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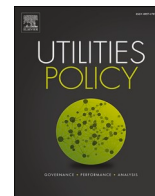


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From business models to value networks and business ecosystems – What does it mean for the economics and governance of the transport system?

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ABSTRACT

The entire transport sector is experiencing disruption on a global scale due to a number of drivers. These include the drivers of technology, changes in governance structures, a range of environmental challenges, and the need to provide mobility and accessibility regardless of social status or income level. To realize socio-economically worthwhile investments in the transport system, particularly where new technologies are involved, fresh views of the economy and investment are needed. This paper explores the relationship between business models, value chains and business ecosystems, and demonstrates a meta-model for transport-related services that involve profound incorporation of new technologies. The meta-model consists of four elements: end customer value (value proposition to the end user), business value (shareholder value), collaborative value (business value to the supply chain) and societal value (value creation in the supply chain and control of negative externalities). The meta-model is tested with a case study.

1. Introduction

1.1. Background

The entire transport sector is experiencing disruption on a global scale due to a number of drivers. The first to mention are the technology drivers, especially digitalization, which is probably the most significant technological trend the world is facing today. In pace with digitalization, also automation, robotization and seniorization are posing challenges to institutions and disrupting social and economic structures (Leviäkangas, 2016). This fundamental disruption is global, yet affecting individual citizens, and the transport sector is one of the most impacted areas.

Technology disruption is changing how businesses are run and how business actors are networking between themselves and in interaction with their customers in different tiers (i.e. direct customers, their customers, etc.). This means not only that business models are changing, but also that value chains and networks are facing a range of disruptive elements. Internet-based mobility services, for example, have brought new intermediary actors between operator services and end users. Hence the value chain has changed, which implies that the operator services might need to redefine their business models.

The second disruptive element is changes to governance structures.

Especially the emergence of public-private partnerships (PPP) in the ownership, financing and operation of transport infrastructures and services has changed the traditional logic of the business. Infrastructure projects and many transport and mobility services have become business investments where private investors seek opportunities for financial returns (Leviäkangas, 2019; Leviäkangas et al., 2016). Whilst there is no standard definition for PPPs, the common denominator is always the introduction of private ownership and/or management to the public service, be that infrastructure, services for the infrastructure, or mobility services for the end users. Typically, PPP also involves sharing of risk between public and private stakeholders.

It is easy to see the connection between technology and governance disruption, the former often enabling the latter, or the latter offering prospects for the innovative entrepreneurs and investors to make use of new technological possibilities. The value chains can be re-engineered with new technology, and traditional *modus operandi* can be changed into a new value chain topology. The new value chains and networks enabled by technology are often based on information-intensive value creation mechanisms and may be riskier than the old ones in many respects (Leviäkangas, 2011). The phenomenon is not only attributable to transport-related services but is generic and can be found in any information-intensive service case, including public information

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services, such as weather services (see e.g. Leviäkangas, 2009).

Third, the transport system is encountering a multitude of challenges with respect to environmental impacts. Transport is one of the most serious generators of environmental adversities and contributes significantly to climate change. Combustion engine emissions include carbon monoxide (CO), carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O) particles (PM), nitrogen oxides (NO_x), sulphur oxides (SO_x), and hydrocarbons (HC). These are all causing adverse impacts on the climate as well as on flora and fauna, and last but not least on humans. Significant improvements have been made largely due to improved vehicle and fuel technologies, but for example in Europe, transport is still responsible for a significant share of all the emissions. The European Environment Agency states bluntly that “the EU’s transport sector is not on track towards its climate goals” (European Environment Agency, 2018).

Finally, the transport system should be offering mobility possibilities to all citizens regardless of their social status and income level. Yet there are emerging issues related to transport poverty (Lucas et al., 2016) and the inclusiveness of the mobility system with regard to people’s accessibility to it. All of these issues – both their environmental and social aspects – pose challenges that call for new thinking in organizing the system, new technologies to improve accessibility and reduce environmental damage, and new approaches to develop transport on a systemic basis. In other words, the entire transport ecosystem needs to change, and will do so because of the environmental and social pressures and technological push.

The above points to the need for a systemic change while fostering some aspects – such as catering for new value chains and take-up of new technology – but controlling and reducing others, such as emissions. Therefore the system needs new governance [governance = “the way that [transport] organisations ... are managed at the highest level and the systems for doing this” (Cambridge Dictionary, accessed January 28, 2020; <https://dictionary.cambridge.org/>)]. According to a definition presented by the International Monetary Fund (IMF, 2007) and later adopted by the OECD (Corporate Governance Factbook 2019), governance can be understood as “the process by which decisions are made and implemented (or not implemented). Within government, governance is the process by which public institutions conduct public affairs and manage public resources.” So, in general, governance can be understood as ruling how decision-making is itself ruled.

1.2. Aims, scope and structure

This paper aims to show the association between business models, value chains and business ecosystems as a hierarchical structure. Since the purpose is to present a structure, the research methodology is constructive and heuristic. It is shown in this paper that in order to realize socio-economically worthwhile investments in the transport system, particularly when new technologies are involved, a novel perspective of the economy of investment is needed. By showing the hierarchy and logical architecture of a business ecosystem entailing value networks or chains and business models of the actors, this paper demonstrates – and hypothesizes – a meta-model for transport system services that involve the profound incorporation of new technologies. The presented model is generic and claimed to be the first of its kind. Its applicability for different purposes is to be further tested and developed by future research.

The model is tested using a case example of Cooperative Intelligent Transport System (C-ITS). C-ITS is a concept that includes multiple different services and applications under a single title. Such applications as advanced public transport priorities, park & ride systems, and automated driving exemplify the C-ITS portfolio (C-ITS Platform, 2017). Although the scope is limited to the transport system, it is not hard to identify features particularly related to the presented generic models that would be applicable to any technology system context.

The outcome for the practitioner community is based on the

presumption that business practitioners’ own business models, their position in the value chain, and understanding of the ecosystem in which they carry out their business can be developed and enhanced so that better profitability and service-product quality is achieved. For the business actors there is the significant question of finding the right partnerships, reducing business risks, and understanding the wider market demand that may extend beyond the immediate business sphere of the actor, for example when business-to-business (B2B) sales depend on the development of the aggregate end-user market. Furthermore, the business practitioners’ understanding of the wider external effects of their business, services or products should be easier with the ecosystem view. The ecosystem perspective contributes to the achievement of corporate social responsibility.

For public actors, it is essential to understand that whenever they are planning to invest in infrastructures, services or just innovation (e.g. through innovation procurement), they must have a clear perception of the capabilities of the business ecosystem – which includes all potential suppliers – to deliver what is wanted. Otherwise, unrealistic calls for tenders may be issued, effective competition may not be achieved, or sub-standard bids may be submitted. Also, it is evident that the ecosystem perspective helps the public actors to understand how the public good can be enhanced by facilitating the creation of business value throughout the value networks.

This paper is divided into the following sections:

- Section 1: Introduction; background and motivation of this paper.
- Section 2: Explanations and definitions of the key concepts; sub-model constructs of the business model, value chain and business ecosystem; these are based on reviewed literature and are well founded in the literature as individual concepts.
- Section 3: Construction of the meta-model, which is the main result of this paper, and assessing the implications of the meta-model on the governance and economics of the transport system; testing the model with a case study of C-ITS; this testing is of course tentative and far from exhaustive but should in the best case highlight the pros and cons of the model in terms of theoretical and practical usability.
- Section 4: Synthesis and conclusion; in this last section, the term ‘new economics’ and ‘new governance’ are introduced as the authors have understood the new thinking and approaches that are called for in the management and governance of transport systems.

2. Business models, value chains and ecosystems

2.1. Business models

A business model is the plan with the help of which a firm is able to make money. However, both academics and practitioners have gone far beyond the simplistic view of business models. Business model definitions are multiple and can be found in the business economics literature in abundance. The following examples demonstrate the variety of definitions reflecting the semantic differences between academics and practitioners:

“A description of the different parts of a business or organization showing how they will work together successfully to make money.” (Cambridge Business English Dictionary [14.5.2019])

“An abstract representation of an organization, be it conceptual, textual, and/or graphical, of all core interrelated architectural, co-operational, and financial arrangements designed and developed by an organization presently and in the future, as well all core products and/or services the organization offers, or will offer, based on these arrangements that are needed to achieve its goals and objectives.” (Al-Debei and Avison, 2010)

“Business model is a method of doing business, by which a company sustains itself and generates value.” (Chesbrough and Rosenbloom, 2002)

Osterwalder and Pigneur (2010) stated that “a business model describes the rationale of how an organization creates, delivers, and captures value” and presented one of the most cited definitions. A business model can be also something that can be defined as a construct rather than a semantic model. It can be said “that value proposition, value architecture, value finance, and value network articulate the primary constructs or dimensions of business models.” (Al-Debei and Avison, 2010). Osterwalder (2004) ontology [structure] of a business model is called the business model canvas (BMC). It shows the different elements of the business model with which a company can do the aforementioned: generate value and make profits. The canvas allows a design of different types of business models by splitting the critical questions into separate issues that build up the ontological structure. Fig. 1 illustrates the Business Model Canvas.

The generation of value is the crucial element. Unless somebody finds value in the service or product, it will not be used and certainly not be paid for. It is value that makes the service or product worth something. The BMC’s key partners, key activities and channels by and large define the value chain that is needed to create value. Customer segments, channels and value propositions are part of the marketing management functions of any firm or organization. Managing cost and resources are part of production management functions. Revenue management falls between financial and marketing management functions.

The early business model literature was focused on monetary value (e.g. Porter, 1985) and explicit profit generation. Whilst value chain analysis focused on cost reduction and competitive positioning and business models on profit making, there was a recognized need to extend this to address more complex value capture. Arend addressed this clearly in 2013, identifying that business models needed to address more than simple monetary outcomes, consider the gains and losses of all affected parties, and that better business models should not be a contest but rather a collaboration (Arend 2013). This leads the thinking to a network of business actors and their corresponding business models, and further to value chains and networks that are largely indebted to the works of Porter (1985).

2.2. Value chains and value networks

Whilst both Osterwalder. (2004) and Porter (1985) focused on the value creation process of a single company or organization, clearly individual companies form various configurations that work in a B2B relationship and deliver services and products to the end-user market, sometimes being linked with each other in the value creation process. Stabell and Fjeldstad (1998) came up with idea of a value network. They relied on as early works as Thompson’s (Thompson, 1967) by identifying that value networks rely on *mediating technology*. In other words, there are technology tools and mediating business processes that allow interactions and transactions between different actors in the network.

When digitalization occurs on the sides of both demand and supply, the value networks start to become useful in the attempt toward strategic positioning of each actor, as well as in understanding the entire value-creation logic, particularly when new business prospects might be available (Peppard and Rylander, 2006).

There is no single, widely agreed and defined ontology for value networks. Typically, they are described as network illustrations that show the companies and organisations involved in the value creation process, where the end user or customer is receiving the end product or service in an exchange process that defines the market for the entire value network (see e.g. Allee, 2000). Links between the actors in the network may represent money flows, contractual relations, information flows or basically any type of commitment or exchange. Fig. 2 demonstrates the idea. Three companies – A, B and C – provide technology to service providers D and E, who deliver services to end users. In an alternative constellation, for example enabled by new technology or new applications that have the potential to substitute some of the existing ones, companies A and B are able to build new business links with service provider E, possibly making service provider D redundant. There are many other possible implications, too. For example, company C could be played out from the market if A, B and E decide to collaborate and exclude the others from the network (and provided the technology that company C provides to B can be substituted).

2.3. Business ecosystems

Business ecosystems have evolved from value networks – a development that can be seen as a natural enhancement and enlargement of the conceptual space. Business ecosystems can be defined as networks of firms which collectively produce a holistic, integrated technological system that creates value for customers (Agerfalk and Fitzgerald, 2008;

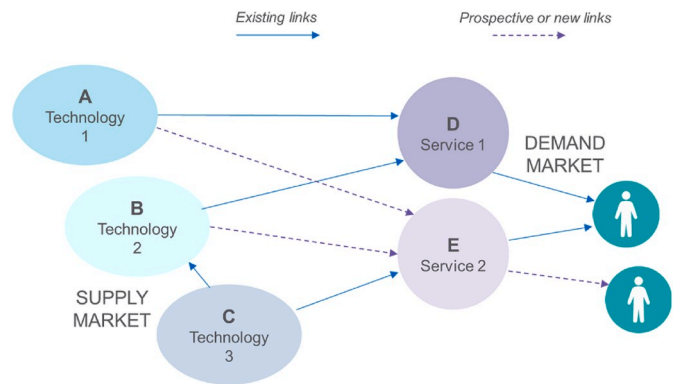


Fig. 2. Value network with existing and alternative constellations (source: P. Leviäkangas).

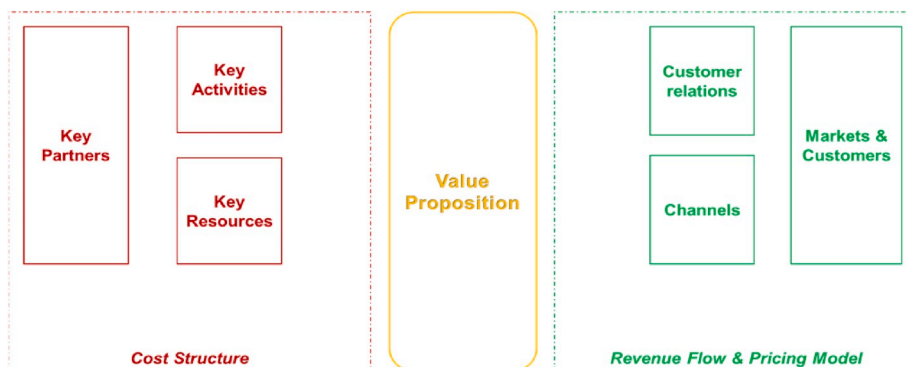


Fig. 1. Business Model Canvas according to Osterwalder (2004; modified).

Bahrami and Evans, 1995; Basole, 2009; Lusch, 2010; Teece, 2007). One of the most cited definitions comes from Moore (1993, 1996), describing a business ecosystem as:

“An economic community supported by a foundation of interacting organizations and individuals – the organisms of the business world. The economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organisms also include suppliers, lead producers, competitors, and other stakeholders. Over time, they coevolve their capabilities and roles, and tend to align themselves with the directions set by one or more central companies. Those companies holding leadership roles may change over time, but the function of ecosystem leader is valued by the community because it enables members to move toward shared visions to align their investments, and to find mutually supportive roles.”

The key word that profoundly adds to the idea of a value network is “stakeholders.” In a way, the ecosystem definition can be regarded to embrace the stakeholder theory view to a value network. The ontology basically includes similar elements as the value network, with some other additional ones such as identification of leader companies and shared visions. Visualized models of business ecosystems tend to resemble value networks with the aforementioned additions. Fig. 3 shows an example.

What is relevant with the ecosystem view is the holism that especially in the transport context must entail the recognition of externalities, such as accidents and emissions. Without considerations of safety, sustainability and socio-economic efficiency, it is hard to see meaningful development of the entire system, especially because these externalities are considered in any standard transport investment cost-benefit analysis. Therefore, the perspective of the public administrator, as a benevolent actor on behalf of the transport system’s end customers, must be included in the ecosystem view.

The relevance for the transport system context becomes obvious with the inclusion of externalities such as accidents, noise, emissions and impacts on the urban environment. The transport system has for many decades been developed to control externalities, especially when it comes to safety. Environmental aspects have become increasingly important over time and nowadays surpass many other impacts assessed in transport development projects. In all transport system investments or developments, externalities assessments are inherently present.

3. Meta-model and its implications

3.1. Model synthesis

Table 1 shows the ontology of business models, value networks and business ecosystems. At the same time, each model can be seen to expand from one model to another by additional elements. Also the theoretical underpinnings that are present and partly define the models are referred to. Business models focus clearly on single companies and attempt to show how they can maximize returns to their owners, whereas value networks consist of multiple companies, prospectively also their customers, and show the chains relevant in the value creation process. Business ecosystems continue further from the value network models and try to capture a wider stakeholder view that includes also stakeholders such as third parties subjected to externalities and regulators trying to control the externalities, especially the adverse ones. It is clear that with each step the models become more complex and conceptually more demanding. At the same time, the theoretical base widens and the ability of a single theory to explain the models becomes increasingly limited.

The theoretical underpinnings, from the management and economics research perspective, focus on two main competing theories: the agency theory and the stakeholder theory. The agency theory largely relies on the shareholder value maximization principle (see e.g. Blyth et al., 1986) and theories of investments (see e.g. Jorgenson, 1963 and Modigliani and Miller, 1958), essentially stating that the purpose of a firm and its existence is to maximize the value of the firm to its owners. However, this view has been challenged by the stakeholder theory that assumes that firms also have a purpose to serve the interests of surrounding stakeholders and the entire society (Donaldson, 1990; Donaldson and Davis, 1991; Freeman et al., 2010, 2004).

The synthesized meta-model is shown in Fig. 4. It starts from the value proposition, which in the end should correspond to the end-user needs, be it valued strictly on monetary basis or as a combination of monetary and non-monetary values. Individual companies incorporate and design their business models so that they are able to maximize their own value, thus building the value for their shareholders. This may occur by enhancing the revenue flows or controlling of costs, or both. Value networks aid in consideration of the possibilities to collaborate or position the company in a way that improves the prospects of business value. The implicit assumption is that the value of collaboration has a price (e.g. shared r&d, IPR agreements, strategic commitments) that may decrease short-term returns but increase long-term returns through advantageous positioning in the value network. At this point, the

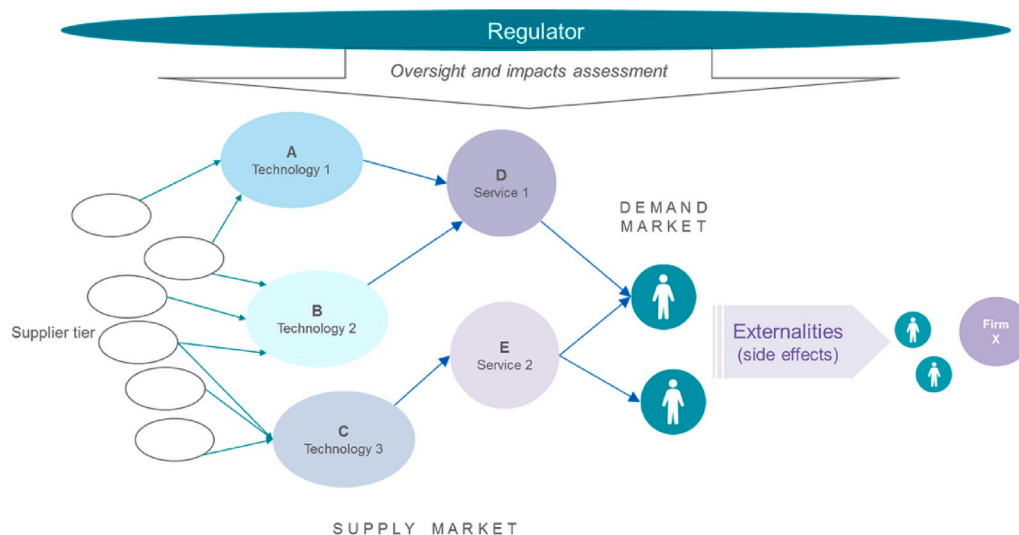


Fig. 3. Business ecosystem (source: P. Leviäkangas).

Table 1
Ontology of business models, value networks and business ecosystems.

Model	Ontology	Theory base	Focus
Business model	Value proposition, cost factors, revenue factors	Agency theory, shareholder value maximization	Single firm
Value network	Business actors, value creation process, customers	Systems theory, value theory, network theory	Network of firms
Business ecosystem	Business actors, customers, alternative value networks, stakeholders, regulators	Systems theory, stakeholder theory	Network of firms, customers and stakeholders

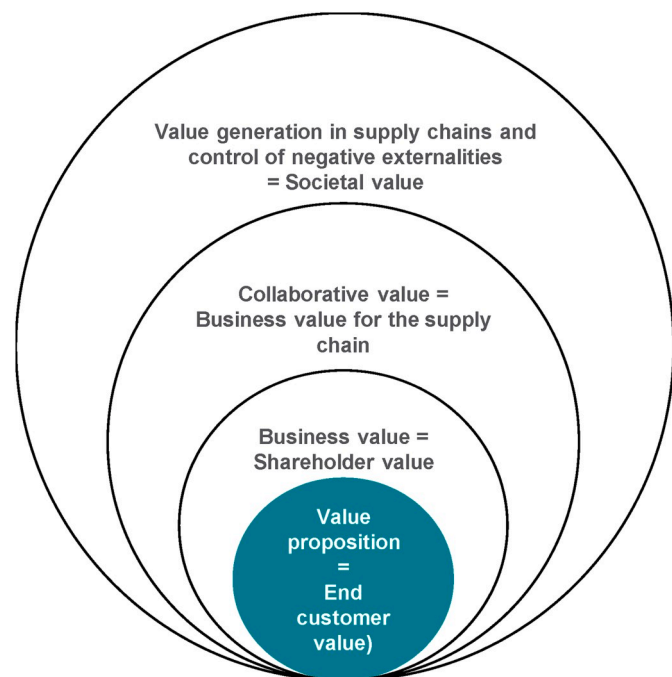


Fig. 4. Meta-model comprising the views of business models, value networks and business ecosystems.

strategic management of the firm becomes more of an exogenous rather than endogenous exercise. When all stakeholders are considered, adopting the view of a stakeholder theory that considers wider benefits that the business is hoped to generate, it is possible to address the societal or socio-economic value that can be generated.

3.2. Implications

The implications for the transport system are interesting. These are discussed from the following perspectives: i) public procurement, ii) organizational governance of the system, iii) regulation, and iv) maximizing societal benefits. The first three answer the main question presented in the title on implications for *governance*, and the latter addresses the question on *economics*. Public procurement can be seen as a management system or process for governing the transport system, and hence can be regarded as included in the framework of governance (highest order of management). Organizational governance refers the organizational and administrative architecture of the transport system, and regulation is by definition a management system of the highest order. These views do not capture all the elements of any governance system, but here exemplify the parts of the governance system that are affected.

3.2.1. Public procurement

If in the transport system context the ecosystem view is prevalent in the present and future state of the world, the public procurer must consider which supply chain is able to deliver the service or product – for

instance a public transport service contract, a highway concession, or a novel ICT system for transport authorities. Looking at a single supplier will probably not be sufficient, since most calls for major tenders are quite complex already. A public transport service contract must consider the reliability of the service operator, the fleet offered, the training and skills of the offered personnel, maintenance process of the fleet, capabilities to handle exceptional situations, value-added services offered to the passengers, etc. The procurement must consider environmental aspects (e.g. the fleet’s emissions), societal aspects (e.g. fair working conditions), and other policy aspects such as the interests of the domestic industry. Therefore, it will be the offering of the ecosystem that weighs in the decision making instead of narrowly defined performance metrics. For a highway concession, issues of sustainability (low-emission construction and maintenance), resilience (quality of infrastructure and withstanding of exceptional situations), life-cycle durability, and so forth, are some obvious examples of such procurement.

The above means that the public client (procurer) needs either to manage a bundle of individual procurements in order to find the best set of combinations, or assess the performance capabilities of an entire consortium with its extended supplier tiers. It goes without saying that few public clients can do the former, and even the latter will be challenging enough. This in turn implies that traditional procurement models, which are based on the one-client-one-supplier type of standards, will be insufficient or even obsolete if maximizing value-for-money procurement is pursued.

For the private sector, the demands are focusing on collaboration readiness, partnership networks, and the ability to build a reputation as a trusted partner. Good governance models regarding intellectual property, risk management and contract management are some of the fundamental management capabilities to be fostered and developed.

3.2.2. Organizational governance implications

Governance of the transport sector is getting increasingly complex. New ‘prosumer’ markets are emerging, and technologies are disrupting the old governance models. There are new ways of travelling from point A to point B. In this new world, governance of the sector relies increasingly on collaborative efforts and recognition of the skills and capabilities that are needed outside the transport sector administration. Many transport administrations have rejected old modal silos in their governance structures (road admin, rail admin, maritime admin, etc.) and converged the modal administrations into a super-administration that governs the entire sector. This is the case, for example, in Finland and Sweden. The Finnish Transport and Communications Agency in fact covers not only all modes but also the former communications administration. The Swedish Transport Agency likewise covers all modes of transport instead of administrative modal division.

These governance-restructuring examples signal an attempt to take a more holistic view of mobility and to govern and develop the system as a whole instead of focusing on individual parts in administrative isolation. To put it plainly, the Finnish and Swedish examples demonstrate the acknowledgement that their mobility system is *de facto* a value network.

3.2.3. Implications on regulation

Uber is an excellent example of how technology disruption is

challenging existing regulation. The traditional taxi industry (as well as local public transport) has been heavily regulated in most countries. The possibility to order an Uber ride via an app downloadable to any mobile phone, not to mention the disruption to incumbent pricing systems, has caused many headaches among regulators. In some countries, the dilemma has become so severe that Uber has been banned. This may partly be on account of safety and security, but undoubtedly also because there has been no way to regulate that market. Additionally, the possibility of privately renting a car on a short-term and *ad hoc* basis through shared mobility apps has caused similar concerns. For example in Finland, the implications are still partly unresolved, but at least the immediate and probably non-permanent solution was to require that Uber drivers have the same professional qualifications as officially registered and licensed taxi drivers. However, it would seem that such disruptive ecosystems as Uber with its ‘unofficial’ drivers are virtually impossible to regulate in a waterproof manner. Thus, questions of safety, fair working conditions, tax liabilities, etc. remain open.

3.2.4. Societal value maximization

A typical approach to the objective of societal value maximization has so far been liberalization by introducing market mechanisms and enhanced fair competition. If disruptive technologies and mobility patterns take place anyway, then the market must be liberalized in order to maintain at least some control over the sector. Alternatively, the disruption takes place regardless of the old rules and may create severe conflicts between ‘what is allowed’ and ‘what is actually taking place’. It can implicitly be assumed that liberalized market structures (less control, less regulation, less standardization) are more adaptive than less liberalized contexts. The other strategy to adopt is to create a new framework of regulation and governance that will gently guide the market players and consumers in the right direction. Effective means of doing this include standardization, taxation and pricing, all of which in a way fall under regulation. The earlier example of Uber in Finland included regulating market access through the licensing of taxi drivers. Another typical example of guiding development and controlling negative effects would be the taxation and pricing of carbon. Introducing a carbon-based tax regime will reduce adverse climate change-accelerating emissions through the control of what type of vehicles are preferred in the mobility market. However, the incorporation of these tools is much easier said than done, and there are more actors in the ecosystem than just car users and the taxman. Questions related to fuel technologies, fairness and distributional economic effects and the fiscal balance of the state bring in many more actors, and renewal of standards and pricing regimes will become a complex stakeholder management exercise, again reminding us of the necessity of an ecosystem perspective.

The more the ecosystem view is adopted, the more important becomes the analysis and treatment of externalities and distributional effects. In addition to externalities, the potential of government to create societal value may be related to mitigation of other market failures such as public goods and incomplete information.

3.3. The C-ITS case

Cooperative Intelligent Transport Systems (C-ITS) can be understood as a group of ITS services that exchange information between ITS stations such as vehicles (e.g. a car), roadside units (e.g. a radio beacon), personal devices (e.g. smartphones) and central ITS stations (e.g. traffic management centre). C-ITS has also been defined as ITS services involving communication between vehicles and roadside infrastructure: “In Cooperative ITS (C-ITS), vehicles communicate with each other and/or with roadside infrastructure, greatly increasing the quality and reliability of information available about the vehicles, their location and the road environment.” (ETSI, 2019a). Communication between vehicles and vehicles and roadside infrastructure allows provision of a large number of services such as road hazard warning, intersection collision

risk warning, and support for automated driving and remote driving (3GPP, 2018; ETSI, 2013; ETSI, 2018). Some of the C-ITS services have been identified as priority services (Day-1 services) for deployment in Europe (European Commission, 2016). The group of Day-1 services includes road hazard warnings and signage applications. C-ITS services can be implemented with different technologies. These include technologies based on 4G and 5G mobile networks (ETSI, 2019b; Molina-Masegosa and Gozalvez, 2019) and communication based on IEEE802.11p radio technology.

C-ITS services were chosen as a case study for a number of reasons. First, C-ITS services have the potential to provide societal benefits such as improved safety, efficiency of the transport system, and reduced energy consumption. Second, the business ecosystem related to C-ITS is worth analysing due to its characteristics and complexity. Successful implementation of C-ITS requires collaboration between a number of stakeholders. Different technical implementations of C-ITS services also have different architectures and participants of the business ecosystem, as well as different business models and cost structures. Third, deployment of C-ITS on a large scale is still expected. Better understanding of the business ecosystem around C-ITS, including the challenges faced and value created at different levels of the meta-model, would likely facilitate implementation of the services and realization of their value to society.

The meta-model in Fig. 4 can be used to classify and analyse the value provided by Day-1 C-ITS services (Table 2), as well as challenges to their deployment (Table 3). Table 2 describes how C-ITS creates value at different levels of this meta-model. Table 3 summarizes the challenges to deployment of C-ITS that are related to the interests of stakeholders at different levels of the meta-model and the processes occurring on different levels. Most of the ways in which C-ITS creates value, as well as the challenges to deployment, have been identified in earlier studies. However, neither the meta-model presented here nor any other similar framework has been used before to analyse the value created by C-ITS and to classify the related challenges to deployment. The summaries presented in Tables 2 and 3 are not exhaustive, as their main purpose is

Table 2
Value created by C-ITS services, at different levels of the meta-model.

End customer value	Business value	Collaborative value	Societal value
Improved safety, Malone et al. (2014)	Direct revenues from products and services (e.g. vehicles, components and telecom services)	Increased connectivity of vehicles (via ITS-G5 and mobile networks) will likely facilitate creation of new innovative services and service platforms (e.g. online monitoring of vehicle condition, services for electric vehicles etc.)	Improved safety, Malone et al. (2014), El Beyrouty et al. (2018)
Reduced fuel consumption, Edwards et al. (2018)	Possibilities for product differentiation	C-ITS may act as a building block for intelligent traffic management, Billot et al. (2014)	Reduced emissions and energy consumption, Malone et al. (2014), El Beyrouty et al. (2018)
Reduced travel time, El Beyrouty et al. (2018)	Potential for monetization of user-generated data (e.g. floating mobile data)	V2X communication introduced with C-ITS services may act as a building block for connected and automated driving (CAD), Rondinone et al. (2018)	Improved traffic efficiency, El Beyrouty et al. (2018)

Table 3
Challenges to C-ITS deployment, at different levels of the meta-model.

End customer	Business	Value network	Business ecosystem
Chicken-and-egg problem, vehicle users will experience limited or no benefits in early stages of deployment if no equipped infrastructure is available. Sjöberg et al. (2017)	Unavailability of a clear business model, Asselin-Miller et al. (2016)	Service benefits may be non-monetary, although many of them can be valued	Uncertainty of costs and benefits, Vreeswijk et al. (2014)
Privacy concerns, Kiometzis (2018)	Chicken-and-egg problem, vehicle manufacturers must invest in software and equipment for several years before all C-ITS applications will create value for their customers. Sjöberg et al. (2017)	Difficulties with coordination of actions between a large number of stakeholders, C-ITS Platform (2016)	Risk of obsolescence of investments due to rapid development of new technology (public sector stakeholders)
	Risk of obsolescence of investments due to rapid development of new technology (private businesses)	Stakeholders reaping the benefits are not necessarily the same as those who need to invest in equipment and service provision, Asselin-Miller et al. (2016)	Difficulties with coordination of actions between a large number of stakeholders, C-ITS Platform (2016)
	Lack of tools for estimation of costs and benefits for localized deployment of C-ITS, McGiffen, Beiker and Paulraj. (2017)		Stakeholders reaping the benefits are not necessarily the same as those who need to invest in equipment and service provision, Asselin-Miller et al. (2016)

to validate the meta-model. The deployment of C-ITS services requires coordination of actions between a large number of stakeholders such as vehicle manufacturers, infrastructure managers, system and component suppliers, telecom operators, and regulators. Lack of a clear business model and of coordination have been identified as substantial barriers to deployment ([Asselin-Miller et al., 2016](#)).

The value chain model, value network model and their combinations have already been found to be useful for analysis of business models related to C-ITS. This was an outcome provided by the Business Models Working Group that operated as part of the European C-ITS Platform ([European Commission, 2017](#)). On the other hand, the business model canvas was considered by the working group as “too static” and too focused on an individual company.

C-ITS clearly seems to possess properties that call for a more holistic approach, and involves a number of stakeholders that are relevant to the realization of C-ITS. Obviously, there are services that will require collaboration between different manufacturers and technology providers and cooperation between industrial ecosystems and the public sector, since the infrastructure is owned largely by cities, municipalities and the state. Externalities, such as safety and emissions, are the core

mission of C-ITS, and therefore the realization of C-ITS is seen as contributing to the maximization of societal value.

4. Synthesis and conclusion

4.1. Synthesis

A synthesis is presented below using the meta-model to point out how the governance and economics of the transport system are affected when traditional views are challenged in a world that must regard value networks and business ecosystems in order to successfully develop the system in the desired directions. This approach, or thinking, is what is here considered as ‘new economics’ and ‘new governance’. We do not claim to propose new economic models beyond the developed meta-model. It must also be underlined that the developed conceptual constructs are not validated but logically deduced. The presented case analysis served equally the hypothesis (construct) building and the preliminary validation. [Fig. 5](#) shows how the economic ‘spheres’ (or sectors) are related in the system, where the hierarchy logic proceeds as follows:

$$\text{Private economy} + \text{Public economy} = \text{National Economy}$$

$$\text{National economy} + \text{Externalities} = \text{Societal economy}$$

[Fig. 5](#) reveals that if improvements in any of the economic spheres (or sectors) are possible without resulting in losses to other spheres, this creates a Pareto-optimal situation. However, this is only true in the absolute sense. It is not possible to increase, for example, the returns of shareholders without resulting in direct costs to the public economy or the consumers – the increased returns must come from somewhere. Also, great potential is available through externalities by reducing emissions, for example, and generating societal benefits. If the benefits of reducing emissions are sufficient to offset additional costs to the private or public economy, the reduction of emissions is worthwhile. The problem is, as usual, that the externalities are hard to turn into cash value, and therefore actual cash investments or willingness to pay may not exist.

Managing this ‘new economics’ of the transport system suggests that the stakeholder theory must be made to work in practice. If this cannot be achieved successfully, there will be plenty of room for political opportunism and frustrating contradictions from actions driven by the self-interest of stakeholders.

For the governance aspects, [Fig. 6](#) attempts to visualize the required construct. It is by no means exhaustive but attempts to capture some of the essential elements needed for new governance of the sector.

First, the governance system needs to be systemic, covering the entire mobility system. Breaking the silos is one strategy, as has been done in e.g. Sweden and Finland. Second, the regulation must consider at all times the overall benefits to the society and control of negative externalities that entail much more than the usual environmental parameters. The procurement system and processes are to be focused on value creation rather than the cheapest contracts. Despite e.g. the European legislation on innovation procurement being quite liberal, the old procurement models still prevail. This is not to say that all procurements must be innovation procurements, but all procurements must consider the best value for money, which is much more than just the lowest bid. Finally, the idea of maximizing the value for the entire society focuses strongly on the pricing and taxation of the system.

These are truly political questions. Most, if not all, political decision-makers are keenly aware of the challenges and needs related to developing the mobility system with respect to taxation and pricing. However, usually there is little willingness to stir the soup by initiating changes that are considered too radical. Such changes present political risks and, as long as such risk-taking does not pay off, there is little to expect from the political domain.

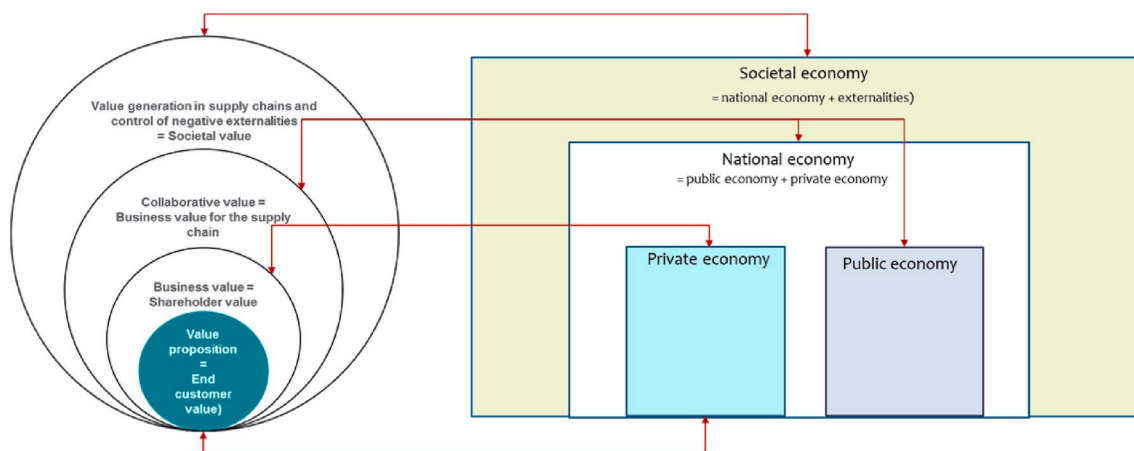


Fig. 5. The new economics of the transport system.

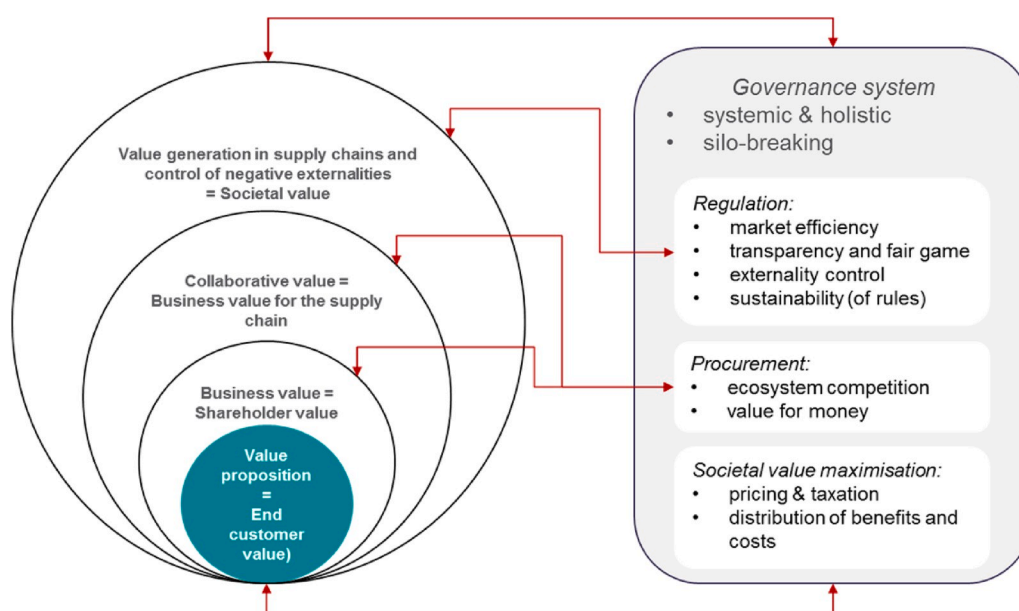


Fig. 6. The new governance of the transport system.

4.2. Conclusion and sum-up

This paper discussed the new governance and economics of the transport system. It showed how business models, value networks and business ecosystems form a hierarchical conceptual construct, which was visualized as a meta-model. The case of a Cooperative Intelligent Transport Systems was used as an example to point out how in fact the technology push seems to urge the new economics and governance forwards. One of the key concepts that is useful in capturing the ontology of the new transport system is the business ecosystem. Business ecosystems merge the views of the market (end users), regulation (authorities), value chains (value creation process), and business models (a single firm’s objectives).

The proposed meta-model was used to reflect how the new economics and new governance relate to the model (or, vice-versa, how the meta-model relates to the new needs), and the perspectives of the governance system and economic system were compared alongside the meta-model. The conclusion is that the hierarchies of the proposed meta-model match the aforementioned perspective. Hence, although it may prove useful for analysing the transport system, clearly the

proposed meta-model is highly conceptual and merely a tool with which to comprehend the new economics and new governance of the transport system, if not yet the actual solutions. Considering the massive challenges ahead, for example regarding climate change and technological disruption – one creating the needs and the other providing the push and prospective solutions – such solutions may be further ahead than we might hope. Nevertheless, what is clear is that the proposed meta-model – or somewhat similar constructs – is needed to structure the multiple challenges to be tackled in an attempt to govern and manage the new economics of the transport system.

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