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ITS service platform: in search of working business models and ecosystem

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Abstract

ITS products and services have been aggressively developed and they are expected to offer multiple benefits, such as traveler convenience and cutting of societal costs through a reduction in fatalities, injuries and emissions. However, technological possibilities and developments have often failed to translate into customer value and successful business to companies. This paper focuses on two issues: 1) filling some holes in empirical knowledge by providing an example of ITS and mobility business platform implementation, and 2) to identify potential business models and ecosystem for an international B2B2C ITS platform.

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Keywords: intelligent transports systems; ITS platform; business models; service concepts; value; e-marketplace; MOBiNET

1. Introduction

Digitalization has improved the performance, quality and productivity of many sectors, from education to health care, and including the transport system. Digitalization is expected to contribute to the economic, social, and environmental sustainability of the functions of our societies (OECD, 2014). Digitalization of the transport system is manifested in Intelligent Transport Systems (ITS). Advanced technologies, e.g. Internet, wireless communications, sensing systems and computational technologies improve every aspect of transportation, all modes of transport, and covering both passengers and goods. Predominantly the mentioned improvements that are brought by ITS comprise reduced congestion, increased safety, and improved traveler convenience. However, and surprisingly enough, there is no commonly accepted taxonomy of ITS and it is kind of an umbrella term that cannot be limited to a certain number of systems and applications. There are hundreds of systems and applications designed for a specific purpose as well as a growing number of new devices. Giannoutakis and Li (2011) and Figueiredo et al. (2001) distinguished ITS as an intelligent road transportation infrastructure and vehicles that include systems and applications designed for road transport infrastructure and users. ITS has grown into an industry of its own. The market projections for ITS are usually regarded promising and optimistic. The market could already be approximated, and a few countries have performed the estimations. The size and structure of the market vary from region to region and from country to country due to significant differences in the technological advancement and purchasing powers among them. In Finland, for example, the ITS market from supply side was approximately €300 million in 2010, with a contribution of around 1700 employees. This value accounted for 0.17% of the country's GDP in 2010, which indicates its national importance. Another ITS market study by the Intelligent

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Transportation Society of America (2011) estimated ITS revenues of $48 billion in 2009 in the US, with associated jobs about 445,000 (0.3% of total jobs in the US). The high market growth was also expected in various market reports (Marketsandmarkets, 2014; Transparency Market Research, 2013; Kristensen, 2011).

In the last 40 years, ITS has mainly been studied from the technological perspectives, and there is a lack of business and business model related studies on ITS. The technological possibilities and developments have failed to be translated into measurable value and benefits to providers, customers and society because the business models of ITS have been widely ignored (Giannoutakis and Li, 2011). Increasing a perception of customer value and new ways of creating is vital (Giannoutakis and Li, 2011; Bygballe and Jahre, 2009). However, finding an appropriate business model is challenging because it involves multiple variables like providers, stakeholders, their roles and interactions, costs and revenues (Zografos et al., 2008).

This study aims to assess potential business models for ITS platforms through case MOBiNET platform – a Europe-wide e-marketplace of mobility services for businesses and end-users. This paper addresses two relevant research questions for MOBiNET and for ITS platforms generally:

RQ1. Who are the stakeholders delivering and obtaining services through an ITS platform?
RQ2. What kind of business models ITS platforms should comply with?

The structure of this paper is depicted in Fig. 1. After this introduction, we give a brief overview of ITS and business model literature. In the third chapter, we present the method and empirical scope of this study. The chapter continues by analyzing the potential participation of different stakeholders in service delivery processes within the MOBiNET case. After that, we present the potential business and service concepts (i.e., value networks) of the MOBiNET platform and discuss the most relevant benefits and aspects of those concepts and models. The final chapter, conclusions, summarizes the study by presenting a value formation for an ITS platform. Also, some ideas for future research and direction of business models for ITS platforms are presented.

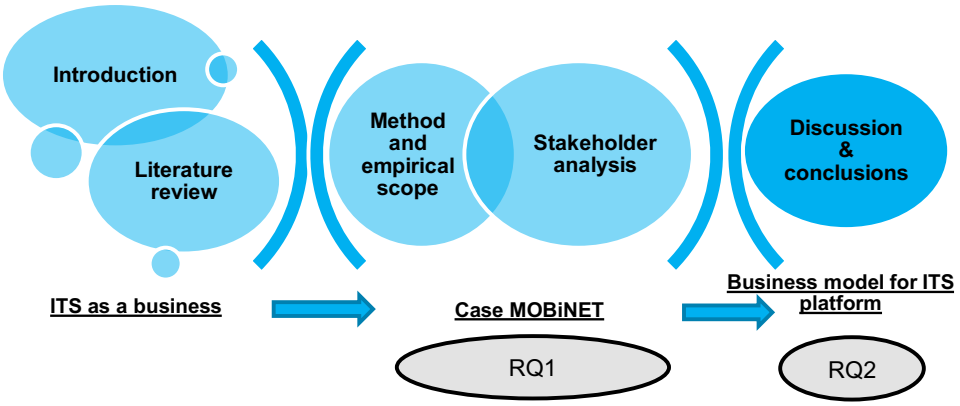

Fig.1.The structure of the study.

2. The societal demand and market supply

2.1. The socio-economic demand for ITS

The emerging development of information and communication technologies (ICT) has introduced many changes in various sectors. It has transformed most industries as well as a public sector from education to health care and is now changing the transport systems (Ezell, 2010). Intelligent Transportation Systems (ITS) are seen as a high growth segment within the transport sector. ITS is the collective term for the use of electronics, communications, and information processing technology to improve all aspects of transportation – including public transportation (The Intelligent Transportation Society of America, 2011). ITS covers all modes of transport for both passengers and goods and brings significant improvement in transport system performance, including reduced congestion, increased safety, and traveler convenience (Fig. 2.).

The potential impacts of ITS have been studied and discussed widely. For example, Ferreira (2010) estimated that emerging ITS applications can reduce congestion by 5-15%; 5-15% fewer fatalities and 5-10% fewer injuries; and possibly save 10-20% CO2 emissions. Grant-Muller and Usher's (2014) later estimations indicate that the environmental impacts of ITS vary from 10-15% reduced congestion and 5-20% fewer emissions. According to Öörni (2012), deployment of V2I and V2V safety applications will probably have a reducing effect on crash rates; 2-25% fewer fatalities and 1-20% fewer injuries. Moreover, regarding the ITS employment impacts, it has been indicated that 445,000 jobs or 0.3% of the 138 million total jobs in the U.S.

are ITS-related jobs in 2009. The U.S. end-use market contributes almost 180,000 private sector jobs (40%) (Intelligent Transportation Society of America, 2011). Transport Systems Catapult (2015) has evaluated that the ITS markets will grow to £56 billion in the United Kingdom and £900 billion markets in worldwide by 2025.

Fig. 2. Intelligent Transport Systems – a meta-system view (European Telecommunications Standards Institute, 2010).

2.2. Overview of ITS market and services

Although ITS may refer to all modes of transport, EU Directive 2010/40/EU defines ITS as systems in which information and communication technologies are applied in the field of road transport, including infrastructure, vehicles and users, and in traffic management and mobility management, as well as for interfaces with other modes of transport (European Parliament, 2010).

ITS products and services comprise various applications. Alberta Transportation (2014) divides ITS applications into the following eight major functional categories:

1. Traveler Information Services (e.g. traveler advisory systems, etc.)
2. Traffic Management Services (e.g. advanced traffic signal systems, freeway incident detection and management systems, etc.)
3. Public Transport Services (e.g. electronic transit schedule information, GPS tracking of bus movements and locations, etc.)
4. Commercial Vehicle Operations (e.g. weigh-in-motion, electronic truck clearance at vehicle inspection stations and border crossings, etc.)
5. Electronic Payment Services (e.g. electronic toll payment, transit fare payment, etc.)
6. Emergency Management Services (e.g. improving emergency vehicle response time by fleet tracking, route guidance and signal pre-emption, etc.)
7. Vehicle Safety and Control Systems (e.g. in-vehicle technologies such as onboard computers, collision avoidance sensor technologies, etc.)
8. Information Warehousing Services (e.g. traffic safety data collection, archived data management, etc.).

The Information Technology & Information Foundation (ITIF) categorizes ITS applications into five primary groups, i.e. Advanced Traveler Information Systems (ATIS), Advanced Transportation Management Systems (ATMS), ITS-enabled Transportation Pricing Systems, Advanced Public Transportation Systems (APTS), and Fully integrated ITS Systems (VII and V2V Systems) (Ezell, 2010). Table 1 lists various ITS applications presented in seven categories (the previous five categories with two additional categories: Commercial Vehicle Operations and Value added services).

Table 1. Different ITS applications and services (Berkers, 2013)

Category	Services and applications
Advanced Traveler Information Systems (ATIS)	Real-time Traffic Information Provision
	Route Guidance/Navigation Systems
	Parking Information
	Roadside Weather Information Systems
Advanced Transportation Management Systems (ATMS)	Traffic Operations Centers (TOCs)
	Adaptive Traffic Signal Control
	Dynamic Message Signs (or "Variable" Message Signs)
	Ramp Metering
ITS-Enabled Transportation Pricing Systems	Electronic Toll Collection (ETC)
	Congestion Pricing/Electronic Road Pricing (ERP)
	Fee-Based Express (HOT) Lanes
	Vehicle-Miles Travelled (VMT) Usage Fees
	Variable Parking Fees
Advanced Public Transportation Systems (APTS)	Real-time Status Information for Public Transit System (e.g.
	Bus, Subway, Rail)
	Automatic Vehicle Location (AVL)
	Electronic Fare Payment (for example, Smart Cards)
Vehicle-to-Infrastructure Integration (VII) and Vehicle-to-	Cooperative Intersection Collision Avoidance System
Vehicle Integration (V2V)	(CICAS)
	Intelligent Speed Adaptation (ISA)
Commercial Vehicle Operations	Fleet management
	Freight management
Value added services	Theft Recovery
	Connected Car
	Vehicle Sharing
	Equipment Theft Recovery

As reported by Transparency Market Research (2013), the global ITS market is expected to grow at a CAGR (Compound Annual Growth Rate) of 11.1% from 2013 to 2019. PRNewswire (2013) furthermore explained that Advanced Transportation Management Systems (ATMS) used for traffic control and management was accounted for the largest revenue share of 42.1% of the overall ITS market. In addition, the latest ITS market report published by Marketsandmarkets (2014) projected an expected growth at a CAGR of 11.57% from 2015 to 2020 by reaching $33.89 billion in 2020.

By geography, North America held the largest market share (42.2%) in 2012 due to increased investment in ITS solutions from both public and private sectors. Asia-Pacific (accounted for $3.12 billion in 2012) is the fastest growing region in the global market through the estimated period and massive investments are expected from developing countries including India, China, Thailand and Malaysia. Furthermore, extensive development of ITS markets is expected in Middle East, Africa and South America as countries in these regions are investing in the transportation sector to support their economic growth (Transparency Market Research 2013).

2.3. Building a competitive advantage through a business model

The concept of business model appeared during the late 1990s when companies acted open-mindedly to formulate new ways of doing business through e-commerce. The concept is frequently blamed for resulting disappointment for many of those who were part of the internet boom. As the business model concept was blatantly misused and misunderstood by innovative entrepreneurs, the concept should not be blamed for those past failures. Instead, every successful company is built on a sound business model, whether that model is explicitly understood and articulated or not (Teece, 2010; Johnson et al., 2008; Magretta, 2002).

Several researchers have presented some definitions for business models. For example, Magretta (2002) defines business models as the stories that explain how enterprises work. A successful business model represents a better way than the existing alternatives in a certain business and answers fundamental questions such as "Who are the customers and what do they value?", "How is money generated in this business?", and "How can the value be delivered to customers at an appropriate cost?" Business

models force managers to think thoroughly about their businesses and focus their attention on how well all the elements of a system fit together as a whole.

Some research has defined business models more formally. Most of that seem to relate to the company's core logic for creating and capturing value, which are the most fundamental functions that all organizations must perform to remain viable over an extended period of time (Shafer et al., 2005). For example Osterwalder and Pigneur (2013) state that "a business model describes the rationale of how an organization creates, delivers, and captures value." Shafer et al. (2005, p.202) propose a similar integrative definition for a business model as "a representation of a firm's underlying core logic and strategic choices for creating and capturing value within a value network".

Business model innovation is the only way to avoid competition even temporarily, as it is business models – not products or companies – that compete against each other (Hamel, 2000). Additionally, a business model itself can give a competitive advantage if the model is sufficiently differentiated to meet particular customer needs and is hard to replicate (Teece, 2010; Morris et al., 2006). However, Chesbrough (2010) notes that even though companies have made extensive investments and have progressed for exploring new ideas and technology; they often have a lack of ability to innovate their business models. Johnson et al. (2008) also state that only some companies understand their existing business model well enough to develop it further and to know when a new business model is required. New ideas and technologies must be commercialized via a suitable business model otherwise they have no objective value and their economic value will remain latent (Chesbrough, 2010).

There is no single correct definition of the elements of a business model. However, literature review reveals that most of the business model researchers (e.g., Sahlman and Haapasalo, 2011; Johnson et al., 2008; Suikki et al., 2006; Morris et al., 2005; Hedman and Kalling, 2003) seem to end up with a very similar set of elements, i.e. *value proposition and offering*, *value creation system*, and *revenue model* (i.e., value capturing) (Pekuri 2015). These three elements (Fig. 3.) give an explanation of how value is created. The only common thing for all the business model definitions is the fact that a business model always begins from the customer value. The ultimate purpose for a buyer and seller engaging in a relationship is to work together in a way that creates value for them. Sometimes value is just defined monetarily, whereas nowadays a broader definition is utilized which also includes non-monetary revenues, such as competitive advantage, competence, market position, and social rewards. In short, the value is a relationship between benefits and sacrifices (Barima, 2009; Ahola et al., 2008; Möller and Törrönen, 2003; Walter et al., 2001).

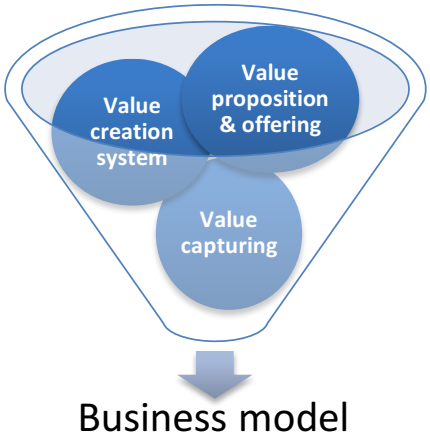

Fig. 3. Business model elements.

Successful companies have always found the way to create customer value (Johnson et al., 2008), but only some companies have been capable of defining or measuring the value created to their customers (e.g., Anderson and Narus, 1998). To make customers focus more on total costs (i.e., mid- or long-term costs) rather than on acquisition price only, a supplier must have a clear understanding of what is of value to their customers. The offering covers the output of the value creation system including both products and services. Companies strive to solve customers' problems and satisfy their needs with the offering and hence the primary objective of any offering is to provide value to a particular customer segment (Osterwalder and Pigneur, 2013).

Many companies ignore the last part of the business, i.e. value capturing (Shafer et al., 2005). Unfortunately, this means that companies also fail to capture revenues relative to the value they create. Value capturing measures a company's ability to translate its value proposition into revenue streams that are essential to its long-term survival (Osterwalder, 2004). Usually, companies do not have just a single revenue stream, because they may have different pricing models for different services or products. Therefore, their revenue models should be in line with the markets they compete in. The applied pricing methods, like

fixed or dynamic pricing, mostly have a significant difference in making revenues which can be used in avoiding direct price competitions (Osterwalder, 2004).

3. The MOBiNET ecosystem

3.1. Method and empirical scope

In this paper, we use the ongoing development activity of MOBiNET ITS business platform as a qualitative and illustrative case study to analyze business models for an ITS e-marketplace. Illustrative case studies are descriptive and they provide readers a common language about the topic (Davey, 1991). Illustrative case studies also aim to describe how the results fill gaps in existing theory (Keating, 1985).

To realize the full potential of ITS deployments, a number of research areas merit continued attention and effort, notably including "construction of an e-marketplace in traveler services, based on open platforms to collect, aggregate and exchange traffic and transport data from various sources, with an emphasis on quality, standardization and cost-efficiency" (European Commission, 2012). One activity addressing this need is the MOBiNET project (http://mobinet.eu/) which is co-funded by the European Commission under the 7th RTD Framework Programme. The aim of the project is to have a positive impact on the European ITS market by developing, deploying and operating the technical and organizational foundations of an open, multi-vendor platform and e-marketplace for Europe-wide mobility services.

This study uses data and knowledge gathered during the project along with relevant literature as the basis for the analysis. MOBiNET works as a good example case for a broader business analysis as it addresses the needs of various stakeholders in a value chain from providers of enabling technology and offering service development tools to business users and end-users. In addition to this, the project consortium includes service providers, technology providers, automotive industry, public authorities, research organizations and user groups. Taking into account the needs, requirements and business interests of the different stakeholders, the MOBiNET platform offers functionalities for B2B as well as B2C service provision, discovery and development, including machine-to-machine interfaces for accessing services, managing the use of different communication technologies, management of identities and clearing financial transactions, component managing the interaction between end-user device and the platform, and tools for collection and brokering of data from different sources (Fig. 4.).

MOBiNET sees a clear need for such a Europe-wide platform since there is fragmented and slow deployment of mobility services despite the fast development of ICT. An ITS platform such as MOBiNET – an e-marketplace with a technology base supporting the creation of new solutions and exchange of content and services – aims to open the door to harmonized services, seamless connectivity, instant access to transport data, single subscription and billing for travelers and a one-stop shop for mobility services ranging from various sectors, transport modes and user groups. However, to work efficiently and to create value for its customers and participants, an e-marketplace needs an applicable business model, which finding and defining seem to be challenging.

Fig. 4. The general concept of the MOBiNET e-marketplace.

This paper focuses on the overall value creation logic in business networks around an ITS platform. While it is based around MOBiNET as a study case and an illustrative example, the analysis is done independent of technical implementations or specific purposes, and therefore the results and findings can be considered applicable for other platforms with a similar offering or similar target audience. The same general rules apply to ITS service business and hence it does not matter what particular service platform and e-marketplace is being addressed.

This paper does not consider more specific details such as approval and registration processes, and potential pricing and commercial models for different actors; or types and quality expectations of services allowed to be published through the platform. Although the issues above are important, first we must understand the interaction of different user groups and the influence of any decisions that make the ITS platform less appealing for some stakeholders.

3.2. Actors of an ITS platform

The following sections analyze the different actors by classifying service providers and users along the dimensions of their role in the network and the nature of their target markets, which mainly are business-to-business (B2B) and business-to-consumer (B2C). The roles and the markets are divided into more specific groups of service providers, consumers, developers and other beneficiaries of the platform, including the platform (e.g. MOBiNET) itself and the organizations involved in the governance of it. Table 2 summarizes and describes the different actors of a B2B2C ITS platform, MOBiNET in this particular case, and their use of it.Moreover, the sub-sections below further discuss the roles of each actor and the value they bring one another and therefore to the platform and e-marketplace as a whole.

Table 2. Actors and roles of an ITS e-marketplace platform for business user and consumers

Actor	Definition	Way of using the platform
B2C provider	Publishes a Service Description of an existing end-user service or application.	Publish end-user services to e-marketplace that offers a channel to reach end-users and to market their services. Services have no interaction with platform components.
B2B (technology/ service) provider	A service provider who publishes a Service Description of an application programming interface (API)	Publish services for business users (e.g. data, software tools or enabling technologies) to the platform. No interaction with platform components.
End-user (private consumer)	A private consumer uses the platform as an e-marketplace (i.e., service directory) to search where to get a mobility-related service that has no interaction with platform components.	End-user's (a private consumer) main use for e-marketplace is to find easily services most suitable for his needs.
B2B user as a consumer	A business user who looks for a provider of specific data set. No interaction with platform's machine-to-machine components.	A business consumer is comparable to a private consumer. The platform offers a centralized place for business consumers to look for services that may or may not use platform functionalities.
B2B user as a service developer	Using platform functionality (e.g. component APIs) to develop a service which can be offered to customers (B2B and/or B2C) outside the platform.	A service developer benefits from the functionalities and APIs offered by the different platform components that enable to enhance/develop their services.
Public Sector Provider	A public authority publishing a dataset to the platform.	A public organization can provide both B2B and B2C services and content. Public sector provider is essentially a subset of service providers.
Research Organization	If a platform were to handle, e.g. user data, it could be used for research purposes. May have a role as a B2B provider, consumer and developer.	Can use the platform like other business users (service providers, consumers or developers). Research organizations can offer services to further developing platform and e-marketplace.
Platform as a B2C Provider	Platform could offer a set of reference end-user services to ensure that it has an offering to fulfill most common mobility service needs of customers.	Platform could offer its own end-user services through the e-marketplace (i.e., service directory) just like any other B2C provider.
Platform as a B2B Provider	Platform can offer services such as data quality assessment as a set of commonly needed tools.	Offer a set of reference services to ensure the platform has an offering to fulfill most common needs of business customers. Services offered can be seen as either integrated parts (or components) of the platform itself or as supporting services.
Platform owners as providers or consumers	An organization involved in the platform governance and operation can offer their own mobility services or content through the platform. The organizations involved in platform ownership can be in the role of any other business actor.	The organizations involved in the management and governance of the platform are a subset of service providers and users. The involvement in the platform ownership or operation does not imply access to any data, information or functionalities of the platform that is not available to other business actors that would use it.

3.2.1. B2C provider

B2C providers are considered here as actors who publish and provide end-user services through the platform which, therefore, offers B2C providers a channel to reach private end-users and to market their services. Hence, services published by the B2C

providers have no active interaction with either platform components or functionalities, or content offered by B2B providers. B2C providers include any actors offering B2C services (e.g. private companies and persons, public authorities and research organizations). A B2C provider can also act as a B2B user as a service developer or a business consumer.

3.2.2. B2B provider

By B2B provider we mean all the service or technology providers whose main objective is to provide and offer something to the platform and its business participants. In other words, B2B providers are the upstream players in the value network of the platform and they benefit from being able to make their services more easily discoverable and accessible.

As an e-marketplace that tries to enable discovery of different types of services, allowing B2B providers to join and publish their services through the platform seems obvious. A significant novelty value for an e-marketplace is to bring together business actors in order to enable better service coverage across borders and interoperability between devices and systems. Without B2B providers, the concept should be focused on 1) platform functionalities and tools for service development, and/or 2) B2C services. Such focus and offering would make it more comparable to mobile app stores (e.g. Apple App Store and Google Play), although covering a broader set of different kinds of end-user services (i.e. not just mobile applications, for example).

Similar to the case of B2C providers, the more B2B providers (and their services) are present, the more other actors benefiting from their offering are attracted to the e-marketplace. A centralized directory of mobility content is particularly useful for service developers who can find and compare the offering of different providers and in the various regions – and with other functionalities offered to service developers by the platform, connect to and utilize those services more efficiently or in completely new ways. A variety of different types of mobility content and services easily accessible through the same platform can foster more creative combinations of services and innovation. So, in addition to increased visibility to the target audience, a platform supporting different types of B2B services can lead to finding new and even unexpected customers.

The only downside of having a platform for B2B providers could be considered the increased competition and visibility of competitors for those service providers who have already cornered a certain market. From the point of view of everyone else, however, increased offering and competition should be a positive thing.

3.2.3. Private consumer as an end-user

The role of end-users (i.e. customers for B2C services) is rather straightforward. If the platform is to support B2C providers, i.e. make the discovery of end-user services possible, end-users need appropriate functionalities and support as well. If the discovery of B2C services were to be omitted from the platform focus, then there would be no role for end-users either.

The B2C market is expected to have an indirect effect on the B2B market as well. B2C services can be based on B2B offering, and a common platform can support the discovery of one another. Therefore, more B2C providers (who are attracted to the platform for reaching end-users) should lead to more customers for B2B providers.

Supporting end-users requires the e-marketplace to develop and maintain interfaces for finding the B2C services as well as providing customer support.

3.2.4. B2B User as a business consumer

There should be no disadvantages whatsoever in allowing business customers join an e-marketplace as they are naturally a primary target group (in addition to end-users when including B2C markets). However, it is important to distinguish between different types of business users.

When considering B2B users as just consumers of offered services without taking into account what they use it for (e.g. developing new products and offering them to their own customers), we can look at an e-marketplace from just the business customer's eyes. For them, the purpose of an e-marketplace is to find new and alternate suppliers to improve own efficiency (through savings in cost, time and effort) (Rask & Kragh 2004).

While the business consumers can also have other roles, such as service developers and service providers, it is important to distinguish them as using different elements of the platform. For example, pricing, terms of agreement and joining process could be different for business consumers using the platform to find services and service developers using platform components as an enhancing part of their services.

To enable more services to be discovered by customers, it is important to not only allow customers to join the community to find and consume services but to also make sure it is as easy as possible. If a customer's experience with the platform is easy and useful, it is more likely they will continue using it and also attracting more service providers. As Rask & Kragh (2004) point out, one of the reasons for many suppliers to participate in e-marketplaces is because they are asked to do so by existing customers.

3.2.5. B2B User as a service developer

Service developers can be a central target group for an ITS platform that offers anything more than the ability to publish and discover services by others. Developers are the ones utilizing the different platform components and functionalities in accessing content, creating new services, B2B or B2C, and enhancing the functionality of existing ones. Being the main customers for platform offering, it is clear that they should be allowed to join the community and use the platform and its components.

As service developers are the ones using various technical features of the platform (while others tend only to use offered graphical user interfaces), they are also the ones for whom different restrictions and usage rights can be defined. Different

functionalities, for example, can be available with different pricing schemes (e.g. free, subscriptions, usage based). This, however, is a matter of revenue models and technical restrictions, and in general service development should be welcomed in order to grow the user base and service offering in the e-marketplace.

3.2.6. Public Sector Provider

For the public sector, the main benefit and use of an e-marketplace is enabling and supporting the creation and supply of services. Here, we consider the public sector from the service provider point of view. As a business consumer, there is no clear difference whether the customer is a public authority or any other type of organization. When it comes to service provision, there is a slight difference from other service providers in that the public sector is not after a profit for selling their data, but rather after societal benefits through enabling better services to be offered to citizens (OECD 2015).

For enabling service development, attracting users of data, and to generate a large offering of content, the public sector has a lot to offer. The public sector has a significant role when it comes to transport and mobility information and data (e.g. data about infrastructure, public transportation, road weather, and traffic status).

"Public authorities should play their part in promoting markets for online content. The challenges of convergence should be addressed in all reviews of public policy, including tax matters. For example, governments can stimulate content markets by making public sector information available on transparent, effective, non-discriminatory terms. This is a major source of potential growth of innovative online services. The re-use of these information resources has been partly harmonized, but additionally public bodies must be obliged to open up data resources for cross-border applications and services." (European Commission 2010)

A significant benefit of including public sector and their contents in the e-marketplace is that it supports the main goal of enabling the creation of services that are interoperable across borders. In addition to being more freely available to be re-used, public sector data is more inclined to be interoperable with other regions and countries due to European policies, such as supporting standards (e.g., DATEX II) to enable coordinated ITS implementation, traffic management and development of seamless pan-European mobility services. (Commission of the European Communities 2008)

In some cases, data provided by the public sector may cause distortion of competition if public offering is free while private content providers are offering similar services (e.g. road weather data or traffic flow information). European policy considers making documents and data held by the public sector a fundamental instrument for extending the right to knowledge, and that they should in principle be made available for commercial and non-commercial use for free or only charging marginal costs (covering the cost of collection, production, reproduction and dissemination) (European Parliament, 2013). Following this principle, national strategies and policies regarding the use of data collected through public funds recommend it should be easily and freely available for anyone to access (e.g. Finnish Ministry of Transport and Communications 2011).

However, it is important to remember that the data produced and stored by the public sector should already be available without ITS platforms and e-marketplaces, and therefore the main difference with them would be making it more easily accessible, not introducing a new service and competitor to the market. Therefore, any disadvantages of including public sector and its offering are questionable. Furthermore, the public sector is also a customer for private companies collecting and producing data as well as providing other services (e.g. ITS systems).

3.2.7. Research organizations

Research organizations as participants are quite neutral; they do not bring major benefits or disadvantages to anyone. Essentially research organizations act like any business users (service provider, developer or consumer). International (pan-European or global) ITS platforms can provide opportunities for research organizations to 1) have an effective and easy way to finding available services of different kinds in the various regions, 2) reach large numbers of end-users for feedback from testing and piloting services, and 3) potentially enable new, more interoperable and integrated ways of collecting more data about user behavior and patterns or service usage.

There should be no reason to exclude specifically research organizations from ITS platforms and e-marketplaces. The same reasoning as for any other business users applies to them as well. The only distinction from other business users could be considered the fact that some data can be available to be used for research while not offered freely for other purposes. For example, a central ITS platform may have the potential for collecting data from a large variety and volume of users. With appropriate privacy practices and user consent, sensitive private data could be used for research purposes to obtain new knowledge (European Council 2015). However, this provides little reason for categorizing research organizations as a specific user group and should rather be considered case-by-case if such needs or interest occur (e.g. co-operation in research projects by utilizing the ITS platform).

3.2.8. Platform as a B2C provider

The organization that owns the platform itself as a B2C and/or B2B provider is perhaps the most interesting role in this particular network, or ecosystem, for the simple reason that they are also running and managing the platform. Competing with B2B and B2C providers may be perceived as an unfair advantage and cause some problems. It must be ensured that the competition between commercial (external) services and platform services is fair and they are not favored in any way. Potential concerns include:

- platform's funding and pricing principles (i.e. who pays for what, what revenue is used for developing and maintaining platform's own services)
- privacy issues and user data (e.g. knowledge about customer relations), and
- unfair promotion opportunities (e.g. platform could recommend and advertise its services ahead of those of others).

With fair, trusted and transparent rules, privacy policies and legal terms, a balanced coexistence should be achievable. With mobile devices, for example, device manufacturers and operating systems providers commonly provide their own applications by default while other service providers can offer similar applications to the same ecosystem (e.g. Apple App Store for iOS and Google Play for Android).

To the external service providers, the benefits are pretty much the same as brought by other firms offering B2C and B2B services; more services attract more users and therefore also service and technology providers. A clear benefit of the platform offering end-user services would be to ensure a reasonable starting point for basic services with certain quality expectations to start attracting end-users. It is, after all, difficult to start populating a marketplace before there is any demand for suppliers.

3.2.9. Platform as a B2B provider

The distinction between the functionalities of the platform components and separate B2B services is not clear. It can be argued that, for example, software tools that integrate data from different sources or evaluate the quality of data would be B2B services. However, they can also be seen as integral parts of what a platform should offer as the basis and support tools for other businesses – a reason to join and use the platform because of the value and benefits provided by such services.

If a platform decides to provide own services, it can bring benefits to the further development of the platform as well as increase its value and appeal to potential users. In the development and realization of own services, the platform functionalities can be both effectively used and further developed and tested. This helps to understand the possibilities and shortcomings of functionalities better and to identify elements that would better support the business of other users as well.

In addition to providing a set of commonly used core tools as a seed or foundation for the platform, a platform can benefit from its central position between end-users and many service providers. For example, platform components utilized in different services can generate new data from users or service usage that could be offered either as is or as more processed information services (e.g. for market research, statistics and targeted marketing).

If the provided services are unique and something that is not otherwise available in the market, it could complement the offering of other B2B providers and attract B2B users. Platform using any data gained from its users or about its users is a matter that needs to be handled in a transparent manner following proper privacy and security regulations.

3.2.10. Platform owners as providers or consumers

The assumption is that individual stakeholders involved in the organization and governance of the platform do not gain any unfair advantage from their position, and should, therefore, be allowed to use the platform like any other businesses. Being a part of the platform governance or operation does not grant access to data or platform features that would not be available to other businesses using the platform. Potential benefits over other users would be related to being aware of discussions and plans, and influencing decisions regarding the future of the platform and its focus.

4. ITS platform business models

Like business ecosystems in general, ITS platforms and e-marketplaces involve various actors with different kinds of roles and interdependencies. According to Moore (1993), a business ecosystem is a network including a bunch of collaborating organizations and actors. Iansiti and Levien (2004) define a business ecosystem as "loose networks – of suppliers, distributors, outsourcing firms, makers of related products or services, technology providers, and a host of other organizations – that affect and are affected by the creation and delivery of a company's offerings." It can be summarized that through interaction, organizations can co-develop and co-evolve their competencies, discover innovations and eventually increase the customer value. After all, in many countries ITS investments, in general, are viewed as a platform for industry development and new emerging products and services, even the ones that many can barely be imagined today (Ezell, 2010).

When it comes to the business model of ITS platforms and e-marketplaces such as MOBiNET, it can be argued that no stakeholder exist who should not be able to provide services through them, because, in the end, the more there are different kinds of service providers the better. More providers and services attract more users and vice versa. As noted by Albrecht et al. (2005), many hubs and B2B e-commerce platforms have failed due to not achieving a critical mass of buyers and sellers participating. With this in mind, ITS platforms should aim to grow a sufficient customer base without limiting who the potential users would be, unless the focus is reshaped towards a specific market segment (whether that be, for example, deciding between B2B or B2C markets, a specific transport sector, or between data and other types of services). Besides, the fewer focal actors there are in the ecosystem, the more vulnerable it becomes in terms of entry and exit of these particular participants, as substitutes may be difficult to find or non-existent. Alternatively, when the number of actors is low, the ecosystem becomes simpler and the interdependencies between the actors increase (Leviäkangas et al. 2014).

4.1. Potential business models of an ITS e-marketplace platform

As the previous sections have indicated, the potential ITS market is significant and growing for providers of various kinds of services, systems and content, each of whom needs to establish a business model that suits their own offering and the environment. ITS platform (such as MOBiNET) that aims to serve as a central e-marketplace for different types of actors must support and comply with the business logic of its users. Therefore, it is important to establish the business relations of various kinds of participants and the value they bring to one another (see Table 2 above).

MOBiNET, as an example of ITS platforms and e-marketplaces, can be referred to as a complex platform environment used by many actors, each one having different objectives, from selling contents and enablers to building ITS services with the capabilities offered by the solution. Currently, it is seen that there may be three high-level business models and roles for the platform and the MOBiNET Legal Entity (MLE) that governs and operates it, as defined below (Fig. 5.) (Bena et al. 2013):

- **Pure MLE2B role**: e-marketplace just for B2B services (excluding functions marked with dashed lines)
- **MLE2B and a service oriented MLE2C role**: includes B2C service discovery and provision (1)
- **MLE2B and a commercial MLE2C role:** includes MOBiNET offering its own services (2)

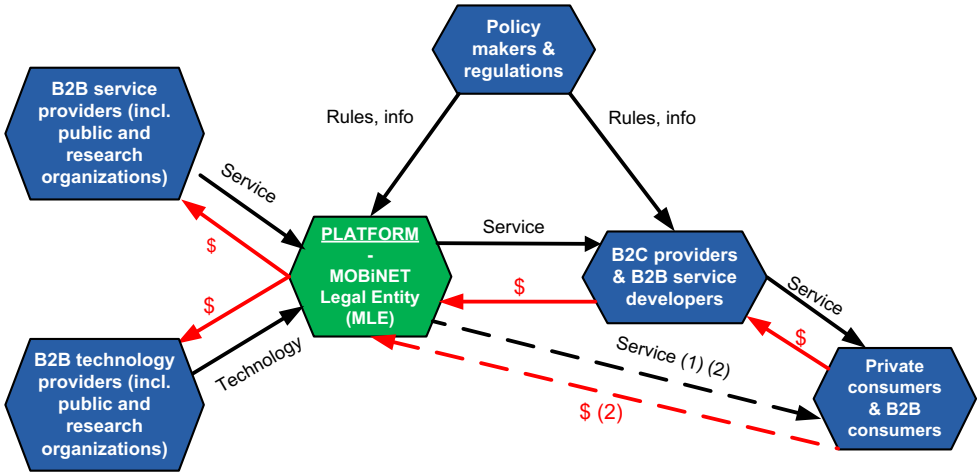

Fig.5 Initial business model alternatives for MOBiNET.

4.1.1. Pure MLE2B

In this case, the B2C service provider or B2B User manages the business relationship with their end customer. The MLE does not have any direct end-user relation, but it has a key role in the market development process acting as 1) an aggregator to reach critical mass of content and customers, 2) a market enabler via its platform functionalities and B2B services, and 3) a focal point where service provider can meet and define common rules and interfaces.

Through MLE2B, the e-marketplace allows different participants, even competitors, to work together to facilitate a timely and cost-effective deployment of ITS services and products. By using the MLE2B business model MOBiNET can provide tools for service development and brokering of content and services and hence help to improve the quality, interoperability and cost of services and products.

The customers of MLE are the B2B service providers, the B2B technology providers, the B2B service developers and the B2C providers because they use the capabilities provided by the framework and, in some cases, participate in the processes that define MLE rules and the interfaces. The MLE does not have any direct end-user relation.

Figure 5 shows a high-level model, but ITS services and related relationships can be very complicated involving many participants, so some elements have to be further explained:

- B2B service and technology providers can offer their own products and services through the MLE marketplace or directly to the B2B users.
- Some providers are not involved directly in the provisioning of a particular service, but they provide enabling infrastructure for a set of services, such as roadside unit providers and managers, onboard unit providers, vehicle manufacturers, and connectivity providers.
- B2B service developers can buy some service components directly from the B2B service and technology suppliers (e.g. mobile network connectivity from a mobile network operator, or onboard devices).
- Payment/transaction models can be very different. For example, some B2B service provider may not use the functionalities and framework offered by the platform to manage transactions with partners or users, while others might want to have a full payment and reconciliation service.

4.1.2. B2B and a service oriented MLE2C role

In this case, the business relation is similar to the one before, but, in addition, the MLE also has a direct connection with the end-user, but only from a service discovery (i.e., *"e-marketplace"*) perspective. Through the e-marketplace, the end-users can search and buy services and products (similar to Google Play market, Amazon, eBay, etc.). The MLE itself, however, does not sell the services directly but only shows via which service providers the service can be acquired. Therefore, the business relationship is owned by the service providers, and the money flow is between the service provider and the end-user.

4.1.3. MLE2B and a commercial MLE2C role

MLE could act as a service provider and developer as well, similar to, for example, Amazon or Apple who sell their own services among offering the discovery of similar services by other providers. Although it might be contrary to the interest of some commercial service providers, acting as a service provider serves the objective of expanding the availability of ITS services.

MLE could potentially sell services to end-users and manage the business relationship with them directly. To do so, it will need all the capabilities to manage customers and sell services to consumers (such as a call center for claims by the end-users).

4.2. Discussion on business model choices

Positioning seems to be a common motivation and driver for buyers and suppliers participating in an e-marketplace and a platform; buyers can have access to a larger and more diversified pool of suppliers allowing them also to obtain relatively lower prices, wider product assortments and better quality (Rask and Kragh, 2004). This finding is supported by Weiller and Neely (2013) who states that in ecosystems, the business models of individual companies are partly dependent on the ecosystem they are working in, but at the same time are impacting on it too.

The biggest question on who should be allowed to offer services is the platform's possible role as a B2C or B2B provider. It would put the platform operator in a dual role providing both the platform as well as other services that may compete with the offering of others via the same e-marketplace. This raises the following concerns and possible challenges:

- The platform operator may have an unfair competitive advantage if it offers B2C and B2B services (e.g. easier to promote/make visible its services) which may discourage external service providers from joining
- Biased service recommendations for platform's own services
- If there is too much emphasis on providing B2B services, end-users may not find the platform
- Broader focus (both B2C and B2B services along with the platform itself) requires more resources, e.g., customer support services and help desk, and it can also take attention away from operating the platform itself

Despite the concerns and potential challenges, there are successful business cases where different platform providers have altered their business model and started to provide own services. For instance, application marketplaces of Google and Apple include own applications (even pre-installed on user devices and operating systems) among the offering of similar applications by others. This approach ensures that the competition is open and market oriented. Obviously, the rules must be clear and fair for all the participants, and at least a platform provider should not have an intent to be partial towards external service providers because it would inevitably harm their own business.

Even with the examples of Google and Apple, their approaches for the ecosystem are very different. Apple is delivering a very focused product and closed environment whereas Google's approach is more about sharing creativity, partnerships and making technology available for everybody (Mian et al. 2011). Google's more open approach is based on the fact that the consumer will choose the open competitor because more people involved means more investment and services (Zakaria 2011). Few limitations on participation and open competition have been a strategic success as indicated by the rapid growth of Android's market share (Gartner, Inc., 2011).

Other examples of providing both third party and own services are Amadeus and Amazon who have changed their business model and logic a lot over the years. Amadeus started offering B2B distribution and IT solutions – including itinerary planning, fare-searching, reservations, ticketing, airlines schedule and inventory control, passenger check-in and departure control and certain post-travel solutions – for travel providers, travel sellers and agencies, and corporate travel buyers, but currently also private consumers can book and buy third party services through their websites. In other words, the B2C relationship is still owned by the third party service provider but Amadeus provides their own search engine that finds and compares different travel options and hence helps consumers in decision making. (Amadeus IT Holding, 2012.)

Compared to Amadeus, the changes in the business model of Amazon have been more fundamental and providing own B2B and B2C services is becoming a vital part of their business. In the beginning, 1995, Amazon offered online retail and a marketplace as well as logistics services for new and used consumer products (e.g., books, DVDs, games, software). In 2007, Amazon published own B2C product, Kindle e-book reader that enables users to download, browse, and read e-books, newspapers, magazines and other digital media. At the same time, Amazon utilizes Kindle platform in B2B services as well by enabling direct publishing and selling through it (Dudley 2007). Additionally, Amazon provides a cloud-based service called Amazon Web Services. Originally developed as a side business, Amazon decided to lease out its own server space to other

companies and individuals because it is a small effort to manage those services for others while maintaining a large number of own services and servers (Amazon, Inc., 2015).

In terms of these four illustrative examples of business concepts (Google, Apple, Amadeus and Amazon) and the findings of this particular case study of MOBiNET, it seems that a B2B2C business model covering both third party and own services ["MLE2B and a commercial MLE2C role", as defined for MOBiNET] would probably be the most qualified for many ITS platforms and e-marketplaces. As Ezell (2010) has stated: "the most successful countries view their ITS investments as creating a platform through which the private sector can develop value-added products and services." However, providing solely third party services is not the whole truth, and if the market position allows, offering own services (B2C and B2B) – especially the ones based on the data and information obtained from the platform and its users – can even be considered advisable for ITS platforms and e-marketplaces. Besides, private companies are often highly focused on their core competence which inherently limits the target markets whereas platforms do not need to be specialized but can serve different sectors and markets that may benefit from it.

5. Conclusions

A business model requires a thorough investigation to work effectively and the overall value creation capability of the platform can only be managed and developed if the platform operator understands how the whole system is currently creating value for its customers (Pekuri et al., 2014). When defining the business model for an ITS platform and e-marketplace, it starts with identifying the potential customers and markets (i.e., B2B, B2C or both) and how their needs are satisfied (i.e., value proposition and offering). When the needs and requirements are clear, the value creation system and network point of view must be assessed as well: What (e.g., data, technology, service) and who (i.e., value network actors) is required to satisfy the customer need. Only after these two phases it is possible to evaluate the revenue streams and value creation as a whole. Therefore, the different elements of business models should never be designed or analyzed in isolation (Pekuri et al., 2014).

Referring to the previous chapter, the value creation of an ITS platform can be considered to be based on three steps: it starts from the ITS provider network who offers intelligent systems, vehicles, infrastructure and services (i.e., *value creation system*). As stated earlier, value creation system is not a group of independent activities but an integrated whole of many interdependent ones. From the first level, value passes on to the user level appearing as safe, reliable, rational and flexible transport and mobility services (i.e., *value proposition/offering*). Ultimately, this translates into societal and economic benefits (i.e., *revenue model/value capturing)* (Giannoutakis and Li, 2011). Because a business model is about the system, all the levels must work; if some level does not work, the other levels are not functioning either. Figure 6 illustrates this interdependence of the levels through the value formation of an ITS platform, such as MOBiNET, at a system-level.

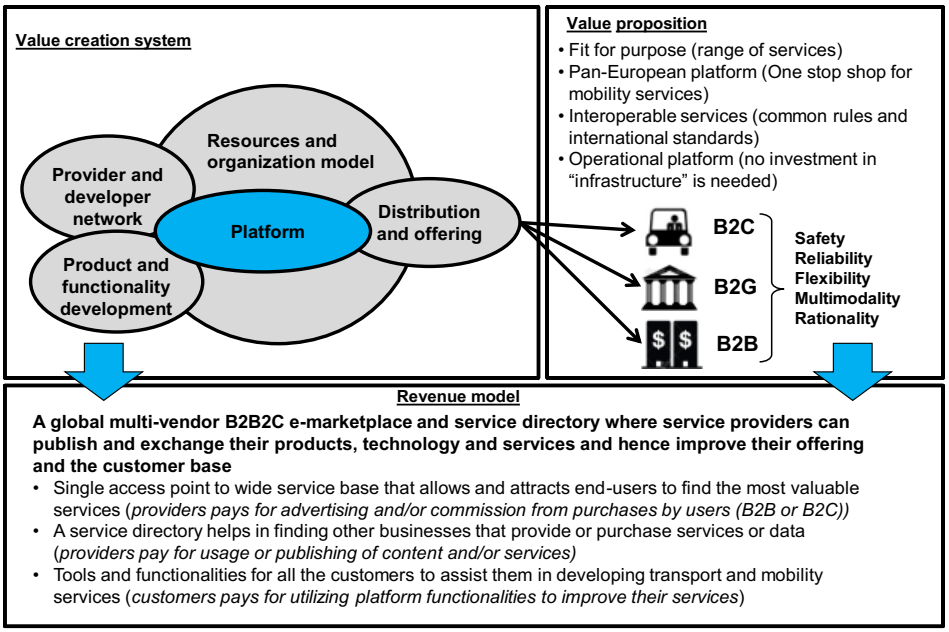

Fig.6 Generic business model of an ITS platform.

When the market potential and position of an ITS platform is discussed in more detail, it seems to have a broad range of 1) key partners and customers, and 2) revenue streams. A broad partner and customer base in different segments may indicate the business potential of the platform. From an ecosystem point of view, a number of partners and customers attract more

participants to join but also enable the extensive development and provision of interoperable and integrated services. Platform-based ecosystems are a new way of managing an offering of independent players. Ultimately this increases the added value for customers by concretizing the synergic benefits of the business ecosystem approach. This change towards high-value integrated solutions in other industrial fields has been witnessed in recent years (see e.g., Brady et al., 2005). These integrated solutions require not only a more comprehensive understanding of available solutions and customers' needs but also the exploitation of new revenue models to strengthen the interdependence of ecosystem participants. As being at the crossroads of providers and customers, a platform provider (e.g., MOBiNET) indeed has an essential role of being the one who can enable the development of these integrated solutions by providing a workable middleware environment.

In the case of MOBiNET, the revenue streams depend on the nature of provided or acquired services. Even though MOBiNET itself might also have its own B2C services, the main business interest is to be a marketplace and platform that enables marketing, publishing and easier integration of available ICT systems, technologies, services (both B2C and B2B) and content. Due to this, the business is focused on B2B sales, which can also be seen from the potential revenue streams. Revenues can base on the traditional one-off or fixed payments, but different kinds of periodic payments, pay-per-usage charges or commissions are valid options too.

Apparently, a platform provider needs various competencies to build up a platform, keeping it operational and making it successful. To exploit the collective know-how and synergic benefits that a platform may provide, platform providers have to build a sufficiently open and modular architecture which is supported by a feasible business model. Modularity sets requirements for the information and knowledge exchange, and interfaces (e.g., APIs) to enable flexible service integration within the ecosystem. For all these reasons, managing a platform-based ecosystem is tricky and crafting a suitable business model for it is a complex exercise since the scope is much wider than in the "regular" business between companies.

When it comes to the limitations and further research areas, they go hand in hand. As already mentioned, this paper did not consider the use of different platform components and functionalities, and therefore their impact on the proposed business models would be worth studying. Naturally the nature and types of published services may also have an impact on the business model of the platform, or on the contrary, the business model may set some kinds of constraints or rules for the services or service providers (e.g. quality requirements and handling of liabilities for safety or privacy related services).

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