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Business Model Innovation in the Smart Mobility Domain

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1 Introduction

All large cities are challenged progressively more with increased population and urbanization. By 2050, the percentage of the world's population residing in urban areas is expected to increase from 54% (in 2014) to 66% [1]. This expected increase in population will intensify the existing problems and mobility challenges of urban areas.

Currently, many developments are taking place in the field of mobility, transportation, and traffic management. Particularly in the mobility domain, there is a move from an emphasis on the ownership of individual vehicles and infrastructure, to an emphasis on integrated services delivering a true value to end users, i.e., to a service-dominant perspective [2]. The end users of mobility solutions are not interested in the characteristics of the individual assets, but in the added value that the use of combinations of assets provides them with [3, 4].

Many research and development efforts, however, have a hard time finding their way to practical, large-scale exploitation [2]. One of the reasons behind this is the limited view on business models and market considerations. Many of these developments have a technology-push character, where things are developed inside-out, with a focus on the concepts and technology in the mobility transportation from the very start, and with limited attention for actual business deployment at the end. This situation is made worse by the fact that complex mobility scenarios involve a multitude of stakeholders, each of which has its own business interests.

Several initiatives in the cooperative intelligent transportation systems (C-ITS) domain (e.g., Compass4D [5], NEWBITS [6]) emphasize the need for exploring the opportunities to derive business models to support large-scale deployment and long-term sustainable operation of C-ITS services. However, business models designed in such initiatives typically address an organization-centric view, reasoning from the perspective of a single party in a pilot site (e.g., municipality) [7]. However, C-ITS services are not deployed in isolation by a single organization, but are the product of collaborations between multiple stakeholders, including private drivers, professional drivers, infrastructure providers, service providers, but also institutions that need to remain accessible, and cities that want to uphold a good image.

These abovementioned challenges are among the main reasons for the slow and fragmented deployment of C-ITS technologies, which inhibit their potential to bring about the expected benefits [8]. When deployed effectively, C-ITS and related technology are expected to make significant contributions to a cleaner, safer and more efficient mobility environment [8, 9].

There is limited research on the business model perspective of C-ITS [7, 10]. The cities are often confronted with high investment costs for infrastructure and service delivery; hence, investigating the business models for C-ITS services has a strong practical relevance in the mobility ecosystem. There is a need for innovative business models for large-scale deployments of C-ITS solutions to address the urban mobility challenges and advance the value that can be reaped from the use of related technology and infrastructure [7, 11, 12].

Recent projects on the design of agile, service-dominant business models in multi-stakeholder contexts in the mobility landscape have shown that the application of such a business design approach offers a constructive, collaborative way to develop blueprints for the definition of cases of concrete added value of mobility technologies and new forms of business collaboration to realize these cases of added value [13–16]. A service-dominant business model identifies the added value of the service to the customer or user, functions and capabilities required by each party (organizations, institutions, companies, customers) participating in the model, as well as the expected costs and benefits. The business models (BMs) for a service (or a coherent collection of services) provide a solid basis for the requirements for the solutions, as well for a cost and benefit analysis for such solutions.

The *objective* of this chapter is to present a set of service-dominant business model blueprints designed in collaboration with several stakeholders in eight European cities within the scope of the C-MobILE project (http://c-mobile-project.eu). The business model blueprints have emerged from stakeholder workshops in these cities. As such, they are catered to the needs and context of the respective cities, and aimed at guiding the implementation of C-ITS services for large-scale and sustainable business within the scope of the C-MobILE project. However, the blueprints are designed in such a way that they can be adopted in other cities to address similar challenges they have.

In designing business model blueprints, we used the service-dominant business model-radar (SDBM/R), which puts emphasis on creating value for all involved stakeholders (including the customer), and as such serves as an incentive for all stakeholders to participate [7].

The remainder of this chapter is structured as follows. In Section 2, we provide a background on the key concepts of service-dominant business and the specific SDBM/R approach that we have used to design and represent the business model blueprints. Section 3 presents the organization of the business model design workshops that we have conducted. In Section 4, we present a set of blueprint business models that have been collaboratively designed in each workshop. Finally, Section 5 presents our conclusions and recommendations to advance research and practice in the mobility domain.

2 Business Model Design using SDBM/R

In this section, we give a background information about the approach – namely, SDBM/R, that we used to collaboratively design service-dominant business model blueprints.

The business model in essence describes the logic of how value is created for the customer, the costs and benefits that emerge from the business model as well as how the outcomes of the model relates to the strategic decision making of the organizations involved [17–19]. Several tools have been proposed for guiding the design of business models. A prominent example is the Business Model Canvas [20]. However, these approaches usually do not adopt a service-dominant perspective and do not accommodate a networked view of business models, in which value is created through a collaboration of multiple organizations. Therefore, for designing service-dominant business models, SDBM/R approach is accommodated by a business model design tool proposed in [21] which takes service-dominant logic as the basis (Figure 1).

At the heart of the radar is the *co-created value-in-use*, which describes the value of the proposed service solution for (and with) the customer. The central co-created value-in-use is encapsulated by three outer rings, for which each ring is divided into slices based on the number of stakeholders involved (and as such created a networked view). Each 'pie slice' represents the actor-specific contributions needed or obtained to create the central value-in-use. Actors (stakeholders) include the *focal organization*, *core* and *enriching partners*, and the *customer*. The focal organization is the party that typically setup and orchestrates the business model. A core partner contributes actively to the essentials of the solution, while an enriching partner enhances solution's added value-in-use.

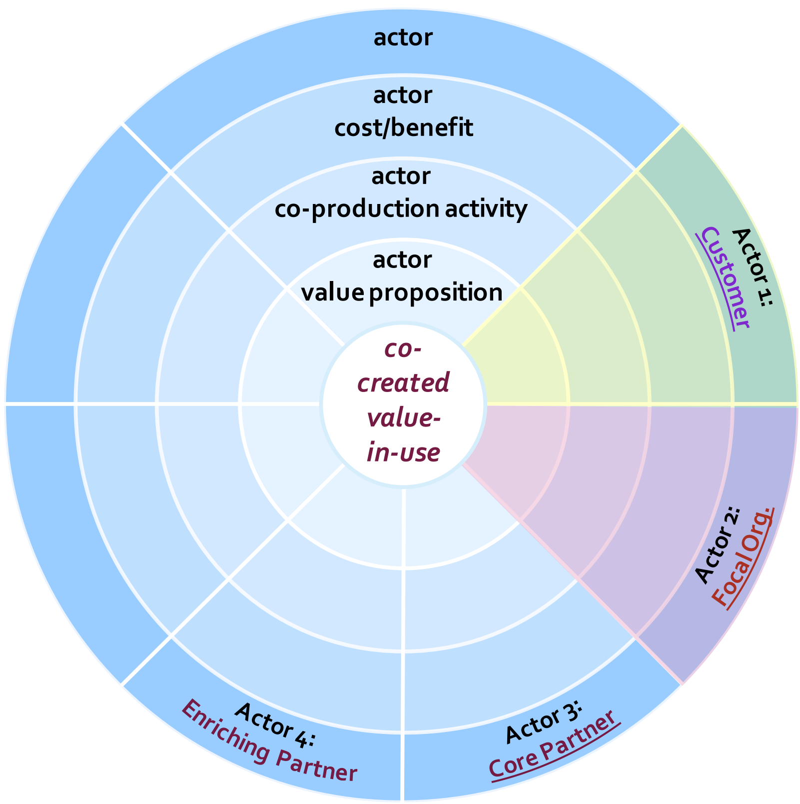

Figure 1 Service Dominant Business Model Radar (SDBM/R) template

The *actor value proposition ring* describes the value contribution that each actor (stakeholder) offers in order to create the central value-in-use. This value proposition may be directly related to or part of the central value-in-use (core partner) or may enhance the value proposition of other stakeholders (enriching partner). The *actor coproduction activity ring* describes the activity an organization conducts or performs in order to offer their respective value proposition. Lastly, the *actor costs and benefits ring* describes the specific costs and benefits which each stakeholder accrues or generates when participating in the business model. These costs and benefits can be *financial*, but also *non-financial* (for instance social or environmental benefits) in nature.

A business model defines a concrete value-in-use for a concrete customer segment, and specifies its realization, i.e., the way the customer experiences the creation and delivery of this value-in-use. Therefore, a business model may take an informal scenario as a basis for inspiration, which is refined during the design process into a description of a *customer service scenario*. The customer service scenario offers a brief description for the high-level operation and future realization of the business model [22].

Although the SDBM/R approach is often applied as an iterative process, following a certain set of design steps in the use of the SDBM/R is considered as a good practice [7]. The design approach starts with identifying and agreeing on the co-created value-in-use and the targeted customer (segment). Next, the actor value propositions and associated actors are determined, including their roles (focal, core, and enriching.). This is followed by determining the costs and benefits for each actor - both in financial and nonfinancial form. It is typical that a cost item of an actor is linked to a benefit of one or more actor. These steps are followed in parallel with the description of the customer service scenario - often in several iterations until the blueprint model is considered complete.

A business model design workshop often follows a practical setup and involves a number of stakeholders brought together around a theme. These workshop sessions are moderated by a person experienced in the use of SDBM/R, who also promotes out of the box thinking while engaging the stakeholders in active communication and collaboration for innovative ideas.

The SDBM/R approach is an integral component of the BASE/X (Business Agility through Service Engineering in a Cross-Organizational Setting) framework [21] that has been successfully used in engineering business in several domains - particularly in mobility and traffic management [15, 16, 23]. SDBM/R contrasts other business model design methods, such as the Business Model Canvas [20] used in previous initiatives, which are more organization-centric and reason from the perspective of a single organization. These methods lack behind in representing how value is created by a network of organizations, appropriated and distributed amongst all stakeholders involved in these business models.

3 Workshops for Business Model Design

To address the urban mobility challenges faced in a number of European cities, we organized a series of business model design workshops with the participation of industry professionals working in organizations operating in the mobility and related domains.

Adopting a service-dominant perspective, we initiated the tasks for designing blueprint business models for the C-ITS services and service bundles in collaboration with the stakeholders in the C-MobILE project. We organized workshops in eight European cities to address their urban mobility challenges and to help engage relevant stakeholders in the region in collaboratively designing business model blueprints for sustainable deployment and operation of C-ITS services. A list of the specific workshops, as well as the dates these have been conducted is given in **Error! Reference source not found.**.

Each city in the list is a *local site* in the context of the C-MobILE project, and represented by a *site leader*. Before the workshops, the local site leaders were asked to consider the mobility challenges faced in their region, and elicit the potential use of C-ITS services to address these challenges that were deemed most important in their local context. Consequently, site leaders were asked to invite a selected group of stakeholders, which were required for implementation of the C-ITS services, potential (end-) users of the services, or interested in joining or contributing to these business collaborations.

The companies that the participants represented were of diverse size, including both SMEs and large enterprises. The companies also varied considerably in terms of type. They included private companies (such as mobility service/technology providers, telecom/mobile network operators, and parking operators), and public organizations (such as municipalities, road authorities, traffic managers, and public transport operators), as well as public-private partnerships or nonprofit organizations (such as automobile/motorcycle clubs, and cycling associations). This helped us to elicit viewpoints of different business stakeholders in the domain.

Table 1 Business model design workshops and resulted business model blueprints

Workshop		Business Model Blueprints	Location / Time	# of Participants
Ws1	BM01	- Comfortable commuting by bike through traffic light prioritization	Helmond, NL Jun.2017	17
Ws2	BM02	- Optimized driving experience through green light optimal speed advisory (GLOSA)	Thessaloniki, GR Jul.2017	20
Ws3	BM03	- Hassle-free concert experience with mode & trip time advice	Copenhagen, DK Aug.2017	9
Ws4	BM04	- Green and comfortable commuting to inner city (with urban parking availability, mode & trip time advice, and green priority)	Bordeaux, FR Aug.2017	8
Ws5	BM05	- Safe Driving Experience with in-vehicle warning services	Barcelona, SP Sep.2017	20
Ws6	BM06	- Fast and safe travel of emergency vehicles via green priority and emergency vehicle warning	Vigo, SP Sep.2017	5
Ws7	BM07	- Efficient freight delivery in urban areas with parking availability	Bilbao, SP Sep.2017	6
Ws8	BM08	- Reliable and efficient transportation via traffic information provisioning	New Castle, UK Sep.2017	7

Each workshop consisted of two phases. The first phase involved a tutorial on the concept of service-dominant business, and on the use of SDBM/R. The second phase comprised the core of the interactive design of a particular business model using the SDBM/R under the guidance of the business model design moderators.

Following a practical approach, large posters and ‘post-its’ were used to represent the SDBM/R blueprints and its specific elements. The blueprinting involved the analysis of the stakeholders (including the customer, the focal organization that orchestrates the service, and other required parties), their exact added value (in qualitative terms), and the cost/benefit structure in a business network of these parties. Emphasis was put on the value created by the mobility solution, and how each stakeholder may contribute and benefit from this business collaboration.

Each workshop was concluded with one or two draft business model blueprints. Each blueprint draft was completed and sent to relevant stakeholders participated in the workshops for review. The blueprint business models were consequently finalized based on the feedback received and further discussions with the stakeholders in local sites.

In designing blueprint business models, we took into consideration that the potential users of the C-ITS services have no or marginal willingness to pay for these services (despite acknowledging their usefulness and positive contributions to the society) [24]. Therefore, in our workshops we targeted at identifying public and/or private organizations who can directly or indirectly benefit from the deployment of the C-ITS services and can act as a source of funding and support. This is aligned with the trend in the mobility initiatives where financing structures through public-private partnerships are becoming more prominent [11, 25].

4 Service-Dominant Business Model Blueprints

In the following subsections, we present the SDBM blueprints developed in collaboration with relevant stakeholders at each city. Although these models surfaced to address the mobility challenges of C-MobILE project local sites, their designs are retained generic to act as templates for concrete models in cities and settings beyond those of the project's.

4.1 BM01- Comfortable Commuting by Bike through Traffic Light Prioritization

Reducing car traffic in certain urban regions is among the common objectives of many mobility initiatives. In this business model scenario, an employer (an organization or and industrial zone) aims to endorse or stimulate cycling as the mode of commuting for its employees. This is with the aim to reduce traffic in the vicinity of the business premises, and to reduce the need for parking spaces for cars on location. To foster this, a service provider offers priority crossing for cyclists via a smartphone application, which can be activated through software codes. These codes are purchased by the employer, which distributes these codes to its employees commuting by bike. The service can be adapted or customized to fit the needs of the user or the environment (i.e., activating only during rush hours). The blueprint business model is presented in Figure 2.

In order to operate the service, floating data is collected concerning the location and travel direction of the user through the smartphone application. The application runs in the background; as such, no interference of the cyclist is needed. Moreover, traffic lights are equipped with C-ITS applications, allowing the application to interact with these systems. Once the cyclist (carrying an active smartphone application) approaches the traffic light, two scenarios can occur. In case of a red light, increased priority is given to the VRU by activating the green light quickly and allowing the cyclist to continue with reduced waiting time. In case of a green light, the duration is extended to support the flow.

The C-ITS service that is used as the key enabling technology for this business model is the 'traffic light prioritization for designated vulnerable road users (VRUs)" [26]. This service aims to increase the safety and comfort of pedestrians or cyclists in traffic through warranting priority or additional crossing time (i.e., extending the green light phase or lessening the red phase). As such, a smoother flow or speed can be maintained whilst cycling, improving the comfort of the user [27]. The service can be catered to the needs or characteristics of the user or can be altered for special conditions (such as the weather).

The co-created value in use is the comfortable commuting by bike to employees who commute or will commute by bike. The comfort implies that the cyclist can maintain a regular speed or flow whilst cycling and is either interrupted less frequently at intersections or can more quickly continue his or her journey after a stop.

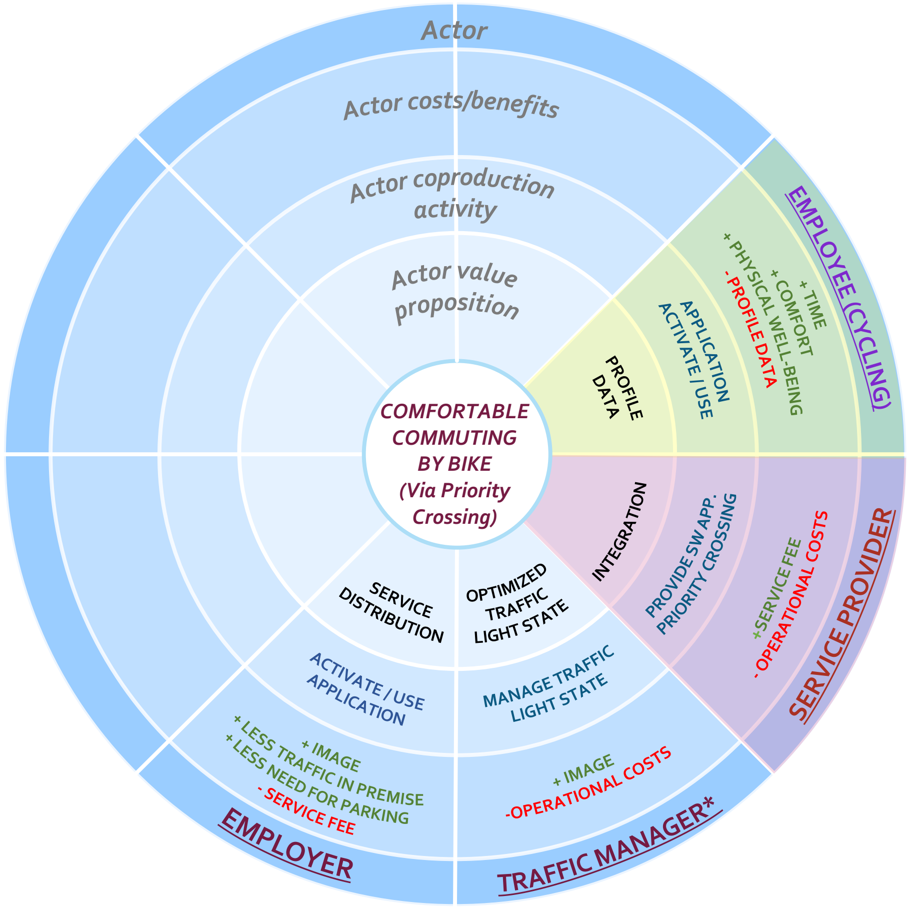

Figure 2 SDBM/R Blueprint for Comfortable Commuting by Bike

The business model can potentially be further financed through including retailers, or retailers can even account for all service fees, allowing the service to be offered to a wider public. The service generates profile and regular routing information of the cyclists which can be used to provide customized promotions for the commuters. Retailers might be interested in advertising products or services through the application if the data profile shows that cyclists take a route on which the retailer is located or in the vicinity.

4.2 BM02- Optimized Driving Experience through Green Light Optimal Speed Advisory (GLOSA)

Green light optimal speed advisory (GLOSA) is a C-ITS service that provides drivers an optimal speed advice when they approach to a signalized intersection [26]. This advice may involve maintaining actual speed, slowing down, or adapting to a specific speed, allowing the user to reach a green light and minimize fuel consumption and emissions. If a green traffic light cannot be reached in time, GLOSA may also provide information on time-to-green when the vehicle has stopped. Application of GLOSA takes advantage of real-time traffic sensing and infrastructure information to communicate to user an ideal advice. The service enables the user to experience more eco-friendly and comfortable driving, as a more regular speed can be maintained, whereas unnecessary braking or stopping can be reduced, which in turn reduces fuel use.

The GLOSA service can provide a more eco-friendly and comfortable driving experience for vehicle drivers. In the business model blueprint depicted in Figure 3, the *service provider* offers the GLOSA with the aim to improve the flow of traffic and reduce pollution due to fuel use, with the expectations that the *drivers*, who are informed of the optimal traffic behavior, can use this information to improve decision making with regards to their speed.

The more vehicle drivers adopt the service, the more benefits can be experienced in the traffic flow and reduction of fuel use. Hence, in order to foster the adoption of the service and to effectively benefit from its potential benefits, the service is offered on a free basis to drivers. The drivers are able to use the service (offered on a software application installed either an on-board unit or smartphone application) that tracks the speed and location of the user, and integrates this data with real-time traffic data to provide the best cruising advice. The blueprint business model for this service is shown in Figure 3.

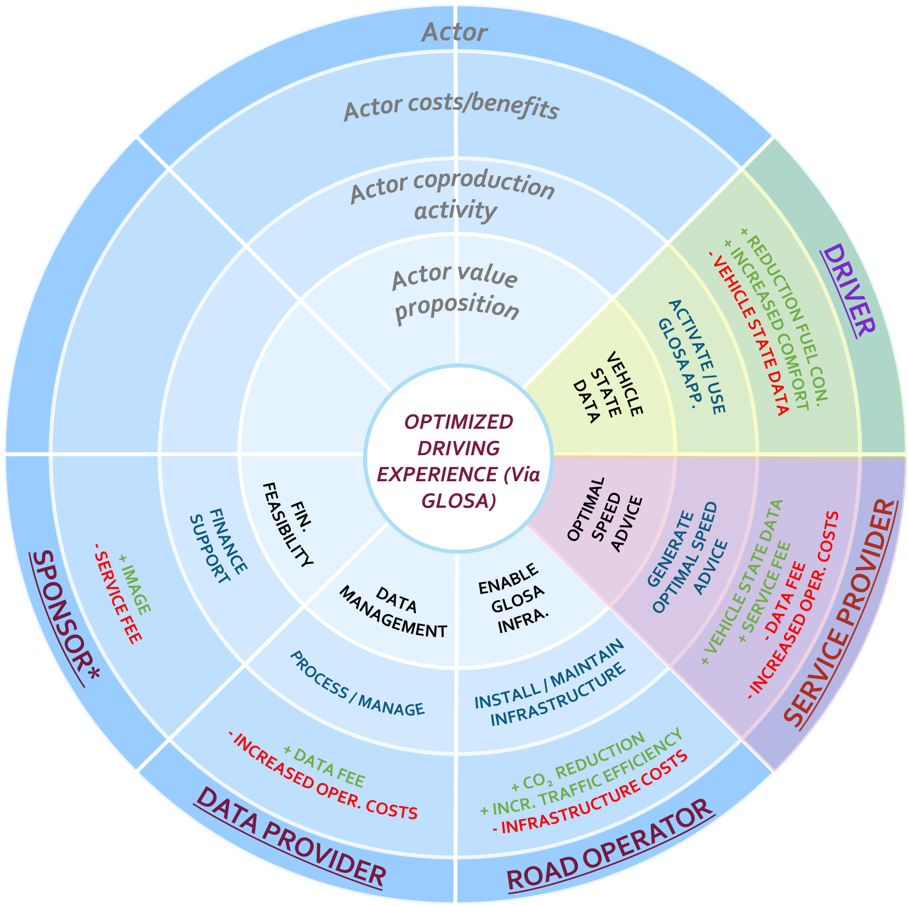

Figure 3 SDBM/R Blueprint for Optimized Driving Experience with GLOSA

In the blueprint, the *road operator* provides the necessary infrastructure for the GLOSA, that requires application to interact with nearby or oncoming intelligent traffic lights, collect data with regards to traffic light state information in order to calculate an optimal speed advice. In turn, this should benefit the road operator through a reduction in CO2-emissions and an improved traffic flow and efficiency.

The data provider is responsible for collecting and transforming the raw data collected by the application into usable data elements, which is consequently transferred to the service provider. It receives a fee for transforming the data also to cover the operational costs that are incurred in doing so.

A sponsor that would fully or partially cover the implementation and/or operation of the service would facilitate the deployment and adoption of the service. In our blueprint, we considered *the city* or *municipality* as sponsoring or financing party that can potentially enable free provisioning of the service to vehicle drivers. In turn, the city would benefit from an improved image, as effort is put in creating a more efficient and eco-friendly traffic flow within the city.

The service solution can also be catered to fleet owners, which can finance the service directly to equip their vehicles with the C-ITS service and benefit from reduced fuel consumptions over their entire fleet which may offset the corresponding costs for deploying and operating the service.

4.3 BM03- Hassle-Free Concert Experience with Mode & Trip Time Advice

Many large cities are characterized by heavy traffic during daily rush hours, which becomes worse when large events, such as football matches or concerts, are held in premises located in or close to city centers. One of the measures to counter this problem is to endorse the use of public transportation. Our business model design workshop in Copenhagen brought a large variety of stakeholders, both of the public, the private and the individual kind to tackle this challenge. The resulting blueprint is depicted in Figure 4.

In this blueprint, the targeted value-in-use for the *event visitors* is a *hassle-free concert experience*. Hassle-free implies that by taking public transport to an event instead of travelling by car, the event visitor benefits from not having to worry about waiting in traffic, dealing with congestion or parking the car at the location, whereas the visitor can experience more freedom at the event location. To facilitate that, the *service provider* assesses the current and near-future traffic conditions at large events. Based on these conditions, the *service provider* may offer free (or with increasing discounts based on the traffic data) public transport tickets with the aim to stimulate visitors to use a different mode of transport and reduce traffic at and around the event location. This is accommodated by a travel advice with regards to connections between modes of transport, trip duration and expected departure and arrival times. Mode & trip time advice (e.g. by incentives) aims to provide a traveler with an itinerary for a multimodal passenger transport journey, considering real-time and/ or static multimodal journey information.

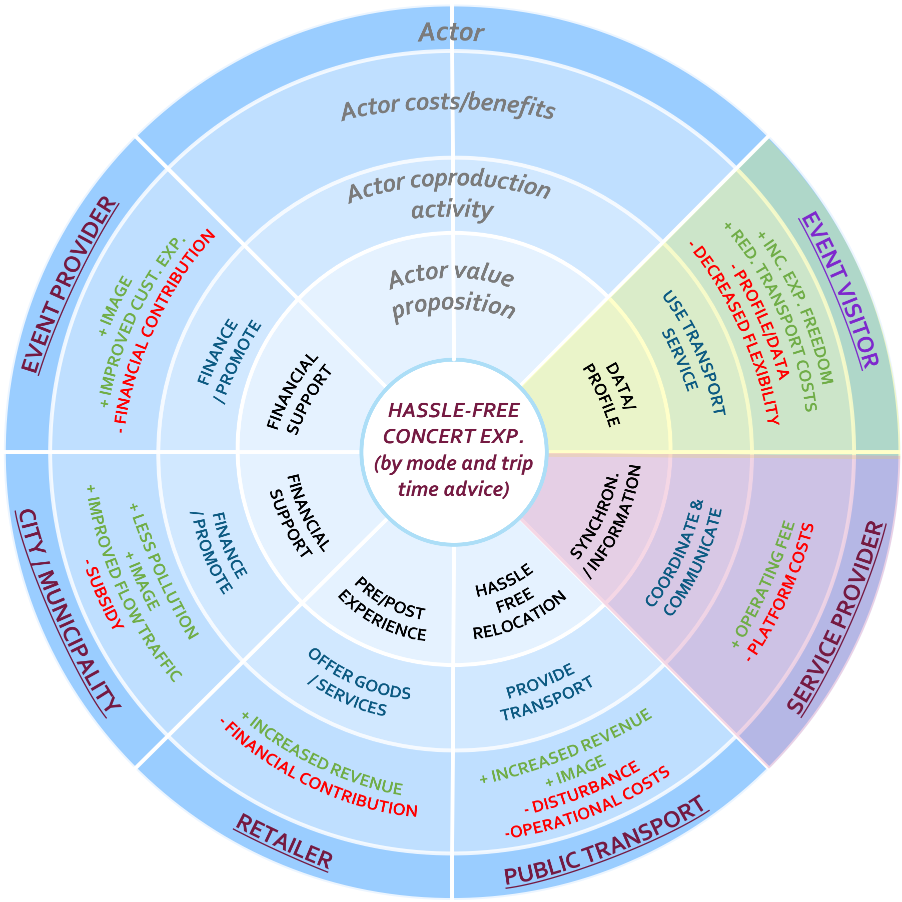

Figure 4 SDBM/R Blueprint for Hassle-Free Concert Experience with Mode & Trip Time Advice

In this business service scenario, the service provider incurs platform costs for offering the service, for which a fee will be obtained as compensation. As public transportation is motivated, the *transport operator* benefits from increased revenues due to increased travelers, which in turn may benefit the image of taking public transport as a suitable travelling alternative. Through offering reduced rates for early public transport tickets, event visitors can be stimulated to arrive early at the event location. Profile data of event visitors can be used by *retailers* to customize their offerings to become more appealing. They can offer pre and post experience through customized goods and services based on the profile of the visitors. Retailers benefits from increased (attention of) customers, whom moreover can spend more as public transport tickets are offered at reduced rates. Part of these increased revenues can be invested in ensuring that the business model is financially feasible (e.g. covering for discounts on public transport tickets).

The *city or municipality* can be included as an enriching partner to further finance the service solution. As the municipality will benefit from decreased pollution, an improved flow of traffic and as such an improved image, the municipality may be willing to subsidize offering the service solution. The *event provider* is responsible for hosting the event, for which the service solution is catered. As the service solution may enhance the full customer experience for the event, the event provider can be stimulated to further support offering the service (through incurring costs of providing a financial contribution towards offering the service). As a result, the event provider benefits from increased image, as event visitors will enjoy a hassle-free experience, as well as increased customer satisfaction.

4.4 BM04- Green and Comfortable Commuting to Inner City

Managing traffic and related infrastructure can be particularly challenging in cities with old or historic city-centers with highly dense and protected areas. Bordeaux (France) is an example of such cities which have reached to the limits of its transport infrastructure and resource capacity, while being confronted with rising car traffic to and from its commuter belt, which also requests more parking space. The city has started initiatives to endorse public transportation. Our blueprint (depicted in Figure 5) that emerged in our workshop aimed to support this objective. It takes the inner-city *commuter* traveling by car on a daily basis as the customer of the mobility solution.

The business model blueprint was built on the idea of offering incentives for the commuters to make a model shift when approaching the condensed inner city, and park their vehicles in the outskirts and make use of public transportation to the final travel destination in inner-city.

A number of C-ITS services supports the solution; the commuter is provided with urban parking availability and mode & trip time advice through an application on their smartphones, while green (light) priority is applied for public transportation vehicles. Urban parking availability provides parking information to its users to make informed decisions about available parking places around the vicinity or destination of the user. This is supported by the mode & trip time advice that aims to provide the commuter with an optimal itinerary with public transportation or other modes for the rest of their commuting path. In addition, the solution is supported by providing priority to public transportation vehicles in roads (through traffic signaling) to help reduce their travel time.

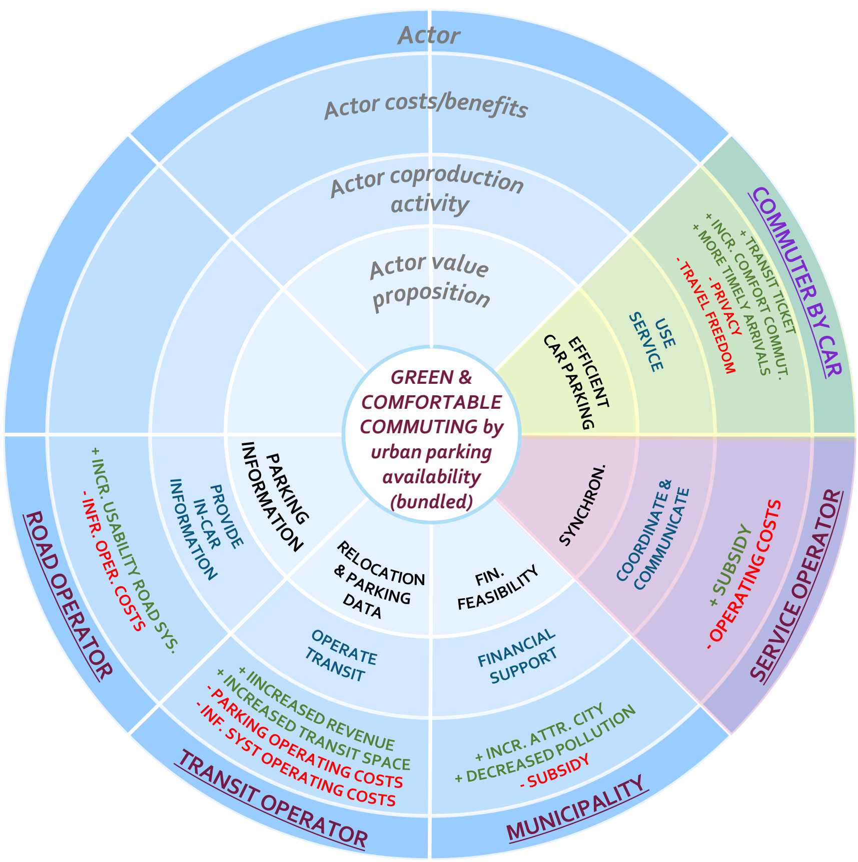

Figure 5 SDBM/R Blueprint for Green & Comfortable Commuting (adapted after [7]*)*

The users that commute into downtown are directed by the application to the nearest suitable parking location in the outskirt, considering dynamic traffic, location, parking, and public transportation data. Accordingly, the application provides advices for the onwards to commuters desired travel destination. Depending on the traffic conditions in downtown, the application offers special incentives to commuters, such as free or reduced-tariff public transportation.

In this service scenario, in addition to reduced travel costs due to free or discounted tickets, the commuters can also benefit from increased comfort, as unnecessary cruising for parking is reduced. The city benefits from decreased pollution and less congestion. The transit operator offers relocation of commuters from the car parks to the vicinity of their final destination, while the road operator ensures a certain level of traffic priority for public transportation vehicles. It provides the parking information and benefits from a better usable road system at the cost of managing or operating the road infrastructure.

The participants of the workshop also designed different variants of the business model by including other enriching parties. For instance, as the commuters' timelines potentially improve, certain employers (companies) located in the inner city can also be included in the network to cover (a part of) the service fee. This can be attractive particularly for those companies that are expected to offer parking facilities to employees. Consequently, employers can benefit from green image and on-time personnel (and can potentially be subsidized for this behavior). Another variant includes a mobility as a service (MaaS) provider that offers relocation through other means (e.g., private taxis) as opposed to public transportation.

4.5 BM05- Safe Driving Experience with In-Vehicle Warning Services

Increasing safety of road users including vulnerable road users (VRUs) is among the key focus areas of C-ITS services [15]. In-vehicle warning services for drivers (such as warning system for VRUs, motorcycle approaching indication, emergency vehicle warning, slow or stationary traffic warning, road works warning) aim to alert the driver in the case of a potential adverse incident to enhance driver's and other road network users' safety [27]. The bundle is particularly valuable when the driver is distracted, visibility is poor, or traffic density is high. In order to operate the service, data is collected on the speed and location of the driver through sources such as road-side units, vehicles, and VRUs (including powered two-wheeler riders). In case a potential incident is detected, the service emits a warning signal to the driver (or automatically takes control) to avoid an incident. In turn, this should improve the safety of both the driver and other traffic users (e.g., pedestrians, powered two-wheeler riders, and other VRUs).

In the business model blueprint depicted in Figure 6, the driver is offered a safe travelling experience through the warning signage services bundle. The bundled service is offered by the service provider through an application either on a smartphone or on an on-board unit. When necessary, the application signals a warning to facilitate the car driver to react timely and adapt to the environment. As such, it enhances the awareness of the driver and improves his or her decision making. This leads to a safer and more comfortable travel experience, as potential accidents can be avoided.

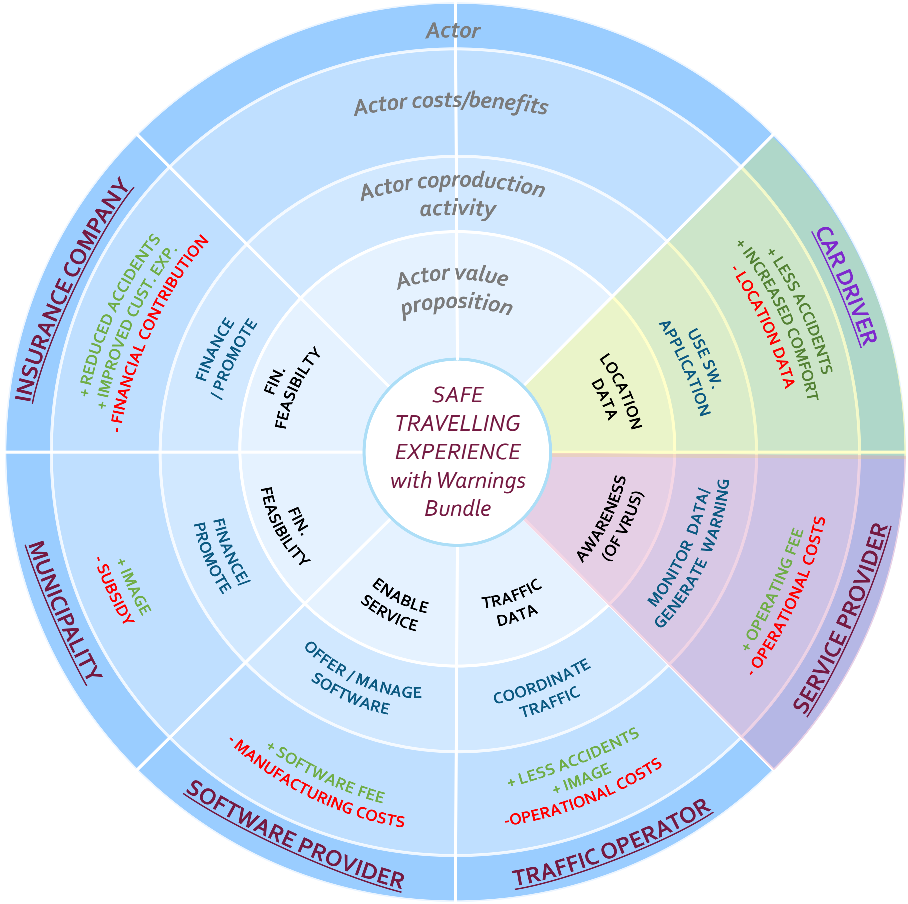

Figure 6 SDBM/R Blueprint for Safe Driving Experience with Warnings Bundle

The traffic operator (or in case integrated, the city/municipality) is responsible for generating and distributing traffic data, specifically with regards to the behavior of VRUs in the vicinity of the driver. This data is consequently integrated by the service provider to provide warning signage when needed. The traffic operator benefits from less accidents as awareness of the driver is increased. The software provider maintains the platform on which the service operates and receives a fee from the service provider.

Financing for the business model is supported mainly by insurance companies, which distribute and promote the service over vehicle drivers in their insurance package. As the amount of accidents is expected to decrease, insurance companies are less frequently required to pay out to compensate for incurred damages. Moreover, this may also lead to an improved corporate image, as the insurance company actively invests in social responsibility. Part of these retained profits consequently can be invested in ensuring that the service remains financially feasible in order to maintain these benefits.

4.6 BM06- Fast and Safe Emergency Vehicles via Green Priority and Emergency Vehicle Warning

The business model blueprint depicted in this section aims to provide fast and safe cruising of emergency vehicles in urban areas with the support of two C-ITS services: green priority and 'emergency vehicle warning for drivers. As mentioned in Section 4.4, the *green priority* service aims to change the traffic signal status in the path of an emergency (or high priority) vehicle to support halting conflicting traffic and allowing the vehicle right-of-way, thereby enhancing traffic safety. The appropriate level of the green priority can depend on vehicle characteristics, such as type (e.g., emergency vehicle) or status (e.g., public transport vehicle on-time or behind schedule). This service can be combined with the emergency vehicle warning to reduce the response times of the emergency vehicles, such as ambulances, fire trucks, and police cars. The green priority request including the location, speed, direction, and identification information of the emergency vehicle can be published via on-board C-ITS applications in the vehicle. Consequently, traffic light controllers can pick up this information and determine in what way they can and will respond the request. The same information can also be picked up by road side units and other vehicles and cooperatively communicated to the traffic on the route of the emergency vehicle. This combination not only allows emergency vehicles to travel faster and safer but also allows other vehicles to react faster and in a safe manner.

In the business model blueprint depicted in Figure 7, the traffic manager offers increased priority for the emergency vehicles operated by the emergency vehicle operator. By making use of this increased priority, emergency vehicle operator provides quicker response times for the cases of emergency. To compensate the increased operating costs, the emergency vehicle operator benefits from lessened driver stress in return. The technology infrastructure required for the services is installed and maintained by the technical service provider. In return for the operational costs related to its co-production activities, the technical service provider benefits from the subsidy support provided by the city/municipality.

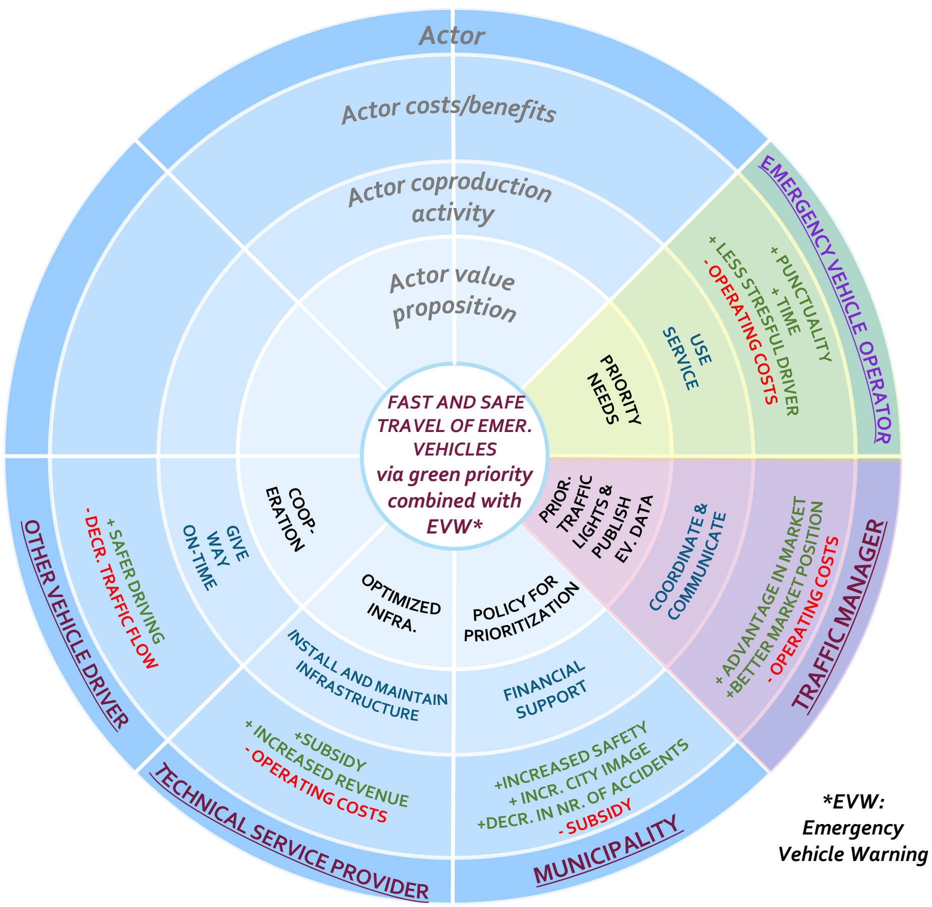

Figure 7 SDBM/R Blueprint for Fast and Safe Emergency Vehicles via Green Priority and Emergency Vehicle Warning

Other traffic users are given timely warnings regarding the emergency vehicle and expected to cooperate so that the potential traffic congestion on the downstream of the emergency vehicle is reduced. They benefit from a safer driving experience as hazardous scenarios are decreased. Furthermore, the city/municipality benefits from increased citizen safety, decreased number of accidents resulting during the response period of the emergency cases, and an improved image, which may justify offering financial support to participate in the business model.

4.7 BM07- Efficient Freight Delivery in Urban Areas with Parking Availability

Freight transport is essential in urban areas for replenishing stocks of various merchandise in shops and markets, and delivering parcels and other supplies to offices in center locations. However, despite the critical need, the freight delivery in urban areas has a number of adverse effects, such as increased traffic congestion and disruption, and increased air and noise pollution. These effects are amplified in city centers where providing sufficient loading and unloading spots are problematic, yet not managed effectively.

The business model (blueprinted in Figure 8) targets at the issues regarding traffic disruption due to urban freight transportation. It does so by bringing structure into the management of parking process and capacity during urban freight delivery through the use of *parking availability* service. The objective is to offer efficient freight delivery in the urban areas with the aim to decrease related traffic disruptions and incidents.

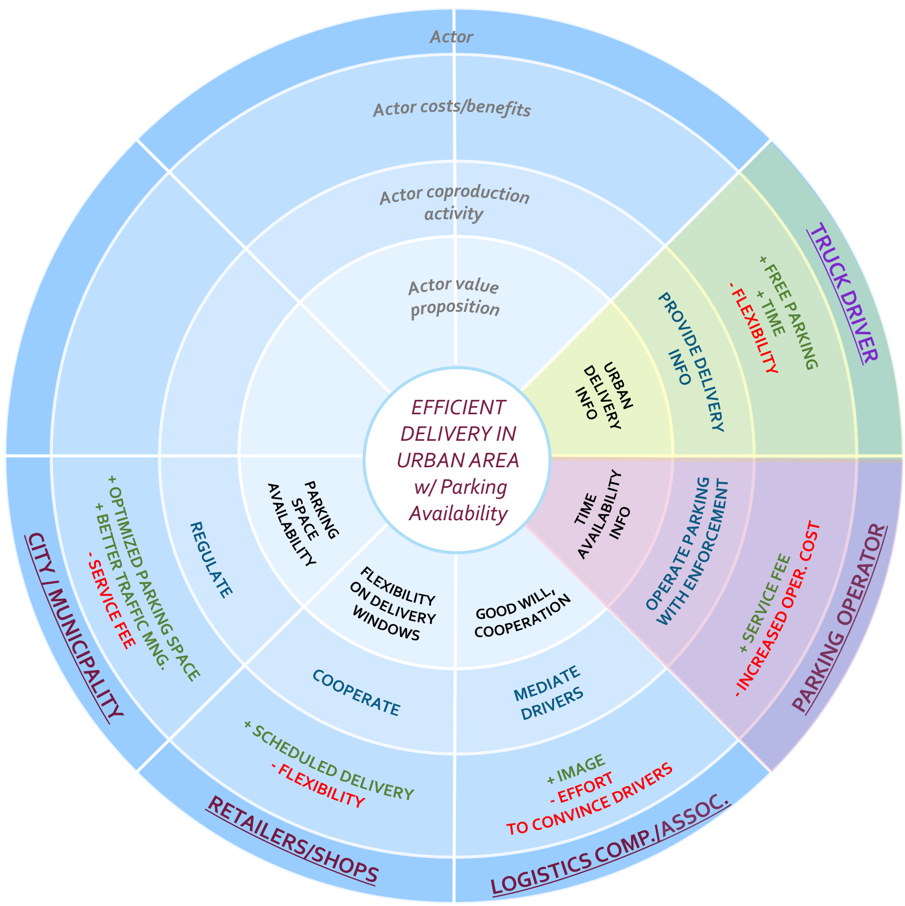

Figure 8 SDBM/R Blueprint for Efficient Freight Delivery in Urban Areas with Parking Availability

The business model is enabled by an application where *parking operator* offers time and availability information about parking spots that are allocated for freight delivery, and *truck drivers* of logistics companies or of specific associations indicate their urban delivery information through reservation. Such parking management schemes is necessary to bring a structure into the related process. However, these schemes are effective only when all relevant stakeholders collaborate closely and the system is operated and monitored effectively.

The key stakeholders include the *city municipality* that owns the parking spaces and is required to regulate this process for traffic efficiency and security; *retailers/shops* that require delivery of goods for their operation; and logistics companies or truck associations that offer the delivery service.

The city municipality provides the parking space that are appropriate for freight delivery free to relevant parties, and pays the parking provider for operating the service. In return, it benefits from the optimized use of parking space, and -more importantly from better traffic management leading to less traffic disruptions around these spots. The parking provider organizes the time availability of these parking spots, and operates the reservation system, and in turn benefits from the service fee it receives from the city municipality. Although the truck drivers can be less flexible in the time-window for their delivery, they spend less time (and fuel) for looking for appropriate parking spots and benefit from securing a parking spot that can be more appropriate for loading/unloading. Trucks that stay longer than their reserved time-slot can be subject to increased parking rates or fines. To provide further support the enabling C-ITS services, specific parking slots that are used for loading/unloading can be equipped with sensors that detect and identify license plates to confirm the presence of the vehicles.

4.8 BM08- Reliable and Efficient Public Transportation via Traffic Information Provisioning

Traffic information services, such as road hazard warning, road works warning, or traffic jam warning, aim to inform the driver in a timely manner, allowing the driver to be better prepared for upcoming obstacles, to improve his or her decision making while driving, and to take necessary actions in advance. These services can either be offered through road-side units (RSUs) or combined with *in-vehicle signage* services. RSUs can collect data on road hazards, road works and traffic jams, as well on real-time behavior of traffic users. Consequently, through either in-vehicle signage or RSUs, this data can be integrated and communicated to traffic users, allowing them to improve their decision making.

The business model, blueprinted in Figure 9, aims to support reliable and efficient public transportation for bus operators through a bundle of traffic information services. The bundle includes services such as road hazards warning, road works warning, GLOSA, and slow or stationary traffic warning. Traffic data is integrated by the service provider and consequently communicated to the *bus operator* as well as *other traffic users. Other traffic users* can use this traffic data to improve their decision making whilst driving. This may include slowing down to adequately cope with hazardous scenarios further up the road or taking a different route instead to avoid a hazardous scenario or traffic congestion. As other traffic users are more informed of upcoming traffic and may potentially change their behavior leading to decrease in congestion.

As busses are confined to standard routes and are not allowed to deviate from these routes, arrival and trip times for busses would become more predictable and reliable as well, considering real-time traffic data. As such, bus operators are able to offer more reliable trip and arrival times to their customers (*commuters by transit*).

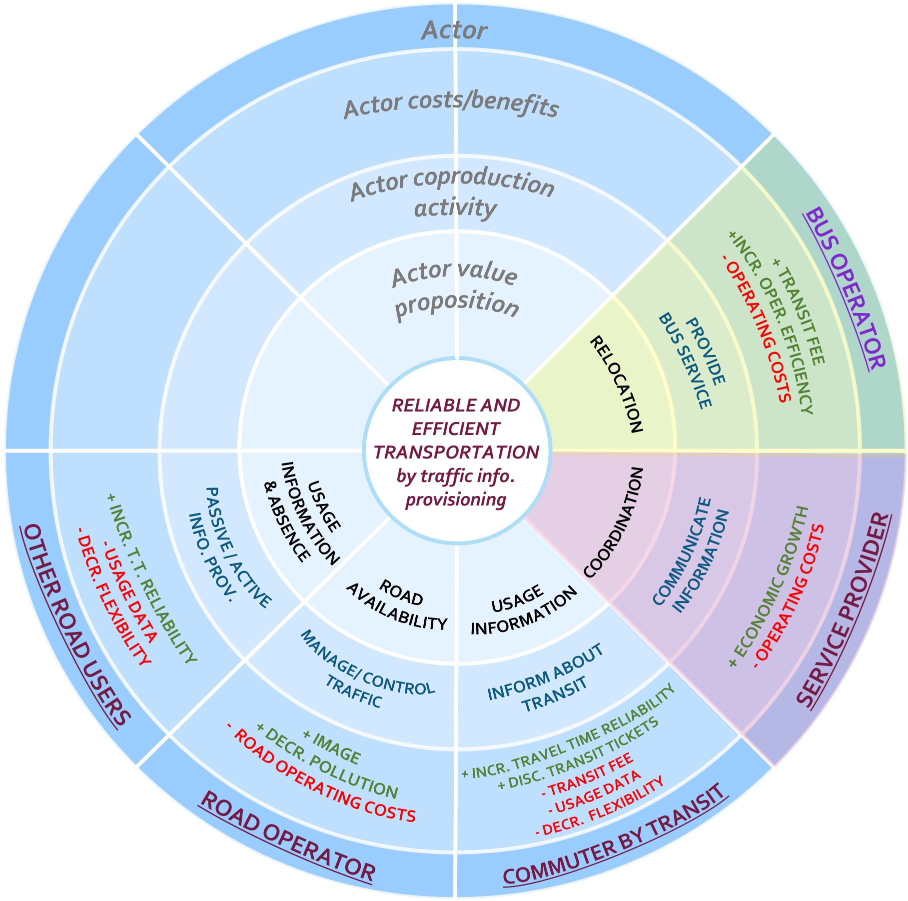

Figure 9 SDBM/R Blueprint for Reliable and Efficient Public Transportation via Traffic Information Provisioning

To further improve the efficiency of transportation for *bus operators*, the *service provider* moreover can collect usage data for busses from *commuters by transit*. This data can be communicated to *bus operators*, showing when peak or high demand periods for busses may occur. Consequently, the *bus operator* can adapt the fleet to match these demand patterns, improving efficiency of the service. *Commuters* which adhere to their proposed travel plans can receive a discount in order to stimulate this behavior.

The business model can be extended by including a social media partner, that can serve to extend the current information platform. In this variant, other road users can receive traffic data from social media channels, serving as an alternative to on-board units. The social media provider can potentially receive a fee for doing so, which is compensated by the decreased operating costs (as part of the information platform is now covered by social media) for the service provider. Moreover, given the adoption of the service, the social media provider can potentially benefit from an increased user base, as road users will use the channel to receive real-time traffic data.

5 Conclusions

Mobility is a promising field with significant opportunities for the exploitation of a service-dominant mindset [4]. Therefore, the use of a collaborative business model design approach that explicitly focuses on value delivery to the customer and that considers the multi-stakeholder nature of the domain can offer significant benefits. In this paper, we show how service-dominance logic can be applied in business model innovation in the mobility domain that exploits the opportunities offered by C-ITS.

C-ITS often acts as an enabling technology in these initiatives. However, business-oriented layers need to be added on top of technology layers to support the viability of applying the technology in practice [8]. In this domain, we see many small-scale digital innovations with a technology-push character. Many C-ITS applications emerge due to increasing technological capabilities. However, these digital technologies rarely offer a value to the end user when applied in isolation and hence have limited impact in the mobility practice. The end-user value is created by composing multiple technologies into complex digital innovations, which involve many building blocks [7].

In this chapter, we presented a set of service dominant business model blueprints that have emerged from the workshops that we have conducted with many stakeholders in eight European cities. Each model involves a particular set of enabling or supporting C-ITS services. A blueprint shows the stakeholders that are involved in offering that solution including their contributions and the main costs and benefits involved in the deployment of the solution. It acts as a guideline in understanding and presenting the operative and economic aspects of the solution. The blueprints can be concretized in local sites and by relevant parties, facilitating an open collaboration of stakeholders in an operational way.

From these practical actions, we can derive a set of key action points that we describe in this section to foster service-dominant business thinking in the mobility landscape. We discuss our recommendations in four categories related to respectively the strategic positioning in the domain, application of the service-dominant business paradigm in the mobility, the use of multi-sided business models, and the importance of explicit treatment of non-financial costs and benefits in business models.

5.1 Strategic positioning in the mobility domain

The service-dominant business leads companies towards an important strategic decision about where they position themselves in ecosystems in this business domain. In the mobility domain, the companies can characterize themselves as asset and technology suppliers, service providers (such as the transportation service provider, content provider, navigation provider), government bodies, policy makers and regulators, and network orchestrators. The last type creates and orchestrates a network of companies and other parties including the customer to co-create a value. They keep the main connection to the customer; hence they control the customer intimacy and often have the greatest potential for getting and keeping the customer engaged.

Complex mobility problems require solutions with multiple services that are provided by a network of parties. Such solutions often require parties from each of the stakeholder groups listed above. However, an individual organization (profit or non-profit) should focus its attention and align its strategy to represent only one of these groups. It should choose the perspective in which it excels and leave the rest to other domain players who excel in their own perspective. Trying to combine multiple perspectives in a single player may lead to a detrimental loss of focus.

The workshops performed with many stakeholders have shown a strong need for the presence of privately managed 'network orchestrators' in the mobility domain. Despite a considerable number of players in other stakeholder groups, orchestrators that would act as the main business catalyst are scarce. However, the business models resulting from this action make a convincing business case for companies to re-align their strategy to become orchestrators.

5.2 Application of the service-dominant business logic

The mobility domain can be considered as an asset-centric business domain, in which business thinking often starts with consideration of assets. Assets can be road-side units, traffic signage equipment and systems, vehicles, and traffic management/information systems, as well as the communication infrastructure and related technology. This often leads to a means-to-goals direction of thinking and an inside-out (provider-to-customer) perception of the market.

End customers in the domain (such as road users), however, are mainly interested in the added value brought by the mobility services or solutions (such as congestion-free travel, safe journey, fast travel) - not so much in the means to accomplish these services. In other words, customers are interested in the value-in-use obtained by the execution of mobility services - they prefer the outside-in-view. Assets in the domain are certainly required, but to customers they are of secondary interest only. The more complex a market gets, the more different the inside-out and outside-in views become.

We believe that the policy makers and other organizations in this domain should promote the thinking that starts from customer value instead of thinking that starts from mobility means. This means that they should promote customer-centric design of business models (outside-in thinking) instead of provider-centric design of these models (inside-out thinking).

5.3 Multi-party business models

Most business settings in the mobility domain have a multi-stakeholder nature. For example, from the mobility point of view, the organization of a large-scale consumer event involves not just transport providers, vehicles and road authorities, but also event organizers, security providers, municipalities, parking providers and many more.

In traditional business design settings, collaboration can only be modeled and designed in bilateral settings, i.e., by considering pairs of organizations in their business relations. Here, more complex scenarios are created by nesting bilateral relations, typically by means of outsourcing. In contemporary mobility settings, complex business models often only become viable when analyzing them directly in a multi-party setting in which more than two parties collaborate at the same level (i.e., to design multi-sided business models). At this collaboration level, several value streams exist between parties that together form a viable business system. The business models developed in our workshops and described in this chapter illustrate this point: all have considerably more than two parties at the same collaboration level. Note that this does not mean that bilateral contracts become obsolete: multi-sided business models can be formalized in a set of bilateral contracts (typically between the orchestrator and each of the other parties).

From the above observations, we argue that organizations in this domain should use techniques that enable the design and analysis of *multi-sided* business models. Policy makers and regulators should trigger organizations to experiment with multi-sided business models in a light, explorative way with multiple stakeholders involved. Experience from our workshops shows that prototypes of business models can be collaboratively designed within a few hours, often leading to interesting new business ideas. Having a moderator who is trained in service-dominant thinking involved in the design process is, however, essential to reach these outcomes.

5.4 Non-financial costs and benefits

In typical business thinking in many domains, the emphasis is often on decreasing financial costs. Sometimes, carbon footprint is explicitly considered, but in many cases, this can be mapped onto financial costs. However, other costs and benefits often are in play as well, which need to be considered to make a multi-sided business model work. For instance, there may be stakeholders that do not have a direct financial benefit in a business model but that are required to make it work; there may be stakeholders that have financial costs that may be offset by non-financial benefits.

For example, public/governmental organizations are expected to emphasize safety and ecological preservation, which are difficult to quantify in financial terms, yet should be considered as non-financial cost/benefit items in business model designs. Another example relates to the value of data. With the increasing attention on data analytics and business intelligence, business data has become more important for organizations and a significant motive to participate in collaborations based on business models that incur direct financial costs but have no direct financial benefits – these financial benefits can be reaped by using the data in other business models.

From these observations we argue that organizations should promote thinking in both financial and non-financial benefits (and costs) in business models. Both types can be exchanged for each other where so required. In doing so, they should start thinking in a qualitative way to keep business model design open, and quantify non-financial costs and benefits in a later stage of business model design. An important consideration is that concrete approaches or standards should be developed to guide the quantification of non-financial costs and benefits related to, for instance- information/data, safety, reduction in ecological impact, image, and visibility.

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