances key projects in the areas of "real-time information within the transport system" (data collection, processing and distribution); open data as well in the area of "integrated public transport system", with a reference to door-to-door trip chains and "interoperable payment system" following a "single payment method, one-stop-shop" (Finnish Ministry of Transport and Communication, 2013).

In 2014, there was already a strong support for sustainable and intelligent transport at the ministry level although business participation was still absent. Therefore, in the beginning of 2015, **LVM** in cooperation with **Tekes'** MaaS team, jointly launched a funding call, to fund 'pre-study' projects and consortium projects Mobility Operators, for Mobility Operators and other organisations such as current transport and technology providers who wanted to make their services compatible with the "MaaS" system. Eight 'pre-studies' were funded, and in the end several "MaaS"-related pilots were performed around Finland during 2015 and 2016. Total figures reported by Tekes in 2015 and 2016 account with almost 5,5 M€ channelled to 31 "MaaS" projects funding (one of them was WHIM app).

The last policy milestone is the approval (**2017**) and enactment (2018) of **the "Act on Transport Services"** (nr. 320/2017, first called the "Transport Code"). This Act *"brings together legislation on transport markets and creates conditions for digitalisation and new business models in transport"*[1] where the key objective is the provision of customer-oriented transport services; *"review the transport system as a whole, make market access easier and promote the interoperability of the different parts of the transport system"* and at the same time "*lighten regulation".* Provisions on Interoperability and ticket payment systems towards the use of a single trip ticket on door-to-door travel chains are some of the focus areas of this legislation.

[1] https://valtioneuvosto.fi/en/artikkeli/-/asset_publisher/vuodenvaihteen-muutokset-lvm-n-hallinnonalal-1 *(Aug. 2018)*

The Finnish Transport Agency would be obligated to open data received on the use of services through open interface, in a form where it cannot be linked to individual users, service providers or services. Likewise, it is referenced in the same *LVM press* release[1] that the future offer of *“trip chains and combined services would be eased by enabling acting on another's behalf (…) incorporating tickets for all modes of transports (..) as well as seasonal products or discounts into a combined mobility service”.*

In January of 2018, the first provision of the “Act on Transport Services” entered into force, but the first and second phase of the “Act on Transport Services” (also called “Transport Code”) was enacted on the 1st July 2018 and has two parts (Smith, Sochor, & Sarasini, 2017): a) It aims at lowering permit requirements and tearing down silos between transport markets through deregulation and b) It focuses on enhancing the use of open and interoperable data interfaces. The Code obliges incumbents as well as new entrants to the transportation market to provide their operational data as well as their single tickets for third-party resale and use – *“The underpinning idea of the Code is to take advantage of digitalization and enable both the development of better and more agile transport services, and the integration of them into MaaS offerings”*.

5. Proposal to structure a “MaaS” public policy framework

5.1 “MaaS” Topology proposal

The main goal for developing a topology for “MaaS” is related with the need to propose a structure while approaching such a volatile and emergent concept as “MaaS”, with a definition purpose while grounding it within the different possible configurations of “MaaS” (associated with differentiated degrees of its core features). It is considered a topology, instead of taxonomy or typology, since the rationale behind is not the categorization but the study of intensities and presence of core features, that determine the capabilities, maturity and configuration of a “MaaS” system.

5.1.1 General and Specific Analysis

The design of a general “MaaS User Journey”, was the basis for the ‘Topology’ proposal, allowing the exploration of all the contact points of the user with the system in a “MaaS” environment.

During this analysis, two types of features can be distinguished: “General” and “Specific” Features. The “general” features are those that are not precisely associated with specific operational details of the “MaaS System”, but instead are materialized by the existence of a set of features or represent the governance established outside the system (e.g. strategic and tactical principles). The specific features are directly associated with the functional “building blocks” of a “MaaS” system.

Stemming out of the user journey analysis, it was possible to disclose the three pillars of a “MaaS system” (specific features): 1) the existence of choice related with the “**diversity of transport services”**; 2) “**Information” -** that allows the user to choose the mobility option most suitable to their needs; and **3) “Payment”** – the acquisition possibility.

A representation of the whole conceptualization of “MaaS” is shown in the Figure 2 scheme, where through an analogy with nature – depicting “a flower” structure – it is possible to demonstrate that such as a specific ‘flower’ needs an adequate climate and a set of conditions to grow and to blossom, so does a “MaaS System”. Different enabling conditions or the presence or absence of some of the “general features” already mentioned, generate different

patterns of “MaaS systems”, or following the analogy: different “flowers”. These different patterns are here considered as the different topological levels of “MaaS”.

Figure 2 - “MaaS Flower Model” (Source: Lajas, 2018*)*

The different levels associated to the first “MaaS” pillar – **“Diversity of Transport Services”** – were defined following a rationale based on two principles: 1) ‘the degree of choice’, which is intimately associated with the nature of the transport services: collective or individual concerning ‘non-self-service’ or ‘self-service’ transport services; 2) ‘capillarity’, which is associated to the aggregated offer that is available in the “MaaS System” and to the “seamless mobility experience” of the user within that system. Consequently, the categorization of transport services can be split in two types: ‘Non-self-service’ and “self-service services” (weather subject to ‘Public Service Obligation’ or commercial), and in a second tier both types can be either ‘collective’ or ‘individual’.

The levels of the second “MaaS” pillar – **“Information”** – “the enabler of choice”, were based on the type of available data associated to each journey planner, since the journey planner is considered the interface of information and defines the capabilities and maturity of a “MaaS System”, as shown in Figure 3 (where it is possible to observe that to each level of journey planner capability corresponds an increase in the type of data available)

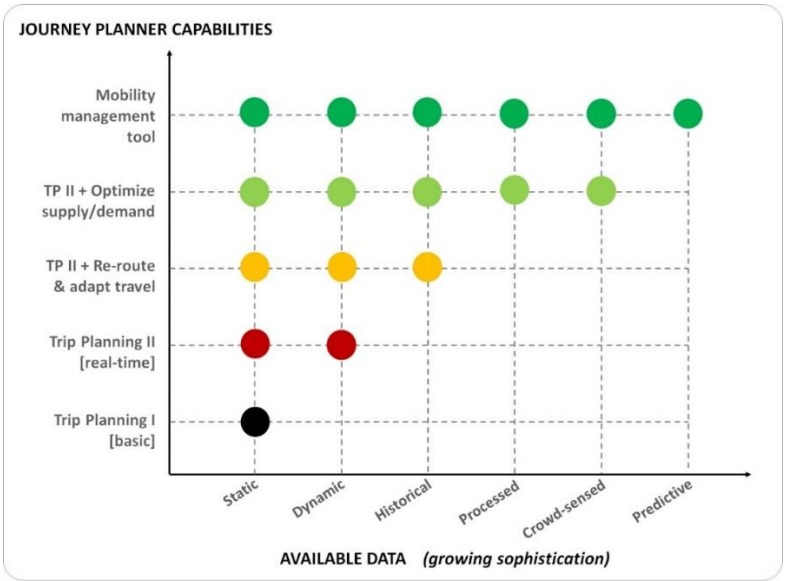

Figure 3 - Availability of data and corresponding “Journey planner capabilities” (Source: Lajas, 2018)

The Data considered was categorized as follows: i) Static (Sochor, Arby, & Karlsson, 2017); ii) Real-time (Gebhardt et al., 2016; Docherty et al., 2017); iii)Archived or Historical data (Giesecke, Surakka, & Hakonen, 2016); iv) Processed or analysed data (e.g. relying on data analysis and “big data analytics”) (Sarasini et al., 2017; Ebrahimi, Sharmeen, & Meurs, 2018); v) Predictive data (e.g. equal to “iv” but with a focus on future events recurring to modelling techniques) (Belletti & Bayen, 2017); and vi) Crowd-sensed data (e.g. data produced and disseminated by the user or the crowd) (Heiskala, Jokinen, & Tinnilä, 2016). The combination of these different types of data, will shape the journey’s planner potential of choice for the customer, its predictive power and the overall efficiency of the mobility system.

The levels associated to the third “MaaS” pillar – **“Payment”** – the “enabler of use” through the possibility to access different mobility services through a single payment, are categorized according to its increase flexibilization and tailor-made subscriptions, besides allowing a Pay-as-you-go function. Other aspect also considered is if there is a possibility of electronic access to the system (through e-ticket for instance).

5.1.2 “MaaS Topology” proposal

As stated before, a topology proposal applied to “MaaS” will have as an outcome the generation of patterns or spatial configurations that correspond to different “MaaS” identities, where is possible to infer its capabilities and maturity level. Since topology derives from the mathematician term - the “study of space”, and it was already defined that the “MaaS System” is based on three pillars - Transport services, Information and Payment - the topology approach followed relies on a **3-Dimensional** system, being each pillar associated with each axis. For this to be possible the units in all axis must represent identical value. For this reason, it was applied a **Multi-Criteria Decision Analysis** (MCDA) model, from the knowledge field of Decision Theory, that with the application of the Multi-Criteria Additive Value Model (Equation 1) allows a coherent and consistent transformation of each axis’s Local Value in Global Value through trade-off procedures

$$V(a) = \sum_{j=1}^{n} w_j v_j(a) \quad , \qquad \text{with} \quad \sum_{j=1}^{n} w_j = 1 \quad \text{and} \quad w_j > 1 \ (\mathrm{j} = 1, \ldots, \mathrm{n})$$

where: $V(a)$ is the overall value of option a; v_j is the (partial) value of option a on criterion j and w_j is the weighting coefficient of criterion j, with $j = 1, \ldots, n$.

Equation 1 – Additive Value Model equation (Phillips & Bana E Costa, 2007)

Methodologically, the model building process has three phases: **1) Structuring; 2) Evaluation** and **3) Testing**.

The **structuring phase (1)** encompasses the **definition of criteria and descriptors of performance** (ordered impact levels) that operationalize those criteria. The criteria considered in this model match the three "MaaS" pillars identified, and the correspondent descriptors of performance (Table 1) match the levels respectively identified.

The **Evaluation phase (2)** is composed by two parts, first the **creation of value functions** for each criterion and secondly the **assessment of the criterion weights**. The **value function** process can be understood as the creation of *"scales anchored at their ends by the most and least preferred options on a criterion (where) the most preferred option is assigned a preference score of 100, and the least preferred a score of 0. (…) Scores are assigned to the remaining options so that differences in the numbers (or levels) represent differences in strength of preference"* (Department for Communities and Local Government: London, 2009).

Table 1 - "MaaS Topology model" Criteria and respective descriptors of performance (source: Author)

C1 – TRANSPORT SERVICES	C2 - INFORMATION	C3 - PAYMENT
1.'Self-service' transport (only) **2.'Non-self-service' transport** (collective or collective and individual); **3.'Non-Self-Service' (**collective or collective and individual) **and 'Self-Service'** collective transport; **4.'Non-Self-Service' (**collective or collective and individual) **and 'Self-Service'** (individual or collective and individual) **transport.**	**1. Static Multimodal Journey Planner** ("Static" data) **2. Dynamic Multimodal Journey Planner** ("Real-time" data) **3. Assistant & Dynamic Journey Planner I** ("User preferences" data) **4. Assistant & Dynamic Journey Planner II** ("Crowd-sensed" data) **5. Assistant & Dynamic Journey Planner III** ("Predictive" data) **6. Intervenient, Assistant & Dynamic Journey Planner**	**1.Pay-as-you-go (PAYG)** (**physical** access only) **2. Pay-as-you-go (PAYG)** (**electronic** possibility) **3.PAYG and Single Subscription** (**physical** access only) **4.PAYG and Single Subscription** (**electronic** possibility) **5.PAYG and Fixed Subscription** (**electronic** possibility) **6.PAYG and Flexible Subscription** (**electronic** possibility)

Based on indifference judgements that represent strengths of preference, and supported by the rational presented before (level proposal for each "MaaS" pillar), the results are represented in Figure 4, and the main fundaments were:

- **"C1-Transport Services"** – It was valued more the passage from Level C1.2 to C1.3 than from C1.1 to C1.2, due to the diversity, capacity and availability increase that the level C1.3 entails when there is a mixture of "Non-Self-Service" and "Self-Service" transport services.
- **"C2 - Information"** – The highest difference in attractivity between consecutive levels considered, is the incorporation of "Real-Time data", which transforms a Static Journey Planner into a Dynamic one (valuing 40 points).
- **"C3 - Payment"** - the importance of the existence of mobility packages, even in its simplest form in detriment of the possibility of having an electronic access to the system. Therefore, the indifference level from worst to best is represented in C3.3 (50

points). Considering that the increase in flexibility of the payment packages is more valued, the passage from “Fixed Subscription” (C3.5) to “Flexible Subscription” (C3.6) is valued higher (30 points) than the passage from “Single Subscription” (C3.3) to “Fixed Subscription” (C3.5) (20 points).

The second and last part of the evaluation phase is the assessment of criteria weights. The **criterion weights** are *“scaling constants that represent the correspondence between value units on one criterion compared to another”* (Phillips & Bana E Costa, 2007), was performed using the trade-off procedure.

The first step of the trade-off procedure is to understand what the reference criteria is to establish the reference basis for the pairwise comparisons. Considering the goals of a “MaaS system” and its “user-centric” focus to provide “seamless mobility”

Being the “seamless property” of travel highly dependent on context Considering (which is the case of “C1-Transport Services”) and considering that is more important to have a “Journey Planner” at its highest level (“C2-Information”) than a more flexible “payment option” to access the system (“C3-Payment”), the most important **“worst-best swing”** was the one verified in criterion “C2-Information”.

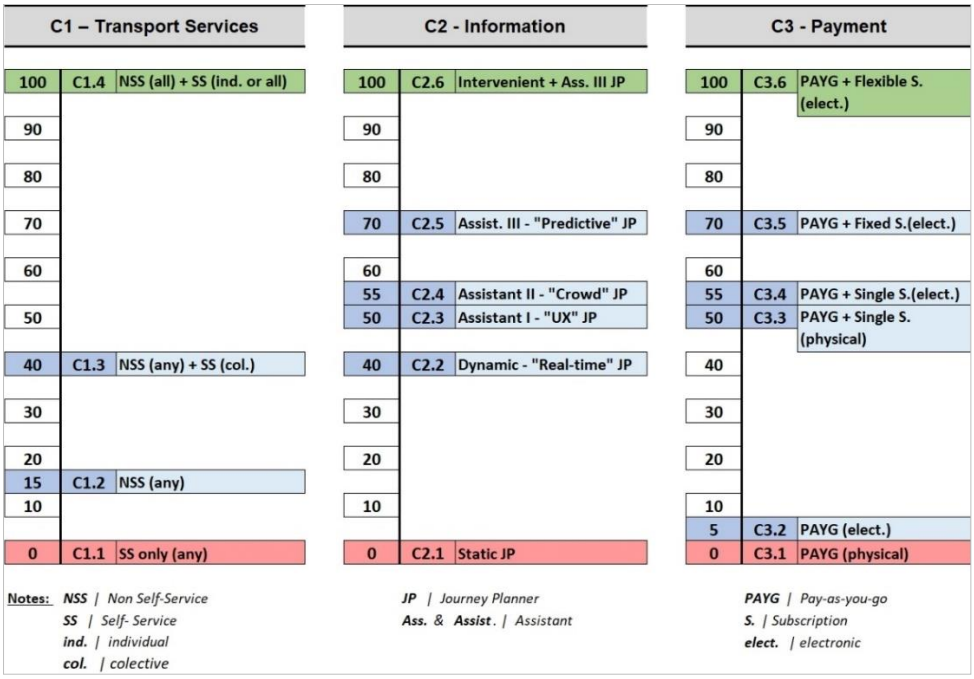

Figure 4 - Value Functions of the criteria: ” C1 – Transport Services”; “C2 – Information” and “C3 – Payment” (source: Author)

For the first pairwise comparison, C2 and C3, it was considered that the indifference point was the one corresponding to level C2.2 [$v_2(a)$=40]. The justification for this choice relies on the following value judgement: «*For the same level of transport services, it is considered that having the most flexible and user friendly mode of payment and a “Static” Journey Planner would be similar to have just a “Pay-as-you-go based only on physical means of access to the system” and a “Dynamic” Journey Planner (that incorporates “real-time” information)*». For the second pairwise comparison, C2 and C1, it was considered that the indifference point was the one that corresponds to level C2.3 [$v_2(a)$=50]. This indifference value judgement was supported by the following rational: «For the same mode of Payment, having a higher choice

in what concerns transport services but a static Journey Planner doesn't allow to fully take advantage of the user experience and interaction with the system.
The resultant system of equations is the one that is represented in Equation 2.

$$\begin{cases} 40w_2 - 100w_3 = 0 \\ 50w_2 - 100w_1 = 0 \\ w_1 + w_2 + w_3 = 1 \end{cases}$$

Equation 2 – System of equations used in the assessment of the Criteria weights (source: Author)

The assessment of the criteria weights is the final part of the evaluation phase, and the result can be written directly in the final equation of the "MaaS Topology" multicriteria model, as it is represented in Equation 3.

$$V(a) = 0{,}263 * v_1(a) + 0{,}526 * v_2(a) + 0{,}211 * v_3(a)$$

Equation 3 – "MaaS Topology" multi-criteria model equation (source: Author)

5.2 Public Policy Framework proposal for "MaaS" implementation

The present proposal will be developed anchored in the following definition of "MaaS":

> *"**MaaS is a mobility management model that allows the emphasis of a value proposal and its articulation with supply and demand, ensuring all the means of information and transaction between the two market sides, and where it is also enabled the feeding of monitoring functions that the authority intends to wield**"*
> *(Rosário Macário and Renata Lajas, October 2018)*

In this section the main goal is to identify what should be in place in terms of Public Policy Framework (policy instruments) as well as stakeholder responsibility (indicative, since the scope of this work doesn't it is not policy transfer), according to each corresponding set of "building blocks" identified previously in the structure of "MaaS" concept and their maturity degree.
Firstly, it's important to recognize that there are not strictly defined and isolated topological levels of "MaaS Systems" but instead, a wide spectrum with numerous configurations possibilities given the different combination of levels or degrees identified in each one of the three pillars that identify a "MaaS System". Therefore, the Public Policy Framework proposed will be anchored in the "General features" and "Specific features" that structure the concept of "MaaS", and not the resulting configuration or pattern itself.
To do so, the understanding of the nature of decisions which are intimately connected with policy making within the Urban Mobility System, is of extreme importance to have a coherent and effective policy framework. It is for this reason that the first step to build the Public Policy Framework is to identify the relation of "Strategic", "Tactic" and/or "Operational" decisions with the enabling of each one of the features identified. The result is presented in Table 2.
The second step to build the Public Policy Framework, would be to consider independently the decision-making levels (only strategic and Tactic), and focusing on each feature at a time, identify which types of policy instruments would best fit the purpose or the enabling of that feature. For this task, the reference taxonomy used was the one of Howlett (2011), where the author references policy instruments through the governing resource type and the purpose of the tool, highlighting reference examples in each category. To complete this step, and within the decision levels of the Urban Mobility System, it was performed an indicative identification

of stakeholders to establish responsibility relationships in what concerns the implementation of each policy instrument proposed Table 3.

In what concerns the general features associated to “MaaS”, the **“Data-Sharing”** and **“Interoperability”** are considered one of the most important ones, since everything on “MaaS” relates to information and specially “Open Data”, as it was already referenced before. These two features, depending on the national context, are enabled by visions and strategies (strategical level) and tactical decisions, that can range from laws to regulation related to “data standardization” for instance. Monitoring actions and entities are especially relevant to the enabling of these features, since they are determinant to the well function of a “MaaS System”.

Following, the next general feature of a “MaaS System” analysed is its desired **“User-Centric”** philosophy. This feature is present on all levels of decision, especially because it gives structure to the rationale behind the “MaaS” philosophy in all the service value it entails.

All the four levels (**C1.1**; **C1.2**; **C1.3** and **C1.4**) of the specific feature **“Transport Services”** are analysed together, since all relate to different configurations of the transport service available, which is highly dependent on the mobility context and specific agreements. The main question here is if the system is “Private-led” or “Public-led”, since the latter encompasses a great involvement in the all the decision levels.

In what concerns the “**Information**” Pillar, the most important would be the first two levels (**C2.1** and **C2.2**) characterized by the existence of “Static” and “Real-Time” information.

			Decision Levels		
			Strategic	Tactic	Operational
General Features		Data-Sharing	●	●	●
		Interoperability	●	●	●
		User-Centric	●	●	●
		Integration of Information	●	◑	◑
		Coordination & Cooperation between mobility agents	◑	○	◑
Specific Features	C1 – Transport Services	C1.1	◑	◑	●
		C1.2	◑	◑	●
		C1.3	◑	◑	●
		C1.4	◑	◑	●
	C2 - Information	C2.1	●	●	●
		C2.2	●	●	●
		C2.3	○	○	◑
		C2.4	○	○	◑
		C2.5	◑	◑	◑
		C2.6	●	●	●
	C3 - Payment	C3.1	●	●	●
		C3.2	●	●	●
		C3.3	○	○	◑
		C3.4	○	○	◑
		C3.5	○	○	◑
		C3.6	○	○	◑

● Required ◑ Optional ○ Absent

Table 2 - Decision Levels associated to each General and Specific MaaS Features

The policy instruments associated to these two levels correspond to the ones that enable in different decision levels the “Data-Sharing” and “Interoperability”. Next, the **C2.3** and **C2.4** levels are considered to be strictly connected to “MaaS” business side. If the vision for a “MaaS

System" is to use it as a mobility management tool (level **C2.6**), allowing or not an interventive power in the overall mobility system, besides the management of user travel function matching with best value-for-money destination according to current mobility conditions of the system, all the decision levels should be in place.

For the last pillar of a "MaaS System", **"Payment"** (Criterion C3), it is fundamental for all levels that besides "Data-Sharing" and "Interoperability", that the "Payment and Ticketing interfaces" are open access and that it is allowed the selling of tickets by a third party, especially the ones belonging to public transport. Once again, only the first two levels (**C3.1** and **C3.2**) will be analysed, since all the remaining are strictly related to the Business operational side. Concerning **C3.1** and **C3.2** levels, the existence of "Pay-as-you-go" systems, despite the access to the system (physical or electronic), will allow by default technically all the other packages.

Due to the specificities of each country organization and its context (e.g. governance, administrative, bureaucratic, etc.), with clear consequences in the functions associated to each decision level, the stakeholders appointed responsible for the implementation of the proposed policy instruments are not specific but instead indicative groups of stakeholders were identified in Table 3**Error! Reference source not found.**.

Table 3 - Indicative Policy Instruments by MaaS feature, according to governing resource and purpose of tool (Source: Author, inspired on Howlett’s (2011) Policy Instruments Taxonomy)

	Features	Policy Instruments (by governing resource and purpose of tool)		Levels of Decision and indicative group of Stakeholders	
				Strategic	Tactic
S ● T ●	• Data-Sharing • Interoperability • C2.1 Static Multimodal Journey Planner (“Static” data) • C2.2 Dynamic Multimodal Journey Planner (“Real-time” data) • C3.1 Pay-as-you-go (PAYG) (physical only) • C3.2 Pay-as-you-go (PAYG) (electronic)	Auth. (subst.)	**Direct Government Regulation [1]**: *Laws, independent regulatory commisions.*	Political autorities	Technical authorities and agencies; Regulating authorities
			Market Creation and Mantenance tools [2]: *establishing of limits and permits*	Political autorities	Technical authorities and agencies; Regulating authorities
			Visions and strategies: *Policy Vision, Strategic options and plans* ***[6]***	Political Authorities	
		Org. (subst.)	**Direct Government [3]**: *Line departments, central support agencies*	Political autorities	Technical authorities and agencies
		Org. (proc.)	**Network management tools**: *Creating or reorganizing government agencies* ***[4]***, *Legislative and executive oversight agencies* ***[5]***	Political Authorities	Technical authorities and agencies; Regulating authorities
S ● T ●	• User-Centric	Auth. (subst.)	**Visions and strategies**: *Policy Vision, Strategic options and plans* ***[6]***	Political Authorities	
			Direct Government Regulation [1]: *Laws (consumer rights protection)*	Political autorities	Technical authorities and agencies
		Org. (proc.)	**Network management tools**: *Legislative and executive oversight agencies* ***[5]***	Political Authorities	Regulating authorities
		Fin. (subst.)	**Tax- or royalty-based financial instruments [7]**	Political Authorities	Regulating authorities
			Cash or Tax-equivalent financial tools [8]: Favourable insurance and loan guarantees, Vouchers for public services	Political Authorities	Technical authorities and agencies; Regulating authorities
	• C2.6 Intervenient, Assistant & Dynamic Journey Planner	Auth. (subst.)	**Visions and strategies**: *Policy Vision, Strategic options and plans* ***[6]***	Political Authorities	
		Org. (subst.)	**Direct Government [3]**: *Line departments*	Political Authorities	Technical authorities and agencies
		Org. (proc.)	**Network management tools:** *Creating or reorganizing government agencies* ***[4]***	Political Authorities	Technical authorities and agencies
		Fin. (subst.)	**Tax- or royalty-based financial instruments [7]**	Political Authorities	Regulating authorities
S ● T ◑	• Integration of Information	Auth. (subst.)	**Visions and strategies**: *Policy Vision, Strategic options and plans* ***[6]***	Political Authorities	
			Market Creation and Mantenance tools [2]		Technical authorities and agencies; Regulating authorities
		Auth. (proc.)	**Policy network activation and mobilization tools [9]**: *Public consultation, stakeholder and consensus conferences*		Technical authorities and agencies; Operators; Suppliers; Clients; Other interest parties
S ◑ T ◑	• C1.1 ‘Self-service’ transport (only) • C1.2 ‘Non-self-service’ transport (collective or collective • C1.3 ‘Non-Self-Service’ (collective or collective and individual) and ‘Self-Service’ collective transport • C1.4 ‘Non-Self-Service’ (collective or collective and individual) and ‘Self-Service’ (individual or collective	Auth. (subst.)	**Direct Government Regulation [1]**: *Laws (access standards to service provision)*	Political Authorities	Technical authorities and agencies; Regulating authorities
		Org. (subst.)	**Direct Government [3]**: *Line departments , central support agencies*	Political Authorities	Technical authorities and agencies
		Org. (proc.)	**Network management tools:** *Legislative and executive oversight agencies* ***[5]***		Regulating authorities
			Quasi-governmental organizational forms [10]: *Partnerships and contracting out*	Political Authorities	Technical authorities and agencies; Operators, Suppliers
		Fin. (subst.)	**Cash or Tax-equivalent financial tools [8]**: Favourable insurance and loan guarantees, Vouchers for public services	Political Authorities	Technical authorities and agencies; Regulating authorities
			Cash-based financial tools [11]: Grants, subsidies and user fees	Political Authorities	Technical authorities and agencies; Regulating authorities
		Fin. (proc.)	**Policy network creation tools [12]**: *Interest group creation (support to start-ups)*	Political Authorities	Technical authorities and agencies; Operators, Suppliers
	• C2.5 Assistant & Dynamic Journey Planner III (“Predictive” data)	Org. (subst.)	**Direct Government [3]**: *Line departments*	Political Authorities	Technical authorities and agencies
		Org. (proc.)	**Network management tools:** *Legislative and executive oversight agencies* ***[5]***	Political Authorities	Regulating authorities
S ◑ T ○	• Coordination and Cooperation between mobility agents	Auth. (subst.)	**Visions and strategies**: *Policy Vision, Strategic options and plans* ***[6]***	Political Authorities	
		Auth. (proc.)	**Policy network activation and mobilization tools [9]**: *Public consultation, stakeholder and consensus conferences*		Technical authorities and agencies; Operators; Suppliers; Other interest parties

Governing Resources: Authoritative (Auth.) | Organizational (Org.) | Fianacial (Fin.) | Informational (Info.)
Purpose of tool: Substantive (subst.) / Procedural (proc.)
Decision Level: Strategic (S) | Tactic (T)
● Required ◑ Optional ○ Absent

6. Conclusions

The proposal of a Public Policy Framework encompassed a two-stage approach. Structuring the concept of "MaaS" focused primarily on the identification of its "building blocks", which can be considered as the starting point to establish a common understanding related to the identification of the founding pillars of "MaaS" concept. Taking into consideration the "MaaS Flower Model" proposed, it was possible to understand the relation between the enabling conditions and its specific core features, their relations which allowed the design of the "MaaS" topology proposal, where it is possible to differentiate degrees of maturity and estimate "MaaS" disrupting potential. The second and final part, was supported by public policy theory, where to each degree of core feature considered in the topologic definition for MaaS created, corresponded a set of policy instruments, the indicative group of stakeholders responsible for its implementation and the identification of the most appropriate urban mobility decision levels where they should be unfolded.

In what concerns challenges and barriers in respect to a "MaaS System" implementation, they stem out from different sectors, e.g. institutional; regulation related; technological and Operational from a business perspective. The financial aspect is also proclaimed as a challenge, normally related with legislation and regulation related with subsidies of public transport (Nikitas et al., 2017; M. Karlsson, 2017; Y. Li & Voege, 2017; Mulley et al., 2018). This aspect brings an important question that is related with the redefinition of the role of Public Transport. The public transport can gain a bigger importance and increase its shares once the "MaaS" concept evolves and disseminates throughout the world in the years to come. The shift from "transport operators' subsidy scheme" to a "user" based subsidy one, whom can freely choose any transport service or "MaaS offering", can be an opportunity for the growth of the public transport share and not otherwise, as it is referenced by some authors quoting Public Transport Stakeholders (e.g. "cannibalization of Public Transport", "fear of losing the relationship with the customer" and "fear of losing the brand" are among some of the concerns) (M. Karlsson, 2017; G. Smith, Sochor, & Karlsson, 2017a).

Frequently is also declared as a challenge the excessive "governance of Mobility led by technology" or the lack of "leadership" and defined roles associated to the "business models" of "MaaS" (M. Karlsson, 2017; Finger & Razaghi, 2017).

If "MaaS" is considered as a Mobility Management tool, as argued in this work, its implementation is aligned in all the decision levels, stemming out firstly from a strategic vision what type of system the proposed policy framework supports. A "MaaS" system concept implemented as a mobility management tool will have a higher potential in terms of monitoring capabilities of the mobility system, where it is possible to actively increase the efficiency of the transport system and at the same time have an active role in the promotion of sustainable mobility goals among other cross-sectorial policy goals (e.g. land-use, environment or housing policy).

For a successful implementation of "MaaS", as it is shown in the paper there is much more to it than just technology. To have a clear vision of the type and maturity of "MaaS" system that is envisaged for a region, will uncover what policies need to be promoted and which policy instruments could be chosen accordingly, in order that the enabling conditions are in place.

Future work can focus on the study of challenges related to the unclear proof that "MaaS reduces traffic congestion" (Hensher, 2017; Mulley et al., 2018), the issue of universal accessibility with the challenge of "equitable access to a MaaS System" (Schweiger, 2017), and in a broader scope: "MaaS" as an opportunity for the redefinition of the public transport role and its contribution to support "sustainable mobility policies".

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To the women than run with the wolves, that teach us to go beyond, the power of resilience and the brilliance of quality and excellence.

Declaration of interest

None

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Appendix

A - List of MaaS definitions considered

Author (year)	Citation of MaaS definition	Source
Heikkilä (2014)	“a scheme in which mobility services are provided as an individual and flexible service in a competing mobility operator market. (…) MaaS refers to circumstances, in which comprehensive supplies of mobility services are provided by mobility operators. Versatile services offered by the operators satisfy all mobility needs, thus decreasing the need to possess a car.”	Master Thesis – Aalto University
Hietanen (2014)	“Mobility as a Service (MaaS) is a mobility distribution model in which a customer’s major transportation needs are met over one interface and are offered by a service provider. (…) The vision is to see the whole transport sector as a co-operative, interconnected ecosystem, providing services reflecting the needs of customers. The boundaries between different transport modes are blurred or disappear completely.”	Article in Press
ITS Europe, 2014	“a mobility distribution model in which all of customer’s major transportation needs are met from a single platform by a single service provider that orchestrates each individual transport service component to meet a customer’s end-to-end service expectations.”	Institution
MaaS Alliance, 2015	“the integration of various forms of transport services into a single mobility service accessible on demand. (…) (implying) the use of a single application to provide access to mobility, with a single payment channel instead of multiple ticketing and payment operations.”	Public-Private Partnership
Kamargianni, Li, Matyas, & Schäfer (2016)	"The term “Mobility as a Service” stands for buying mobility services as packages based on consumers’ needs instead of buying the means of transport. Via “Mobility as a Service” systems consumers can buy mobility services that are provided by the same or different operators by using just one platform and a single payment. MaaS platforms usually provide an intermodal journey planner, a booking system, easy-payment, and real time information."	Peer-Reviewed (T)
Dimitrakopoulos, Bravos, & Stabologlou (2016)	“MaaS bridges the gap between public and private transport operators, envisaging the integration of all the fragmented tools (planning, booking, real time information, payment and ticketing) a traveler needs to conduct a trip.“	Peer-Reviewed (IT)
Leviäkangas (2016)	“The concept of MaaS is relatively simple: bundling different transport means, public and private, into one easy-to-use package for the customer. The service is provided to the customer via mobile applications and payment is handled via a digital wallet.“	Peer-Reviewed (IT)
Sochor, Karlsson, & Strömberg (2016)	“Mobility as a service (MaaS) is an emerging concept that entails a mobility distribution model in which a customer’s major transportation needs are met over one interface and are offered by a service provider, in other words, “combining all forms of personal transport together into seamless trip chains, with bookings and payments managed collectively for all legs of the trip.”	Peer-Reviewed (T)
Docherty, Marsden, & Anable (2017)	“(…) ‘Mobility as a Service’ (MaaS), where individuals’ ownership of vehicles is increasingly replaced by “usership”, that is the ability to purchase access rights to an interoperable package of mobility services (car, taxi, bus, rail, bike share) owned by others, usually corporate, providers.”	Peer-Reviewed (T)
Li, Luo, & Hampshire (2017)	“Mobility-as-a-Service (MaaS) is a solution that integrates multiple modes of transport into seamless trip chains. (...) allows a shift from personally-owned vehicles towards easy mobility services by combining transportation services from public and private providers through a unified way.”	Peer-Reviewed (T)

Y. Li & Voege (2017)	“The concept of MaaS is to use a single app to access and pay for various transport modes within a city or beyond; and the app will give options to allow a traveller to select the most suitable transport mode.”	Peer-Reviewed (T)
Mulley, Nelson, & Wright (2018)	“MaaS is variously defined but the essential idea is to see transport or mobility not as a physical asset to purchase (e.g. a car) but as a single service available on demand and incorporating all transport services from cars to buses to rail and on-demand services”	Peer-Reviewed (T)
Veerapanane, Taylor, & Kaparias (2018)	“At its core, MaaS combines transportation services from public and private providers through a unified gateway that handles individual door-to-door trips, managing all stages of their creation and implementation (planning, payment, real-time monitoring, etc.). “	Peer-Reviewed (T)
Sprei (2018)	“is a bundling of services such as public transportation, car sharing, bike sharing and taxis. The idea is to offer a subscription or pay-per-use service that will cover different types of mobility needs and create a seamless intermodal travel.”	Peer-Reviewed (U&SSc)
Rantasila (2015)	"The concept of MaaS is relatively simple: bundling different transport means, public and private, into easy-to-use service to end-customer. (…) The idea behind intelligent transport services like MaaS is to utilize possibilities of ICT and mobile devices for better user experience."	Conference Paper
Surakka, Haahtela, HÄrri, Mich, & Horila (2017)	"Mobility as a Service (MaaS) is an example of a systemic innovation, where sustainable mobility services addressing different customers’ transport needs are integrated with traveller information and ticketing/ payment services."	Conference Paper
Matyas & Kamargianni (2017)	"Mobility as a Service is a user-centric, intelligent mobility distribution model in which all mobility service providers’ offerings are aggregated by a sole mobility operator and supplied to users through a single digital platform."	Conference Paper
Eckardt, Aapaoja, & Sochor (2017)	"Mobility as a service (MaaS) is an emerging mobility concept that heavily relies on digitalization and an end-user oriented approach. The great vision in the MaaS concept is to connect all available transport and mobility services together in a one-stop-shop package and hence offer an agile sustainable and effective competitor to private cars, which can be tailored according to the needs of end users."	Conference Paper
Ebrahimi, Sharmeen, & Meurs (2018)	" (...) an innovative concept that has recently emerged to offer door-to-door mobility services. MaaS potentially enhances accessibility and efficiency of transport systems by identifying more deeply the supply and demand patterns. MaaS is believed to provide sustainable and user-centric services and to offer unique opportunities to bundle (latent) travel demand, to organize the smart use of existing systems and support orchestrated and/or self-organizing innovative travel services in which an interface automatically matches travelers’ demand and supply.”	Conference Paper
EPOMM (2017)	“Mobility as a Service (MaaS) is such a concept, combining services from public and private transport providers through a unified gateway that creates and manages the trip, which users can pay for with a single account.”	Institutional Position Paper
Polis Network (2017)	“‘Mobility-as a-Service' has been marketed as a new transport concept that may change or disrupt current models of transport provision, particularly in urban areas. The concept of MaaS claims to offer a personal mobility package based on lifestyle needs and delivered through an IT model."	Institutional Position Paper
Transport Systems Catapult (2016)	"The Transport Systems Catapult has defined MaaS as using a digital interface to source and manage the provision of a transport related service(s) which meets the mobility requirements of a customer. This definition seeks to encapsulate the vision of a MaaS Provider offering their customer, any type of travel experience using any type of transport service, public or private. (...) MaaS is a new concept that offers consumers access to a range of vehicle types and journey experiences."	Public-Private consultancy company

König et al. (2017)	“Multimodal and sustainable mobility services addressing customers' transport needs by integrating planning and payment on a one-stop-shop principle.”	"MaaSiFiE" - EU Project
MaaS Global (https://maas.global/)	“a way of combining options from different transport providers into a single mobile service, removing the hassle of planning and one-off payments”	MaaS Provider

B - Howlett’s (2011) Policy instruments taxonomy

	Purpose of tool	
Governing Resource	**Substantive**	**Procedural**
Authoritative implementation tools	**Visions and Strategies** • *Policy visions, strategic options and plans* **Direct government regulation** • *Laws* • *Independent regulatory commisions* **Indirect government regulation** • *Delegated professional regulation* • *Voluntary or incentive regulation* **Market creation and maintenance**	**Policy network activation and mobilization tools** • *Advisory Councils* • *Public consultation, stakeholder and consensus conferences*
Organizational implementation tools	**Direct government** • *Line departments* • *Central support agencies* • *Social and health insurance and pension plans* **Quasi-governmental organizational forms** • *Public enterprises and other corporate forms* • *Organizational hybrids (alternative service delivery)* • *Partnerships and contracting out*	**Network management tools** • *Staff or central (executive) agencies* • *Tribunals and other quasi-judicial bodies* • *Creating or reorganizing government agencies* • *Establishing analytical units* • *Establishing clientele units* • *Establishing gov. reviews, ad hoc task forces, commisions, enquiries and public hearings* • *Legislative and executive oversight agencies*
Financial implementation tools	**Cash-based financial tools** • *Grants, subsidies and user fees* **Tax- or royalty-based financial instruments** • *Tax- or royalty-based financial expenditures* • *Excise taxes* **Cash or Tax-equivalent financial tools** • *Preferencial Procurement* • *Favourable insurance and loan guarantees* • *Vouchers for public services* • *Sales and states assets at below price markets*	**Policy network creation tools** • Interest group creation ***Network mobilization tools*** • *interest group alterations/manipulation/co-optation*
Information implementation tools	**Information dissemination tools** • *Exhortation and moral suasion* • *Information campaigns* **Information and knowledge colection tools** • *Judicial inquiries and executive commisions* • *National statistical agencies* • *surveys and polling*	**Information release tools** • *Freedom of information legislation* **Information release prevention tools** • *Censorship* • *Official secret acts* • *Privacy acts*

Observation: in *"italyc"* are represented *examples of implementation tools*

Public policy framework supporting "Mobility-as-a-Service" implementation

JEL classification: R00; R40; R50; K20

Keywords: Mobility-as-a-Service; Public Policy; MaaS; Policy Instruments; Mobility; Topology

ABSTRACT

World population forecasted growth, ageing population, rising urbanization and congestion levels carry several challenges inside urban mobility systems. The digitalization megatrend is reshaping lives worldwide while at the same time "Usership" is thriving along collaborative consumption. "Mobility-as-a-Service" ("MaaS") emerges as a potential mobility disruption, in this new mobility ecosystem.

Inspired in Finland's "MaaS" ecosystem, this paper aims to propose a "Mobility as a Service Public Policy Framework" with a two-stage approach. First structuring the "MaaS" concept, looking for the core features, its relations, that leads to its reconceptualization and a topology proposal. Secondly, a public policy framework is proposed, considering the policy instruments, indicative group of stakeholders responsible and the different urban mobility management decision levels.

The authors argue that is fundamental to understand the nature of decisions which are intimately connected with the Urban Mobility system, to design and implement a coherent and effective policy framework, where the policy tools chosen to materialize policy decisions regarding "MaaS" should first consider the identification of the founding pillars of the "MaaS" concept, guiding the process of policy design accordingly.

If "MaaS" is considered a Mobility Management tool, it can constitute an opportunity to redefine public transport and its financing.

1. Introduction

With the continuous growth of the world population and rising urbanization, urban sprawl is taking up the scene of human settlements and several challenges arise consequently inside the urban mobility system. Increasing levels of congestion and its related cost, in economic, social and environmental dimensions, affect greatly the quality of life. At the same time, in a hyper-connected world, the Digitalization megatrend is reshaping lives worldwide. Accelerated advancements of Information and Communications Technologies (ICT), that already changed Industrial processes and led us to Industry 4.0, are democratizing data, which is seen as the new "oil" of the XXI century. Enabled by digitalization, consumption attitudes are also shifting from "Ownership" to "Usership" where within this environment and based on the existent diversity of transport services, Mobility-as-a-Service ("MaaS") emerges as a potential mobility disruption.

"MaaS" recently became a trendy word, sometimes used as a voguish slogan, others as a "buzzword" that resonates with the "FOMO" ("*Fear of missing out"*) attitude by central and local governments along with transport operators. In brief, MaaS is commonly defined as a one-stop-shop for mobility, where different transport services are available seamlessly and accessed and purchased through one single digital user account.

This paper dedicates its first part to the clarification of what is the "MaaS" concept avoiding the recurrent non-definition pitfall, as it is shown in the old adage cited in Klijn (2008): *"if a concept is everything, it is nothing".*

Within the structuring of the concept comes a deeper understanding of its core features, their relations and a "MaaS" topology proposal is designed, where it is possible to differentiate degrees of maturity and estimate its disrupting potential.
To successfully implement "MaaS", the authors argue that a policy framework must guide decisions in different urban mobility management levels, comprehending the identification of policy instruments and indicative group of stakeholders responsible, according to each topological level envisaged (intimately related with its core features).

2. Methodology

The proposed work was developed first using an inductive logic followed by a deductive logic methodology. The work begins with an inductive logic approach, with *"data collection from which theoretical ideas and concepts emerge"*(Robson & McCartan, 2016), since it was needed to conduct a systematic literature review of the concept of "MaaS" and its fundamental questions. To analyse 121 documents found, "MAXQDA" software (developed by "Verbi") was used, that facilitated its content analysis (qualitative analysis) and was determinant to process around 5000 pages of information.
The emergence of a "MaaS System" in Helsinki (Finland) was considered the inspirational case-study for the development of the Policy Framework proposal envisioned in this work. Besides official documents (laws) and websites, that constituted the initial base for the characterization of the case study, three semi-structured interviews with Finnish stakeholders (Central Government, Local Government and MaaS Provider) were conducted between August and September 2018 to validate and gather more information on the case-study.
Afterwards, a deductive logic methodology was conducted in order to structure the "MaaS Public Policy Framework", divided in two moments: i) the structure of the "MaaS" concept and design of the "MaaS topology proposal", that relied on Multicriteria Decision Analysis model, and ii) the proposal of a Public policy framework, with the identification of implementation tools (policy instruments) and indicative group of stakeholders responsible for its implementation by each urban management decision level and "MaaS" core feature. The policy framework was anchored in the literature review of the theoretical framework on Public Policy and policy instruments, Urban Mobility Decision levels and Stakeholders identification.

3. Theoretical Framework

3.1 The Universe of MaaS questions – literature review

The definition of the emergent concept of mobility consumption "MaaS" is scattered throughout numerous channels of information: in its early days (2014-2017) it can be seen a high concentration of conference papers where innovation dissemination is key; from 2016 on an increment of peer-reviewed scientific articles begin; and also a wide range of publications from news-based companies to consulting companies dedicated their attention to "MaaS" under a disruption perspective since the beginning. The literature review for this paper was conducted using only the word "Mobility as a Service" (Google Scholar, Scopus database and ISI Web of Science database until April of 2018), which returned only 37 peer-reviewed articles and 45 conference papers for this period. Besides conference papers and peer-reviewed articles, it was possible to add 39 documents that matched the search criteria, like: 16 policy and position papers from international organizations, 13 MSc. and PhD. thesis, 4 working papers and 6 book chapters, which totals 121 documents.
Almost 100 authors wrote about this topic, and despite this number there is no particular journal that can be recognized as being the sole influencer on "MaaS". The universe of relations and

perspectives wrote about this concept vary from urban mobility; smart cities; urban planning; business models; innovation; IT or governance and policy.

Numerous “MaaS” definitions were analysed and three clusters were found, that correspond to different perspectives in complexity levels:

i) **“MaaS” exists when a specific action occurs** (and is defined by it) (Transport Systems Catapult, 2016; Y. Li & Voege, 2017). This perspective is focused on the access to mobility services through specific actions (e.g. “purchasing ability”, “means of access”);

ii) **“MaaS” is what happens when some conditions exist** (no direct action needed for “MaaS” to exist) (Leviäkangas, 2016, Eckardt, Aapaoja, & Sochor, 2017; Sprei, 2018). This perspective bases the existence of “MaaS” in conditions, that can be understood as the necessary relations between systems (transport, information, payment, data infrastructure, etc) and stakeholders (public and private transport providers, authorities, etc).;

iii) **“MaaS” understood as a Mobility Distribution Model** (a model that enables a set of conditions that allow afterwards the occurrence of specific actions within the mobility system) (Matyas & Kamargianni, 2017b). This perspective aims to encompass the whole ecosystem of relations and conditions, stating that “MaaS” exists when there is a coordinated scheme of relations, where different actions (functions) and their enabling conditions can take place matching supply and demand through one single interface, hence the distributional character.

After the structuring of the “MaaS” concept conducted in this paper, a definition of “MaaS” will be stated and will anchor the public policy framework proposal

3.2 Public Policy and Policy Instruments

Policy can be understood as the science or art of governing what is public in a society ecosystem and the questions that are addressed are directly related with **public policy**. Anything a government chooses to do or not to do is one of the most concise definitions of public policy (Dye, 2013), that entails two main ideas: 1) the government is considered a determinant for the enactment of policies and 2) governing implies “choice”, and each choice is directly related with the promotion of the well-being of citizens and the protection of public value. Complementing this definition, Lasswell (1958) adds that besides government decisions, public policy is a composition of two elements: *policy goals* and *policy means* (cited *in* Howlett, 2011). Following the logic of “principal components of public policies” (Howlet & Cashore, 2009), Howlett (2011) also emphasizes that policies are based on policy goals and means that range from strategical level (answering “Why” question); Tactic level (first level of operationalization answering the “How to” question); to operational level (answering the “What” question, or “what has to be done for the monitorization of the implementation of “goals” and “means” in terms of public policy)

Identify the policy process is fundamental to understand the different stages and decisions and choices of policy making. Depicting **policy making as a process** underpins *“a set of interrelated stages through which policy issues and deliberations flow in a more or less sequential fashion from ‘inputs’ (problems) to ‘outputs’ (policies)”* (Lasswell, 1958 cited by Howlett, 2011). The policy process can be perceived as a cycle, which has its roots in *“systems theory and the pioneering work by David Easton on political systems (Easton 1965, 1966)”*. From the five policy process stages defined by Howlett (2011), this paper will look at the Helsinki case study under the focus of the first two and indicate the necessary policy

instruments for the Public Policy Framework proposed, which corresponds to the fourth stage: 1) Agenda-Setting; 2) Policy Formulation; 3) Decision-Making; 4) Policy Implementation; 5) Policy Evaluation.

The relation between policy formulation and policy implementation is of high importance for the proposal of an effective and coherent policy framework, therefore the choice of the policy instruments is very relevant to produce the intended effects and attain the proposed policy goals. **Policy means or instruments** are relevant for the enactment of policies and can be described as "*technical mechanisms used to attain policy goals and as existing only in the stages of 'policy formulation' – when policy means are proposed - and 'policy implementation' – when they are put into effect"* (Howlett, 2011).

As it is revealed by Rist, Vedung, & Bemelmans-Videc (1998) there is a wide variety of classifications types of policy instruments (Doern,1981 cited in Howlett & Ramesh, 1993; Rist, Vedung, & Bemelmans-Videc, 1998; Howlett, 2011; Macário, 2011), and it is recognized that *"nowhere in the international literature (…) is to be found a uniform, generally embraced classification of policy instruments".* For the development of the policy framework proposed it was used the **taxonomy of policy instruments** proposed by Howlett (2011), where it is taken into consideration that despite the complexity of the reasons behind government's policy instrument choices *"the set of possible choices is limited in nature, bound as they are to the limited number of types of different governing resources they have at their disposal".*

Howlett (2011) organizes instruments according to four categories of governing resources, dividing them in two types of instruments (Figure 1): i) substantive – *"those directly providing goods and services to members of the public or governments"* and ii) procedural – *"rather than affect the delivery of goods and services, their principle intent is to modify or alter the nature of policy processes at work in the implementation process"*.

		Governing resource			
		Information	*Authority*	*Treasure*	*Organization*
Purpose of tool	Substantive	Public Information Campaigns	Independent regulatory agencies	Subsidies and grants	Public enterprises
	Procedural	Official secret acts	Administrative advisory committees	Interest-group funding	Government reorganizations

Figure 1 - Taxonomy of substantive and procedural implementation tools according to governing resource (source: Author, adapted from Howlett, 2011)

3.3 Urban Mobility System, levels of decision and stakeholders

Mobility by itself can be seen as a process-oriented system that *"results from a sort of productive chain where several agents (authorities, operators, and users) intervene at different stages of the mobility chain (and also at different decision levels) to pursue the final objective that is to access a number of urban functions"* (Macário, 2011).

Understanding the nature of decisions which are intimately connected with policy making within the Urban Mobility System, is of extreme importance to have a coherent and effective policy framework, leading to a consistent policy process with the highest efficiency potential. Moreover, matching the nature of decisions (decision levels) with the stakeholders responsible for its implementation according to their mission and role, is also of outmost importance. In fact, after defining "Why" and "How", only with this matchmaking practise is possible to

understand “Who” has the responsibility to do “What” and “When”, resulting in a clear roadmap to policy implementation and evaluation.
According to Macário (2011), the allocation of responsibilities within each decision level cannot be object of generalization because of its highly contextual dependency, especially at the political and administrative organization (as well as culture). Although, among the several principles of good practices to establish a management model for Urban Mobility Systems, the author reinforces that there is a need to *“ensure clear distinction between the three levels of planning and control (strategic, tactical, and operational), or decision levels, with different organizational requirements and functional roles and a clear allocation of these roles to different institutions, whenever possible”* (citing *Anthony, 1989; EC, TIS.PT, 1997*). A clear separation between these levels provides higher consistency to the distinct phases of policy-making and implementation, resulting in a *“network of institutions (i.e., authorities, operators, and third parties) linked by varying degrees and forms of interaction”* (Macário, 2011).
The three levels of planning and control, or decision levels adapted to this work, are defined as follows:

- **Strategic** - the level that corresponds to policy formulation phase, where the rationale behind the policy is established answering **the “Why” question;**
- **Tactic** - this level corresponds to the policy implementation phase, where strategies, goals and visions (the Why) are matched with the necessary package of policy tools (means) to its operationalization, answering in this way **the “How” question;**
- **Operational** – this level relates to “evaluation and monitoring”, where it is decided specifically **“What”** to do in order to ensure the compliance with the strategical goals (Why) and the correlated and enabling policy means (How) that frame activities for final consumption of users.

In what concerns Stakeholders, which can be described as *“any group or individual who can affect or is affected by the achievement of the organization’s objectives”*(Freeman, 1984), their responsibilities when acting in mobility systems are also dependent on the Political and administration organization context of a country as well as its whole ecosystem of agents.
Indeed, by understanding within the universe of stakeholders, their roles, missions, contributions, expectations, power and strategy, a contextual adapted management strategy can be implemented throughout the entire policy process.
A high-level approach to stakeholder identification was conducted recurring to literature review, being the final categories inspired in the work of Macário (2011), and represented by the following group of Stakeholders: i) Politcal authorities; ii) Regulating authorities; iii) Technical authorities and agencies; iv) Operators; v)Suppliers; vi) Clients; vii) Other interest parties (e.g. NGO; Academia).

4. “MaaS” implementation case-study: Finland

Numerous authors reference Helsinki’s “MaaS” experience and Finland as being at the forefront of “MaaS” design and implementation (Casey & Valovirta, 2016), even the first one to initiate it worldwide (Y. Li & Voege, 2017). Declared as one of the most famous (Nikitas, Kougias, Alyavina, & Njoya Tchouamou, 2017) or as the best example of “MaaS” (EPOMM, 2017), Finland is seen as the country where “MaaS” was born (Dotter, 2016) with higher consistency and that lasts since its first appearance (2016). Studying the chronology of the “MaaS” policy process in Finland, considered as an “inspirational” case study, paved the way

for the comprehension of the policy process, the reasons behind determinant choices, and the effects on the emergence of "MaaS".

All the process dates to 2009 with the **1st Intelligent Transport Strategy** driven by the Finish Ministry of Transports and Communications (LVM), which mission is to *"ensure that people have access to well-functioning, safe and reasonably priced transport and communications networks".* This strategy was considered *"the world's first national ITS strategy covering all modes of transport"* (Ministry of Transport and Communications, 2009), and triggered the development of the policy process until today. With this strategy it was proposed an "**administration reform"** (performed in 2010) where the focus of transport administration would expand from individual transport modes to an organization focused on the transport as a whole reflected also in the transport information structure. This shift in transport policy was of foremost importance since it fostered *"a customer-oriented view of the entire transport system".*

The background for the implementation of a renewed transport policy in Finland was in place with this administration reform and at the same time, during 2010 began what is called the **"Transport Revolution programme"**, that aimed at "*developing a new mind-set for urban and transport planning and policies and policy implementation"* (Tuominen & Kanner, 2011).

The **second Intelligent Transport Strategy** is published in 2013, and advances key projects in the areas of "real-time information within the transport system" (data collection, processing and distribution); open data as well in the area of "integrated public transport system", with a reference to door-to-door trip chains and "interoperable payment system" following a "single payment method, one-stop-shop" (Finnish Ministry of Transport and Communication, 2013).

In 2014, there was already a strong support for sustainable and intelligent transport at the ministry level although business participation was still absent. Therefore, in the beginning of 2015, **LVM** in cooperation with **Tekes'** MaaS team, jointly launched a funding call, to fund 'pre-study' projects and consortium projects Mobility Operators, for Mobility Operators and other organisations such as current transport and technology providers who wanted to make their services compatible with the "MaaS" system. Eight 'pre-studies' were funded, and in the end several "MaaS"-related pilots were performed around Finland during 2015 and 2016. Total figures reported by Tekes in 2015 and 2016 account with almost 5,5 M€ channelled to 31 "MaaS" projects funding (one of them was WHIM app).

The last policy milestone is the approval (**2017**) and enactment (2018) of **the "Act on Transport Services"** (nr. 320/2017, first called the "Transport Code"). This Act *"brings together legislation on transport markets and creates conditions for digitalisation and new business models in transport"*[1] where the key objective is the provision of customer-oriented transport services; *"review the transport system as a whole, make market access easier and promote the interoperability of the different parts of the transport system"* and at the same time "*lighten regulation".* Provisions on Interoperability and ticket payment systems towards the use of a single trip ticket on door-to-door travel chains are some of the focus areas of this legislation.

The Finnish Transport Agency would be obligated to open data received on the use of services through open interface, in a form where it cannot be linked to individual users, service providers or services. Likewise, it is referenced in the same *LVM press* release[1] that the future offer of *"trip chains and combined services would be eased by enabling acting on another's behalf (…)*

[1] https://valtioneuvosto.fi/en/artikkeli/-/asset_publisher/vuodenvaihteen-muutokset-lvm-n-hallinnonalal-1 *(Aug. 2018)*

incorporating tickets for all modes of transports (..) as well as seasonal products or discounts into a combined mobility service”.

In January of 2018, the first provision of the “Act on Transport Services” entered into force, but the first and second phase of the “Act on Transport Services” (also called “Transport Code”) was enacted on the 1st July 2018 and has two parts (Smith, Sochor, & Sarasini, 2017): a) It aims at lowering permit requirements and tearing down silos between transport markets through deregulation and b) It focuses on enhancing the use of open and interoperable data interfaces. The Code obliges incumbents as well as new entrants to the transportation market to provide their operational data as well as their single tickets for third-party resale and use – *“The underpinning idea of the Code is to take advantage of digitalization and enable both the development of better and more agile transport services, and the integration of them into MaaS offerings”*.

5. Proposal to structure a “MaaS” public policy framework

5.1 “MaaS” Topology proposal

The main goal for developing a topology for “MaaS” is related with the need to propose a structure while approaching such a volatile and emergent concept as “MaaS”, with a definition purpose while grounding it within the different possible configurations of “MaaS” (associated with differentiated degrees of its core features). It is considered a topology, instead of taxonomy or typology, since the rationale behind is not the categorization but the study of intensities and presence of core features, that determine the capabilities, maturity and configuration of a “MaaS” system.

5.1.1 General and Specific Analysis

The design of a general “MaaS User Journey”, was the basis for the ‘Topology’ proposal, allowing the exploration of all the contact points of the user with the system in a “MaaS” environment.

During this analysis, two types of features can be distinguished: “General” and “Specific” Features. The “general” features are those that are not precisely associated with specific operational details of the “MaaS System”, but instead are materialized by the existence of a set of features or represent the governance established outside the system (e.g. strategic and tactical principles). The specific features are directly associated with the functional “building blocks” of a “MaaS” system.

Stemming out of the user journey analysis, it was possible to disclose the three pillars of a “MaaS system” (specific features): 1) the existence of choice related with the “**diversity of transport services”**; 2) “**Information” -** that allows the user to choose the mobility option most suitable to their needs; and **3) “Payment”** – the acquisition possibility.

A representation of the whole conceptualization of “MaaS” is shown in the Figure 2 scheme, where through an analogy with nature – depicting “a flower” structure – it is possible to demonstrate that such as a specific ‘flower’ needs an adequate climate and a set of conditions to grow and to blossom, so does a “MaaS System”. Different enabling conditions or the presence or absence of some of the “general features” already mentioned, generate different patterns of “MaaS systems”, or following the analogy: different “flowers”. These different patterns are here considered as the different topological levels of “MaaS”.

Figure 2 - "MaaS Flower Model" (Source: Lajas, 2018*)*

The different levels associated to the first "MaaS" pillar – **"Diversity of Transport Services"** – were defined following a rationale based on two principles: 1) 'the degree of choice', which is intimately associated with the nature of the transport services: collective or individual concerning 'non-self-service' or 'self-service' transport services; 2) 'capillarity', which is associated to the aggregated offer that is available in the "MaaS System" and to the "seamless mobility experience" of the user within that system. Consequently, the categorization of transport services can be split in two types: 'Non-self-service' and "self-service services" (weather subject to 'Public Service Obligation' or commercial), and in a second tier both types can be either 'collective' or 'individual'.

The levels of the second "MaaS" pillar – **"Information"** – "the enabler of choice", were based on the type of available data associated to each journey planner, since the journey planner is considered the interface of information and defines the capabilities and maturity of a "MaaS System", as shown in Figure 3 (where it is possible to observe that to each level of journey planner capability corresponds an increase in the type of data available)

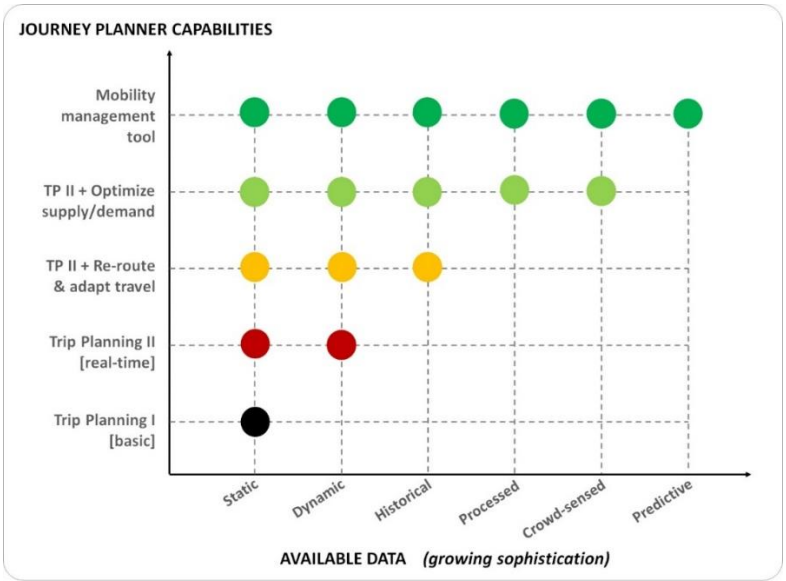

Figure 3 - Availability of data and corresponding "Journey planner capabilities" (Source: Lajas, 2018)

The Data considered was categorized as follows: i) Static (Sochor, Arby, & Karlsson, 2017); ii) Real-time (Gebhardt et al., 2016; Docherty et al., 2017); iii)Archived or Historical data (Giesecke, Surakka, & Hakonen, 2016); iv) Processed or analysed data (e.g. relying on data analysis and “big data analytics”) (Sarasini et al., 2017; Ebrahimi, Sharmeen, & Meurs, 2018); v) Predictive data (e.g. equal to “iv” but with a focus on future events recurring to modelling techniques) (Belletti & Bayen, 2017); and vi) Crowd-sensed data (e.g. data produced and disseminated by the user or the crowd) (Heiskala, Jokinen, & Tinnilä, 2016). The combination of these different types of data, will shape the journey’s planner potential of choice for the customer, its predictive power and the overall efficiency of the mobility system.
The levels associated to the third “MaaS” pillar – **“Payment”** – the “enabler of use” through the possibility to access different mobility services through a single payment, are categorized according to its increase flexibilization and tailor-made subscriptions, besides allowing a Pay-as-you-go function. Other aspect also considered is if there is a possibility of electronic access to the system (through e-ticket for instance).

5.1.2 “MaaS Topology” proposal

As stated before, a topology proposal applied to “MaaS” will have as an outcome the generation of patterns or spatial configurations that correspond to different “MaaS” identities, where is possible to infer its capabilities and maturity level. Since topology derives from the mathematician term - the “study of space”, and it was already defined that the “MaaS System” is based on three pillars - Transport services, Information and Payment - the topology approach followed relies on a **3-Dimensional** system, being each pillar associated with each axis. For this to be possible the units in all axis must represent identical value. For this reason, it was applied a **Multi-Criteria Decision Analysis** (MCDA) model, from the knowledge field of Decision Theory, that with the application of the Multi-Criteria Additive Value Model (Equation 1) allows a coherent and consistent transformation of each axis’s Local Value in Global Value through trade-off procedures

$$V(a) = \sum_{j=1}^{n} w_j v_j(a) \quad , \qquad \text{with} \ \sum_{j=1}^{n} w_j = 1 \ \text{ and } \ w_j > 1 \ (\text{j} = 1, \dots, \text{n})$$

where: $V(a)$ is the overall value of option a; v_j is the (partial) value of option a on criterion j and w_j is the weighting coefficient of criterion j, with $j = 1, \dots, n$.

Equation 1 – Additive Value Model equation (Phillips & Bana E Costa, 2007)

Methodologically, the model building process has three phases: **1) Structuring; 2) Evaluation** and **3) Testing**.
The **structuring phase (1)** encompasses the **definition of criteria and descriptors of performance** (ordered impact levels) that operationalize those criteria. The criteria considered in this model match the three “MaaS” pillars identified, and the correspondent descriptors of performance (Table 1) match the levels respectively identified.
The **Evaluation phase (2)** is composed by two parts, first the **creation of value functions** for each criterion and secondly the **assessment of the criterion weights**. The **value function** process can be understood as the creation of *“scales anchored at their ends by the most and least preferred options on a criterion (where) the most preferred option is assigned a preference score of 100, and the least preferred a score of 0. (…) Scores are assigned to the*

remaining options so that differences in the numbers (or levels) represent differences in strength of preference" (Department for Communities and Local Government: London, 2009).

Table 1 - "MaaS Topology model" Criteria and respective descriptors of performance (source: Author)

C1 – TRANSPORT SERVICES	C2 - INFORMATION	C3 - PAYMENT
1.'Self-service' transport (only) **2.'Non-self-service' transport** (collective or collective and individual); **3.'Non-Self-Service' (**collective or collective and individual) **and 'Self-Service'** collective transport; **4.'Non-Self-Service' (**collective or collective and individual) **and 'Self-Service'** (individual or collective and individual) **transport.**	**1. Static Multimodal Journey Planner** ("Static" data) **2. Dynamic Multimodal Journey Planner** ("Real-time" data) **3. Assistant & Dynamic Journey Planner I** ("User preferences" data) **4. Assistant & Dynamic Journey Planner II** ("Crowd-sensed" data) **5. Assistant & Dynamic Journey Planner III** ("Predictive" data) **6. Intervenient, Assistant & Dynamic Journey Planner**	**1.Pay-as-you-go (PAYG)** (**physical** access only) **2. Pay-as-you-go (PAYG)** (**electronic** possibility) **3.PAYG and Single Subscription** (**physical** access only) **4.PAYG and Single Subscription** (**electronic** possibility) **5.PAYG and Fixed Subscription** (**electronic** possibility) **6.PAYG and Flexible Subscription** (**electronic** possibility)

Based on indifference judgements that represent strengths of preference, and supported by the rational presented before (level proposal for each "MaaS" pillar), the results are represented in Figure 4, and the main fundaments were:

- **"C1-Transport Services"** – It was valued more the passage from Level C1.2 to C1.3 than from C1.1 to C1.2, due to the diversity, capacity and availability increase that the level C1.3 entails when there is a mixture of "Non-Self-Service" and "Self-Service" transport services.
- **"C2 - Information"** – The highest difference in attractivity between consecutive levels considered, is the incorporation of "Real-Time data", which transforms a Static Journey Planner into a Dynamic one (valuing 40 points).
- **"C3 - Payment"** - the importance of the existence of mobility packages, even in its simplest form in detriment of the possibility of having an electronic access to the system. Therefore, the indifference level from worst to best is represented in C3.3 (50 points). Considering that the increase in flexibility of the payment packages is more valued, the passage from "Fixed Subscription" (C3.5) to "Flexible Subscription" (C3.6) is valued higher (30 points) than the passage from "Single Subscription" (C3.3) to "Fixed Subscription" (C3.5) (20 points).

The second and last part of the evaluation phase is the assessment of criteria weights. The **criterion weights** are *"scaling constants that represent the correspondence between value units on one criterion compared to another"* (Phillips & Bana E Costa, 2007), was performed using the trade-off procedure.

The first step of the trade-off procedure is to understand what the reference criteria is to establish the reference basis for the pairwise comparisons. Considering the goals of a "MaaS system" and its "user-centric" focus to provide "seamless mobility"

Being the "seamless property" of travel highly dependent on context Considering (which is the case of "C1-Transport Services") and considering that is more important to have a "Journey Planner" at its highest level ("C2-Information") than a more flexible "payment option" to access the system ("C3-Payment"), the most important **"worst-best swing"** was the one verified in criterion "C2-Information".

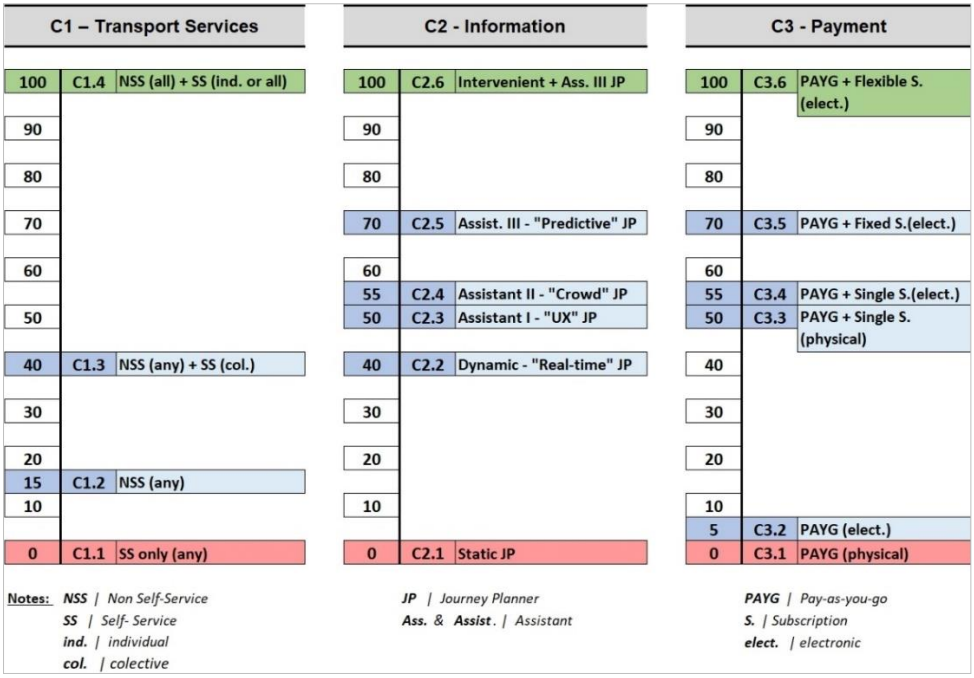

Figure 4 - Value Functions of the criteria: ” C1 – Transport Services”; “C2 – Information” and “C3 – Payment” (source: Author)

For the first pairwise comparison, C2 and C3, it was considered that the indifference point was the one corresponding to level C2.2 [$v_2(a)$=40]. The justification for this choice relies on the following value judgement: «*For the same level of transport services, it is considered that having the most flexible and user friendly mode of payment and a “Static” Journey Planner would be similar to have just a “Pay-as-you-go based only on physical means of access to the system” and a “Dynamic” Journey Planner (that incorporates “real-time” information)*». For the second pairwise comparison, C2 and C1, it was considered that the indifference point was the one that corresponds to level C2.3 [$v_2(a)$=50]. This indifference value judgement was supported by the following rational: «For the same mode of Payment, having a higher choice in what concerns transport services but a static Journey Planner doesn’t allow to fully take advantage of the user experience and interaction with the system.
The resultant system of equations is the one that is represented in Equation 2.

$$\begin{cases} 40w_2 - 100w_3 = 0 \\ 50w_2 - 100w_1 = 0 \\ w_1 + w_2 + w_3 = 1 \end{cases}$$

Equation 2 – System of equations used in the assessment of the Criteria weights (source: Author)

The assessment of the criteria weights is the final part of the evaluation phase, and the result can be written directly in the final equation of the “MaaS Topology” multicriteria model, as it is represented in Equation 3.

$$V(a) = 0{,}263 * v_1(a) + 0{,}526 * v_2(a) + 0{,}211 * v_3(a)$$

Equation 3 – “MaaS Topology” multi-criteria model equation (source: Author)

5.2 Public Policy Framework proposal for “MaaS” implementation

The present proposal will be developed anchored in the following definition of “MaaS”:

> ***"MaaS is a mobility management model that allows the emphasis of a value proposal and its articulation with supply and demand, ensuring all the means of information and transaction between the two market sides, and where it is also enabled the feeding of monitoring functions that the authority intends to wield"***
> *(Rosário Macário and Renata Lajas, October 2018)*

In this section the main goal is to identify what should be in place in terms of Public Policy Framework (policy instruments) as well as stakeholder responsibility (indicative, since the scope of this work doesn't it is not policy transfer), according to each corresponding set of "building blocks" identified previously in the structure of "MaaS" concept and their maturity degree.

Firstly, it's important to recognize that there are not strictly defined and isolated topological levels of "MaaS Systems" but instead, a wide spectrum with numerous configurations possibilities given the different combination of levels or degrees identified in each one of the three pillars that identify a "MaaS System". Therefore, the Public Policy Framework proposed will be anchored in the "General features" and "Specific features" that structure the concept of "MaaS", and not the resulting configuration or pattern itself.

To do so, the understanding of the nature of decisions which are intimately connected with policy making within the Urban Mobility System, is of extreme importance to have a coherent and effective policy framework. It is for this reason that the first step to build the Public Policy Framework is to identify the relation of "Strategic", "Tactic" and/or "Operational" decisions with the enabling of each one of the features identified. The result is presented in Table 2.

The second step to build the Public Policy Framework, would be to consider independently the decision-making levels (only strategic and Tactic), and focusing on each feature at a time, identify which types of policy instruments would best fit the purpose or the enabling of that feature. For this task, the reference taxonomy used was the one of Howlett (2011), where the author references policy instruments through the governing resource type and the purpose of the tool, highlighting reference examples in each category. To complete this step, and within the decision levels of the Urban Mobility System, it was performed an indicative identification of stakeholders to establish responsibility relationships in what concerns the implementation of each policy instrument proposed Table 3.

In what concerns the general features associated to "MaaS", the **"Data-Sharing"** and **"Interoperability"** are considered one of the most important ones, since everything on "MaaS" relates to information and specially "Open Data", as it was already referenced before. These two features, depending on the national context, are enabled by visions and strategies (strategical level) and tactical decisions, that can range from laws to regulation related to "data standardization" for instance. Monitoring actions and entities are especially relevant to the enabling of these features, since they are determinant to the well function of a "MaaS System".

Following, the next general feature of a "MaaS System" analysed is its desired **"User-Centric"** philosophy. This feature is present on all levels of decision, especially because it gives structure to the rationale behind the "MaaS" philosophy in all the service value it entails.

All the four levels (**C1.1**; **C1.2**; **C1.3** and **C1.4**) of the specific feature **"Transport Services"** are analysed together, since all relate to different configurations of the transport service available, which is highly dependent on the mobility context and specific agreements. The main question here is if the system is "Private-led" or "Public-led", since the latter encompasses a great involvement in the all the decision levels.

In what concerns the “**Information**” Pillar, the most important would be the first two levels (**C2.1** and **C2.2**) characterized by the existence of “Static” and “Real-Time” information.

		Decision Levels		
		Strategic	Tactic	Operational
General Features	Data-Sharing	●	●	●
	Interoperability	●	●	●
	User-Centric	●	●	●
	Integration of Information	●	◑	◑
	Coordination & Cooperation between mobility agents	◑	○	◑
Specific Features	C1 – Transport Services			
	C1.1	◑	◑	●
	C1.2	◑	◑	●
	C1.3	◑	◑	●
	C1.4	◑	◑	●
	C2 - Information			
	C2.1	●	●	●
	C2.2	●	●	●
	C2.3	○	○	◑
	C2.4	○	○	◑
	C2.5	◑	◑	◑
	C2.6	●	●	●
	C3 - Payment			
	C3.1	●	●	●
	C3.2	●	●	●
	C3.3	○	○	◑
	C3.4	○	○	◑
	C3.5	○	○	◑
	C3.6	○	○	◑

● Required ◑ Optional ○ Absent

Table 2 - Decision Levels associated to each General and Specific MaaS Features

The policy instruments associated to these two levels correspond to the ones that enable in different decision levels the “Data-Sharing” and “Interoperability”. Next, the **C2.3** and **C2.4** levels are considered to be strictly connected to “MaaS” business side. If the vision for a “MaaS System” is to use it as a mobility management tool (level **C2.6**), allowing or not an interventive power in the overall mobility system, besides the management of user travel function matching with best value-for-money destination according to current mobility conditions of the system, all the decision levels should be in place.

For the last pillar of a “MaaS System”, **“Payment”** (Criterion C3), it is fundamental for all levels that besides “Data-Sharing” and “Interoperability”, that the “Payment and Ticketing interfaces” are open access and that it is allowed the selling of tickets by a third party, especially the ones belonging to public transport. Once again, only the first two levels (**C3.1** and **C3.2**) will be analysed, since all the remaining are strictly related to the Business operational side. Concerning **C3.1** and **C3.2** levels, the existence of “Pay-as-you-go” systems, despite the access to the system (physical or electronic), will allow by default technically all the other packages.

Due to the specificities of each country organization and its context (e.g. governance, administrative, bureaucratic, etc.), with clear consequences in the functions associated to each decision level, the stakeholders appointed responsible for the implementation of the proposed policy instruments are not specific but instead indicative groups of stakeholders were identified in Table 3**Error! Reference source not found.**.

Table 3 - Indicative Policy Instruments by MaaS feature, according to governing resource and purpose of tool (Source: Author, inspired on Howlett's (2011) Policy Instruments Taxonomy)

	Features	Policy Instruments (by governing resource and purpose of tool)		Levels of Decision and indicative group of Stakeholders	
				Strategic	Tactic
S ● T ●	• Data-Sharing • Interoperability • C2.1 Static Multimodal Journey Planner ("Static" data) • C2.2 Dynamic Multimodal Journey Planner ("Real-time" data) • C3.1 Pay-as-you-go (PAYG) (phy sical only) • C3.2 Pay-as-you-go (PAYG) (electronic)	Auth. (subst.)	**Direct Government Regulation [1]**: *Laws, independent regulatory commisions.*	Political autorities	Technical authorities and agencies; Regulating authorities
			Market Creation and Mantenance tools [2]: *establishing of limits and permits*	Political autorities	Technical authorities and agencies; Regulating authorities
			Visions and strategies: *Policy Vision, Strategic options and plans [6]*	Political Authorities	
		Org. (subst.)	**Direct Government [3]**: *Line departments, central support agencies*	Political autorities	Technical authorities and agencies
		Org. (proc.)	**Network management tools**: *Creating or reorganizing government agencies [4], Legislative and executive oversight agencies [5]*	Political Authorities	Technical authorities and agencies; Regulating authorities
S ● T ●	• User-Centric	Auth. (subst.)	**Visions and strategies**: *Policy Vision, Strategic options and plans [6]*	Political Authorities	
			Direct Government Regulation [1]: *Laws (consumer rights protection)*	Political autorities	Technical authorities and agencies
		Org. (proc.)	**Network management tools**: *Legislative and executive oversight agencies [5]*	Political Authorities	Regulating authorities
		Fin. (subst.)	**Tax- or royalty-based financial instruments [7]**	Political Authorities	Regulating authorities
			Cash or Tax-equivalent financial tools [8]: Favourable insurance and loan guarantees, Vouchers for public services	Political Authorities	Technical authorities and agencies; Regulating authorities
	• C2.6 Intervenient, Assistant & Dynamic Journey Planner	Auth. (subst.)	**Visions and strategies**: *Policy Vision, Strategic options and plans [6]*	Political Authorities	
		Org. (subst.)	**Direct Government [3]**: *Line departments*	Political Authorities	Technical authorities and agencies
		Org. (proc.)	**Network management tools**: *Creating or reorganizing government agencies [4]*	Political Authorities	Technical authorities and agencies
		Fin. (subst.)	**Tax- or royalty-based financial instruments [7]**	Political Authorities	Regulating authorities
S ● T ◑	• Integration of Information	Auth. (subst.)	**Visions and strategies**: *Policy Vision, Strategic options and plans [6]*	Political Authorities	
			Market Creation and Mantenance tools [2]		Technical authorities and agencies; Regulating authorities
		Auth. (proc.)	**Policy network activation and mobilization tools [9]**: *Public consultation, stakeholder and consensus conferences*		Technical authorities and agencies; Operators; Suppliers; Clients; Other interest parties
S ◑ T ◑	• C1.1 'Self-service' transport (only) • C1.2 'Non-self-service' transport (collective or collective • C1.3 'Non-Self-Service' (collective or collective and individual) and 'Self-Service' collective transport • C1.4 'Non-Self-Service' (collective or collective and individual) and 'Self-Service' (individual or collective	Auth. (subst.)	**Direct Government Regulation [1]**: *Laws (access standards to service provision)*	Political Authorities	Technical authorities and agencies; Regulating authorities
		Org. (subst.)	**Direct Government [3]**: *Line departments , central support agencies*	Political Authorities	Technical authorities and agencies
		Org. (proc.)	**Network management tools**: *Legislative and executive oversight agencies [5]*		Regulating authorities
			Quasi-governmental organizational forms [10]: *Partnerships and contracting out*	Political Authorities	Technical authorities and agencies; Operators, Suppliers
		Fin. (subst.)	**Cash or Tax-equivalent financial tools [8]**: Favourable insurance and loan guarantees, Vouchers for public services	Political Authorities	Technical authorities and agencies; Regulating authorities
			Cash-based financial tools [11]: Grants, subsidies and user fees	Political Authorities	Technical authorities and agencies; Regulating authorities
		Fin. (proc.)	**Policy network creation tools [12]**: *Interest group creation (support to start-ups)*	Political Authorities	Technical authorities and agencies; Operators, Suppliers
	• C2.5 Assistant & Dynamic Journey Planner III ("Predictive" data)	Org. (subst.)	**Direct Government [3]**: *Line departments*	Political Authorities	Technical authorities and agencies
		Org. (proc.)	**Network management tools**: *Legislative and executive oversight agencies [5]*	Political Authorities	Regulating authorities
S ◑ T ○	• Coordination and Cooperation between mobility agents	Auth. (subst.)	**Visions and strategies**: *Policy Vision, Strategic options and plans [6]*	Political Authorities	
		Auth. (proc.)	**Policy network activation and mobilization tools [9]**: *Public consultation, stakeholder and consensus conferences*		Technical authorities and agencies; Operators; Suppliers; Other interest parties

Governing Resources: Authoritative (Auth.) | Organizational (Org.) | Fianacial (Fin.) | Informational (Info.)
Purpose of tool: Substantive (subst.) / Procedural (proc.)
Decision Level: Strategic (S) | Tactic (T)

● Required ◑ Optional ○ Absent

6. Conclusions

The proposal of a Public Policy Framework encompassed a two-stage approach. Structuring the concept of “MaaS” focused primarily on the identification of its “building blocks”, which can be considered as the starting point to establish a common understanding related to the identification of the founding pillars of “MaaS” concept. Taking into consideration the “MaaS Flower Model” proposed, it was possible to understand the relation between the enabling conditions and its specific core features, their relations which allowed the design of the “MaaS” topology proposal, where it is possible to differentiate degrees of maturity and estimate “MaaS” disrupting potential. The second and final part, was supported by public policy theory, where to each degree of core feature considered in the topologic definition for MaaS created, corresponded a set of policy instruments, the indicative group of stakeholders responsible for its implementation and the identification of the most appropriate urban mobility decision levels where they should be unfolded.

In what concerns challenges and barriers in respect to a “MaaS System” implementation, they stem out from different sectors, e.g. institutional; regulation related; technological and Operational from a business perspective. The financial aspect is also proclaimed as a challenge, normally related with legislation and regulation related with subsidies of public transport (Nikitas et al., 2017; M. Karlsson, 2017; Y. Li & Voege, 2017; Mulley et al., 2018). This aspect brings an important question that is related with the redefinition of the role of Public Transport. The public transport can gain a bigger importance and increase its shares once the “MaaS” concept evolves and disseminates throughout the world in the years to come. The shift from “transport operators’ subsidy scheme” to a “user” based subsidy one, whom can freely choose any transport service or “MaaS offering”, can be an opportunity for the growth of the public transport share and not otherwise, as it is referenced by some authors quoting Public Transport Stakeholders (e.g. “cannibalization of Public Transport”, “fear of losing the relationship with the customer” and “fear of losing the brand” are among some of the concerns) (M. Karlsson, 2017; G. Smith, Sochor, & Karlsson, 2017a).

Frequently is also declared as a challenge the excessive “governance of Mobility led by technology” or the lack of “leadership” and defined roles associated to the “business models” of “MaaS” (M. Karlsson, 2017; Finger & Razaghi, 2017).

If “MaaS” is considered as a Mobility Management tool, as argued in this work, its implementation is aligned in all the decision levels, stemming out firstly from a strategic vision what type of system the proposed policy framework supports. A “MaaS” system concept implemented as a mobility management tool will have a higher potential in terms of monitoring capabilities of the mobility system, where it is possible to actively increase the efficiency of the transport system and at the same time have an active role in the promotion of sustainable mobility goals among other cross-sectorial policy goals (e.g. land-use, environment or housing policy).

For a successful implementation of “MaaS”, as it is shown in the paper there is much more to it than just technology. To have a clear vision of the type and maturity of “MaaS” system that is envisaged for a region, will uncover what policies need to be promoted and which policy instruments could be chosen accordingly, in order that the enabling conditions are in place.

Future work can focus on the study of challenges related to the unclear proof that “MaaS reduces traffic congestion” (Hensher, 2017; Mulley et al., 2018), the issue of universal accessibility with the challenge of “equitable access to a MaaS System” (Schweiger, 2017), and in a broader scope: “MaaS” as an opportunity for the redefinition of the public transport role and its contribution to support “sustainable mobility policies”.

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To the women than run with the wolves, that teach us to go beyond, the power of resilience and the brilliance of quality and excellence.

Declaration of interest

None

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Appendix

A - List of MaaS definitions considered

Author (year)	Citation of MaaS definition	Source
Heikkilä (2014)	"a scheme in which mobility services are provided as an individual and flexible service in a competing mobility operator market. (…) MaaS refers to circumstances, in which comprehensive supplies of mobility services are provided by mobility operators. Versatile services offered by the operators satisfy all mobility needs, thus decreasing the need to possess a car."	Master Thesis – Aalto University
Hietanen (2014)	"Mobility as a Service (MaaS) is a mobility distribution model in which a customer's major transportation needs are met over one interface and are offered by a service provider. (…) The vision is to see the whole transport sector as a co-operative, interconnected ecosystem, providing services reflecting the needs of customers. The boundaries between different transport modes are blurred or disappear completely."	Article in Press
ITS Europe, 2014	"a mobility distribution model in which all of customer's major transportation needs are met from a single platform by a single service provider that orchestrates each individual transport service component to meet a customer's end-to-end service expectations."	Institution
MaaS Alliance, 2015	"the integration of various forms of transport services into a single mobility service accessible on demand. (…) (implying) the use of a single application to provide access to mobility, with a single payment channel instead of multiple ticketing and payment operations."	Public-Private Partnership
Kamargianni, Li, Matyas, & Schäfer (2016)	"The term "Mobility as a Service" stands for buying mobility services as packages based on consumers' needs instead of buying the means of transport. Via "Mobility as a Service" systems consumers can buy mobility services that are provided by the same or different operators by using just one platform and a single payment. MaaS platforms usually provide an intermodal journey planner, a booking system, easy-payment, and real time information."	Peer-Reviewed (T)
Dimitrakopoulos, Bravos, & Stabologlou (2016)	"MaaS bridges the gap between public and private transport operators, envisaging the integration of all the fragmented tools (planning, booking, real time information, payment and ticketing) a traveler needs to conduct a trip."	Peer-Reviewed (IT)
Leviäkangas (2016)	"The concept of MaaS is relatively simple: bundling different transport means, public and private, into one easy-to-use package for the customer. The service is provided to the customer via mobile applications and payment is handled via a digital wallet."	Peer-Reviewed (IT)
Sochor, Karlsson, & Strömberg (2016)	"Mobility as a service (MaaS) is an emerging concept that entails a mobility distribution model in which a customer's major transportation needs are met over one interface and are offered by a service provider, in other words, "combining all forms of personal transport together into seamless trip chains, with bookings and payments managed collectively for all legs of the trip."	Peer-Reviewed (T)
Docherty, Marsden, & Anable (2017)	"(…) 'Mobility as a Service' (MaaS), where individuals' ownership of vehicles is increasingly replaced by "usership", that is the ability to purchase access rights to an interoperable package of mobility services (car, taxi, bus, rail, bike share) owned by others, usually corporate, providers."	Peer-Reviewed (T)
Li, Luo, & Hampshire (2017)	"Mobility-as-a-Service (MaaS) is a solution that integrates multiple modes of transport into seamless trip chains. (...) allows a shift from personally-owned vehicles towards easy mobility services by combining transportation services from public and private providers through a unified way."	Peer-Reviewed (T)

Y. Li & Voege (2017)	“The concept of MaaS is to use a single app to access and pay for various transport modes within a city or beyond; and the app will give options to allow a traveller to select the most suitable transport mode.”	Peer-Reviewed (T)
Mulley, Nelson, & Wright (2018)	“MaaS is variously defined but the essential idea is to see transport or mobility not as a physical asset to purchase (e.g. a car) but as a single service available on demand and incorporating all transport services from cars to buses to rail and on-demand services”	Peer-Reviewed (T)
Veerapanane, Taylor, & Kaparias (2018)	“At its core, MaaS combines transportation services from public and private providers through a unified gateway that handles individual door-to-door trips, managing all stages of their creation and implementation (planning, payment, real-time monitoring, etc.). “	Peer-Reviewed (T)
Sprei (2018)	“is a bundling of services such as public transportation, car sharing, bike sharing and taxis. The idea is to offer a subscription or pay-per-use service that will cover different types of mobility needs and create a seamless intermodal travel.”	Peer-Reviewed (U&SSc)
Rantasila (2015)	"The concept of MaaS is relatively simple: bundling different transport means, public and private, into easy-to-use service to end-customer. (…) The idea behind intelligent transport services like MaaS is to utilize possibilities of ICT and mobile devices for better user experience."	Conference Paper
Surakka, Haahtela, HÄrri, Mich, & Horila (2017)	"Mobility as a Service (MaaS) is an example of a systemic innovation, where sustainable mobility services addressing different customers’ transport needs are integrated with traveller information and ticketing/ payment services."	Conference Paper
Matyas & Kamargianni (2017)	"Mobility as a Service is a user-centric, intelligent mobility distribution model in which all mobility service providers’ offerings are aggregated by a sole mobility operator and supplied to users through a single digital platform."	Conference Paper
Eckardt, Aapaoja, & Sochor (2017)	"Mobility as a service (MaaS) is an emerging mobility concept that heavily relies on digitalization and an end-user oriented approach. The great vision in the MaaS concept is to connect all available transport and mobility services together in a one-stop-shop package and hence offer an agile sustainable and effective competitor to private cars, which can be tailored according to the needs of end users."	Conference Paper
Ebrahimi, Sharmeen, & Meurs (2018)	" (...) an innovative concept that has recently emerged to offer door-to-door mobility services. MaaS potentially enhances accessibility and efficiency of transport systems by identifying more deeply the supply and demand patterns. MaaS is believed to provide sustainable and user-centric services and to offer unique opportunities to bundle (latent) travel demand, to organize the smart use of existing systems and support orchestrated and/or self-organizing innovative travel services in which an interface automatically matches travelers’ demand and supply.”	Conference Paper
EPOMM (2017)	“Mobility as a Service (MaaS) is such a concept, combining services from public and private transport providers through a unified gateway that creates and manages the trip, which users can pay for with a single account.”	Institutional Position Paper
Polis Network (2017)	“‘Mobility-as a-Service' has been marketed as a new transport concept that may change or disrupt current models of transport provision, particularly in urban areas. The concept of MaaS claims to offer a personal mobility package based on lifestyle needs and delivered through an IT model."	Institutional Position Paper
Transport Systems Catapult (2016)	"The Transport Systems Catapult has defined MaaS as using a digital interface to source and manage the provision of a transport related service(s) which meets the mobility requirements of a customer. This definition seeks to encapsulate the vision of a MaaS Provider offering their customer, any type of travel experience using any type of transport service, public or private. (...) MaaS is a new concept that offers consumers access to a range of vehicle types and journey experiences."	Public-Private consultancy company

König et al. (2017)	“Multimodal and sustainable mobility services addressing customers' transport needs by integrating planning and payment on a one-stop-shop principle.”	"MaaSiFiE" - EU Project
MaaS Global (https://maas.global/)	“a way of combining options from different transport providers into a single mobile service, removing the hassle of planning and one-off payments”	MaaS Provider

B - Howlett’s (2011) Policy instruments taxonomy

	Purpose of tool	
Governing Resource	**Substantive**	**Procedural**
Authoritative implementation tools	**Visions and Strategies** • *Policy visions, strategic options and plans* **Direct government regulation** • *Laws* • *Independent regulatory commisions* **Indirect government regulation** • *Delegated professional regulation* • *Voluntary or incentive regulation* **Market creation and maintenance**	**Policy network activation and mobilization tools** • *Advisory Councils* • *Public consultation, stakeholder and consensus conferences*
Organizational implementation tools	**Direct government** • *Line departments* • *Central support agencies* • *Social and health insurance and pension plans* **Quasi-governmental organizational forms** • *Public enterprises and other corporate forms* • *Organizational hybrids (alternative service delivery)* • *Partnerships and contracting out*	**Network management tools** • *Staff or central (executive) agencies* • *Tribunals and other quasi-judicial bodies* • *Creating or reorganizing government agencies* • *Establishing analytical units* • *Establishing clientele units* • *Establishing gov. reviews, ad hoc task forces, commisions, enquiries and public hearings* • *Legislative and executive oversight agencies*
Financial implementation tools	**Cash-based financial tools** • *Grants, subsidies and user fees* **Tax- or royalty-based financial instruments** • *Tax- or royalty-based financial expenditures* • *Excise taxes* **Cash or Tax-equivalent financial tools** • *Preferencial Procurement* • *Favourable insurance and loan guarantees* • *Vouchers for public services* • *Sales and states assets at below price markets*	**Policy network creation tools** • Interest group creation ***Network mobilization tools*** • *interest group alterations/manipulation/co-optation*
Information implementation tools	**Information dissemination tools** • *Exhortation and moral suasion* • *Information campaigns* **Information and knowledge colection tools** • *Judicial inquiries and executive commisions* • *National statistical agencies* • *surveys and polling*	**Information release tools** • *Freedom of information legislation* **Information release prevention tools** • *Censorship* • *Official secret acts* • *Privacy acts*

Observation: in *"italyc"* are represented *examples of implementation tools*

Credit Author Statement

Public policy framework supporting “Mobility-as-a-Service” implementation

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