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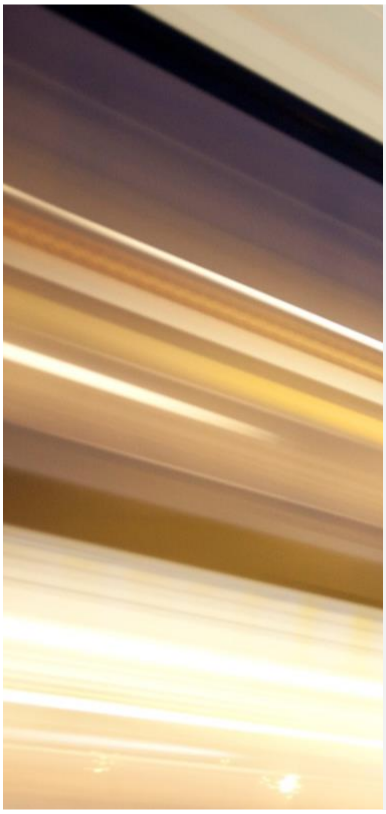

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Future Rail Business Models

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The SBB Research Fund supports research on current issues concerning the Swiss transport network or in an international context with a special focus on innovation and the future of mobility. It aims to support long-term sustainable development of the transportation network and to strengthen collaboration and the visibility of Swiss research in the field of transportation management. Its research advisory board hosts leading transportation researchers from Swiss universities, polytechnic institutes, and universities of applied sciences.

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ABBREVIATIONS

1stP#	First-order parameter (# represents parameter number)
2ndP#	Second-order parameter (# represents parameter number)
BM	Business model
BMI	Business model innovation
CapEx	Capital Expenditure
Cont.	Continued
Etc.	Et cetera
F&B	Food and beverages
Ger.	German
IC	Inter-city train
IR	Inter-regional train
MA	Morphological analysis
MaaS	Mobility as a service
MAX	Maximizing directionality of attribute fulfillment
MIN	Minimizing directionality of attribute fulfillment
MIT	Motorized individual transportation
Mm	Millimeter
O&D	Origin and destination
OK	Optimizing directionality of attribute fulfillment
OpEx	Operational expenditure
PoP	Point of purchase
PoS	Point of sale
PT	Public transport
RBV	Resource-based view
RE	Regional Express Train
RTA	Regional tariff associations
S	Local mass transit
SBB	Swiss Federal Railways
SLA	Service level agreement

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DISCLAIMER

This research was conducted pre Covid-19 and pandemic implications neither prominently feature in the source material for scenario development nor the results of this report.

ACADEMIC ABSTRACT

While existing studies envision the future of mobility and foreshadow change, they omit to discuss implications for specific business models and their value creation logics. Yet, identifying development trajectories for existing and new business models is key to determine how railway companies will provide sustainable value in tomorrow's mobility landscape – specifically, as consumer preferences and technologies change. New technologies enable virtual integration along service, travel, and logistics chains, new transportation production concepts, and added functionality. This opens trajectories for new business models and the augmentation of existing models of passenger and freight transportation. In this report we develop a morphology of configurational options for railway companies' business models based on the Swiss case, identify novel configurations based future mobility scenarios, and deduce strategic implications for existing railway business models with a particular focus on passengers.

MANAGEMENT SUMMARY

This report suggests viewing the future of incumbent railways as a matter of developing a portfolio of future mobility business models from a customer perspective. Unless they become focused on a single aspect of transportation chains, there is no single business model for future integrated railway companies. Thus, incumbent railway undertakings should consider assuming different roles within those future mobility business models in relation to their respective strengths, the inherent service potential of their resources that enable value creation in future mobility systems, the entrepreneurial freedom granted by (political) mandates, and their ability to capture value by means of creating lock-in, complementarity, and efficiency.

This conclusion is based on scenario development for the future Swiss mobility landscape, business model mapping with Swiss Federal Railways (SBB) as case study, and morphological analysis to develop a morphology for future mobility business model with a rail focus as a disciplined innovation tool. The end of those research outputs it to demonstrate how railway companies can systematically develop novel mobility business model configurations to provide value-added from future mobility services.

The report identifies six topical clusters that summarize 100 drivers, which 73 existing future mobility studies and reports published until 2019 expect to affect future demand, supply, and their contingencies by 2040: (1) innovations in materials and information technology, (2) intensified cooperation and sharing of resources, (3) urbanization and efficient use of land, (4) shift towards sustainability and renewable resources, (5) regulatory issues and the inclusion of minorities, as well as (6) increasing flexibility and virtuality. These clusters informed the development of eight scenarios for the Swiss mobility landscape 2040 differentiated by the degree of technology diffusion (y-axis) and the density of interaction points for productive, consumptive, or social transactions and exchanges (x-axis).

The morphology for future mobility business models, tested with 12 senior case-company representatives, identifies 10 second-order parameters and 52 first-order parameters with 312 parameter values detailing the options for design decision to map present and envision future business models. The morphology and the associated innovation process are a helpful tool to explore alternative business model configurations and complement the Business Model Canvas for more depth and disciplined variation in exploring a portfolio of alternatives potentially suited to address future customers' jobs-to-be-done.

1 INTRODUCTION

The drive to understand the future of mobility has inspired a considerable number of studies and reports. Existing studies elaborate several competing scenarios of mobility systems and context (economic, social, environmental, and legal) for 2025-2050 that foreshadow change in three key areas with implications for portfolios of different business modes that integrated railway companies are running today.

First, developments in materials and information technology facilitate the shift towards higher levels of sustainability and renewables in the transport sector. Process automation and digitization, connectivity (vehicles, infrastructure, users), autonomous and learning technology in tandem with electrification are expected to drive the opportunities and threats of the new competitive landscape of mobility solutions. Second, increasing urbanization and land use (congestion, overcrowding, emissions) drive intermodal cooperation and sharing of resources. The development of urban work and living arrangements makes access to integrated door-to-door mobility solutions more important while ownership is less sought-for. Third, growing flexibility and virtuality of work and life is reflected by more diverse travel patterns and motivations, work-life blending, spontaneous consumption, shifting social contracts (intergenerational, user-pays principle), and on-the-go work and consumption. Those behaviors relate to shifts in customer preferences and expectations associated with mobility services. Regulation and the inclusion of people with very diverse needs require flexible, convenient, efficient, and customizable on-demand services of predictable and reliable quality.

While these are important pointers for a strategic discussion of the future of mobility that preoccupy the management of European railway companies, there is a key omission. These studies rarely, if at all, discuss implications for specific business models and their value creation logics. This is, however, important to address to inform the future profile in value creation, capture, and dissemination of mobility solutions at a system- and at an operator-level – particularly given tight system integration, national and economic importance as well as investment and commitment of public resources. Furthermore, this is important because these changes challenge the inherent service potential of current resources and capabilities. They question the perceived value-added experienced by specific customers based on their respective jobs-to-be-done. And they might imply changes in the degrees of freedom for entrepreneurial management the regulatory framework defines.

The outlined gap motivates this research project. Specifically, we ask, *how can railway companies systematically develop novel mobility business model configurations to provide value-added from future mobility services?* To this end, we consider rail-based mobility as relevant anchor for the discussion of future mobility business models in context of multi-modal transportation systems. The Swiss mobility landscape and its integrated national railway undertaking (short: SBB) serve as case context and iconic case study of high network density based on legacy infrastructure, extensive public and government commitment to public transportation, and wide use from customers independent of social status.

This research report contributes to the ongoing discussion on the future of mobility in two key ways: First, it integrates insights from the current literature on the future of mobility in a set of *scenarios* for the Swiss national context. These scenarios serve as both a future to develop new mobility business models in as well as a future to project existing rail business models into for a discussion of challenges and development trajectories. Second, it proposes a new *morphology* of configurational options and complementary process to develop mobility business models of railway companies for the future with a clear customer focus. We thereby contribute to the literature on business models as concept in action and the transportation literature concerned with the future of mobility. What this report neither attempts nor could reasonably provide is a prediction of what the portfolio of future mobility business models (with a rail focus) will be in 2040. It does, however, provide a valuable tool for disciplined imagination working toward potential futures and it offers observations as to what considerations might guide future business model development for incumbent railway companies.

This report is structured into six main sections: Chapter 2 provides the theoretical and conceptual background for this report. It introduces the business model, the scenario, and the morphology as concepts and explains how they relate to one another in the context of business model innovation efforts. Chapter 3 reviews existing work on the future of mobility and existing literature on future mobility business models. In tandem with the previous chapter, those considerations motivate the research design and methodology that is introduce in Chapter 4. The subsequent Chapters 5 and 6 detail the results of this study and discuss implications for current railway business models from a portfolio perspective as well as for innovation efforts in designing future mobility business models. Chapter 7 closes with high-level conclusions, limitations, and pointers for future work in this area.

2 THEORETICAL AND CONCEPTUAL BACKGROUND

This chapter introduces three key concepts relevant to this research report: the *business model* as a concept from managerial and organizational research well-suited to study how future mobility will create value to different stakeholders; the *scenario* as a mental model in disciplined foresight to both anticipate potential future business model configurations and to challenge existing ways of value creation and value capture in mobility services; and, finally, the *morphology* as a configurational take on the systematic deconstruction of the complex problem that the anticipation of future mobility business models presents for administrative, industry, and other actors with an interest in the future of transportation. The chapter ends with integrating the three concepts to explain the how innovation and change is understood in context of this report.

2.1 Business models

The strategic management literature defines the *business model* as an integrated description of the logic and mechanism by means of which a focal actor (e.g., a firm, a business unit, etc.) creates and captures value (Massa, Tucci, & Afuah, 2017). As such, the business model "demonstrates how a business creates and delivers value to customers. It also outlines the architecture of revenues, costs, and profits associated with the business enterprise delivering that value" (Teece, 2010, p. 173). In addition, it explains how the value captured in profits and free cash flows is disseminated among key stakeholders to sustain and evolve the business (Bieger & Reinhold, 2011). Unlike other management concepts (e.g., competitive strategy, marketing plans, etc.), it enables an unprecedented integrated, systemic perspective of value creation across organizational, functional, and conceptual boundaries.

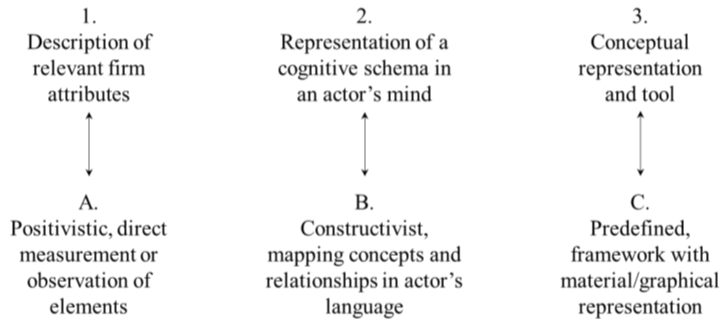
The scale and scope of a business model sometimes corresponds with the boundaries of organizational units whereas in other instances, it cuts across different units and hierarchy levels and critically involves external contributors. For example, a division like passenger transportation at Swiss Federal Railways can operate one or multiple different business models in lead or supporting role. This makes the concept challenging from a practical perspective. But it also makes the business model particularly valuable and worthwhile to understand the implications of potentially disruptive change and new competition (Snihur, Thomas, & Burgelman, 2018) that does not necessarily adhere to how established firms do and structure their business and associated processes (Fjeldstad & Snow, 2018).

A business model is not the same as a strategy (Casadesus-Masanell & Ricart, 2010). A strategy is a contingent plan of action that outlines a firm's area of activities while considering relevant competition. Within the general scope and normative guidelines of a strategy, a firm can pursue multiple potential business models. For example, "Switzerland's leading mobility service provider" (strategy claim) could operate business models as diverse as low-cost train services, a sub-terrestrial infrastructure for cargo distribution, a price comparison website for inter-modal transportation services, a mobile application to locate free peer-to-peer sharing cars, or an advertisement-sponsored news alert for commuters pushing train line disruptions. Whatever the firm choses, any implemented business model enables a set of tactical actions for specific operational decisions (e.g., specific marketing strategy to push certain services that embellish the value proposition defined in the business model).

In practice, business models are reflected in but not limited to strategy tools such as the Business Model Canvas (Osterwalder & Pigneur, 2009) or implicitly in business plans for projects and initiatives as well as strategy presentations and reports (Doganova & Eyquem-Renault, 2009) used in both established and new venture settings. However, business models also manifest as the sum of strategic choices that define the activities and policies to create value for customers and capture sustainable revenues for the firm in daily operations (Reinhold, Zach, & Krizaj, 2017) – that is the implemented business model(s). While there is a considerable number of companies that grapple with understanding and evolving their own business models (Johnson, Christensen, & Kagermann, 2008), business model innovation is a key priority of established firms across industries (e.g. De Jong & van Dijk, 2015; IBM, 2010).

Figure 1 summarizes the different takes on the business model concepts represented in academic and practitioner discourse based on Reinhold and colleagues (2017).

Figure 1: Conceptualizations of the business model



Source: Adapted from Reinhold, Zach, and Krizaj (2017, p. 475)

This report builds on these existing notions of the business model concept to develop a morphology of configurational options for railway companies' business models in future mobility scenarios. As such it deals with relevant firm attributes (1.) embedded in a conceptual representation (3.) to influence how actors in the transportation system think about the future of mobility (2.). Chapter 4.4 details methodological considerations of business model mapping whereas chapter 5.1.2 presents the business model maps for the case study at hand.

2.2 Scenarios

Scenarios are a key ingredient to discussing how the mobility context of the future will challenge and serve as the basis for future mobility business models. The use of scenarios has its roots in strategic, operational, and tactical planning for military purposes as well as the language of theatre and film. It was introduced to futurology and economics in 1967 by Herman Kahn and Anthony J. Wiener in their seminal book "The Year 2000: A Framework for Speculation on the Next Thirty-Three Years" and finds regular use to this day in politics, science, and industry as forecasting technique in strategic processes.

Kahn and Wiener (1967) define the term *scenario* as "a hypothetical sequence of events constructed for the purpose of focusing attention on causal processes and decision points" (p. 6). Hence. scenarios are alternative visions of the future created based on extrapolating a synthetic sequence of events based on assumptions about causal processes and their impact to create parallel and/or competing end-states for a specific system within a given timeframe. This report proposes multiple parallel future mobility scenarios for the Swiss transportation system in 2040.

The ends associated with scenario planning include anticipation (prospective thought), action (strategic will, either reachable or non-reachable) or appropriation (collective mobilization) (Godet & Roubelat, 1996). These three ends are to varying degrees associated with three different scenario types (Börjeson, Höjer, Dreborg, Ekvall, & Finnveden, 2006): the *predictive* type (i.e., forecasts or what-if exploring what will happen given certain assumptions), *explorative* type (i.e., what will happen to external factors or if certain strategic action is taken), *normative* types (i.e., how can a target be reached by preserving or transforming the status quo). A minimal process for scenario development for either one of these types normally consist of three steps: first, knowledge collection and idea generation; second, data collection and integration of information to "pictures of the future"; and finally, consistency checks (Börjeson et al., 2006).

Chapter 5.2 details this report's exploratory scenario of external factors that undergird the Swiss future mobility scenarios for 2040. Given the plethora of existing literature on the future of mobility (see chapter 3.1), the first step for the creation of scenarios in this report consisted of reviewing that body of knowledge. To subsequently explore what the predictions on the future development of external factors imply in interaction, we integrated and consistency-checked the literature with a systemic factor-condition-level-array (also known as Zwicky table) (Duczynski, 2017; Ellinas, Allan, & Johansson, 2016). The details of this methodology are specified in chapter 4.2. The resulting vision of the future of Swiss mobility serves as a frame of reference and basis for evaluating existing and developing future business models.

2.3 Morphologies

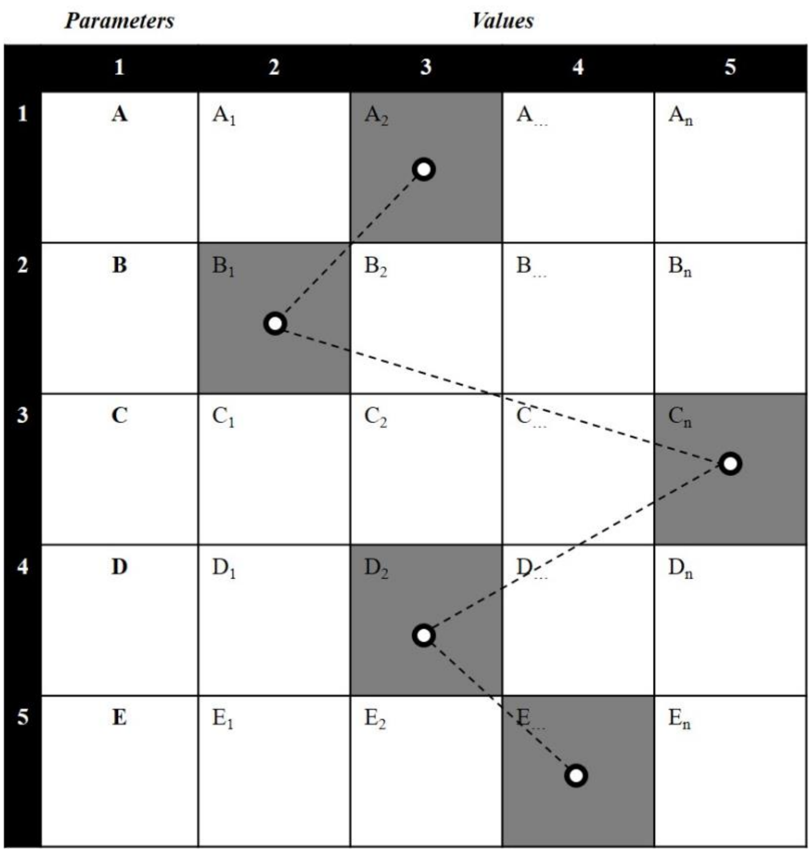
Morphology as a term refers to the ontological deconstruction of research objects to understand how the configuration of their essential elements ("building blocks") shape the gestalt and nature of those very objects (Ritchey, 2011). Across scientific disciplines, researchers have been using morphology to understand objects such as social systems (e.g., organizations), mental constructs (e.g., ideas or concepts), and biological and physical systems (e.g., ecologies) in their past, present, and potential future states (Ritchey, 2011).

A *morphological model* establishes relationships between two or more variables that can assume different values on the basis of logical, statistical, or any other type of argument whereby variables (also referred to as *parameters*) represent the building blocks of the object being studied (Ritchey, 2011). For instance, the common 2-by-2 consultancy matrix frequently used to represent concepts in business studies is a simplistic form of a morphological model. The relationship between parameter values across morphological fields is mostly argued for on logical grounds because morphological analysis is predominantly used for investigating research objects that are inherently multi-dimensional and hard to quantify (Ritchey, 2011). Herein lie the strengths of this method:

> "It is built upon the basic scientific method of going through cycles of analysis and synthesis and 'parameterizing' a problem space. It defines structured variables and thus creates a real model, so to speak, in the form of a linked variable space in which inputs can be given, outputs obtained, and hypotheses ("what-if" assertions) made" (Ritchey, 2011, p. 39).

The method is thus compatible with approaches to innovation used in new business model design and scenario planning that build on designing experiments for trial-and-error learning and theory-driven planning (Govindarajan & Trimble, 2004; McGrath, 2010).

Figure 2: Generic morphological table



Source: Own illustration.

Figure 2 illustrates a generic morphological model in the form of a *morphological table* (also referred to as Zwicky table). Each row heading (in column 1) refers to a different parameter (i.e., A through E), each of the four columns to the right of the figure detail different values per parameter (i.e., A_1 trough E_n). The cells that contain values per parameter are known as *morphological fields* (Ritchey, 2011). A particular selection of fields meaningful to the object at hand is called a field configuration (i.e., grey shaded fields connected by a dotted line).

Figure 2 is using a pivoted notation of Ritchey's (2011) tables because this is the form that the morphology for future mobility business models will take to still be legible and printable. Also note that that equal numbers in values per parameters, like Figure 2 suggests, is no requirement of morphological analysis. That is, the morphological table for a specific research problem might list just two values for one parameter, while for other parameters, it might feature long lists of potentially meaningful values.

In this report, morphological models and analysis inform the design of future mobility scenarios and the configurational options for future rail business models. For details on how this is implemented in the methodological design and analytical strategy, refer to chapter 4.5. The resulting morphology for future (rail) mobility business models is detailed in chapter 5.3.

2.4 Business model innovation and change

Business model innovation refers as much to finding new ways to create and capture value as it denotes attempts to discover fundamentally new business logics in existing industries (Casadesus-Masanell & Zhu, 2013; Markides, 2006). This report focuses on work that helps understand efforts to develop new business and understand transformation in existing business models (Spieth, Schneckenberg, & Ricart, 2014) for the future of mobility.

Unlike other innovation types, business model innovation is concerned with how "a system of products, services, technology, and/or information flows that […go] beyond the focal firm" (Clauss, 2017, p. 387) is innovated as an overall logic of business. A non-trivial change (e.g., more than an isolated product tweak or new supplier for parts) is required in "the key elements of a firm's [business model] and/or the architecture linking these elements" (Foss & Saebi, 2017a, p. 216). Thereby, business model innovations exhibit at least three characteristics that make them essential yet difficult for incumbent organizations such as existing railway undertakings:

First, business models are not bound to the organizational boundaries of a focal firm. In many instances, value creation and capture require the activities and contributions of an entire *network of partners* and stakeholders (Zott & Amit, 2010) that may collaborate in varying constellations and arrangements (Bieger & Reinhold, 2011). Finding the commitment and resources to innovate, determining innovation trajectories, and "fair" keys to share the risk and distribute the value from innovation is inherently difficult.

Second, even with a focus on a single focal firm, the *systemic nature* of the business model concept with its numerous interdependent subsystems (Foss & Saebi, 2017b) requires manifold choices with hard to anticipate consequences (Casadesus-Masanell & Ricart, 2010). This involves considerable cognitive complexity (Martins, Rindova, & Greenbaum, 2015) that is amplified when firms manage a portfolio of different business models (Snihur & Tarzijan, 2018) – as is the case for many integrated transportation companies. Innovating and changing business models hence requires managers to understand the interdependencies and consequences of interventions, which are hard to foresee without market tests (Chesbrough, 2010). One way to address this suggested in the literature as well as (corporate) entrepreneurial practice is by means of designing organizational experiments (McGrath, 2010) and in using business model mapping, templates and other disciplined innovation methods (Reinhold, 2014). But many existing tools are limited in their cognitive effectiveness (Henike, Kamprath, & Hölzle, 2019) risking to result in either limited use or a misconstrued understanding of the essence of business models analyzed.

Finally, for business model innovation efforts to materialize beyond early conceptual considerations requires *managerial attention and support* because of its systemic nature as well as its stretch across inter- and intra-organizational boundaries. Among other things, managers need to make sense of and enact nascent developments to shape opportunities (Shepherd, Mcmullen, & Ocasio, 2017) while freeing resources and allowing innovation efforts to break with existing routines (Gilbert, 2005), shield development efforts from conflicts with established business following a different business logic (Bucherer, Eisert, & Gassmann, 2012; Govindarajan & Trimble, 2004), and develop a strategy and narrative on how to link new business activities to the incumbent organization over time (Markides, 2006, 2015).

In sum, the purpose of the scenarios and morphology presented in this report (see chapter 5) is to contribute to business model innovation and change efforts of railway undertakings for future mobility in two important ways that address those three challenges:

First, the review of existing studies on the future of mobility and the integration of their suggested drivers and developments in scenarios provide signposts as to what developments in different organizational environments and interaction spheres (Post, Preston, & Sachs, 2002) are potentially deserving of managerial attention (see chapters 3.1 and 5.2). That is, either to assess the resulting need for change in existing business models or to develop new ones in terms of their systemic – rather than isolated – consequences. Exemplary consequences are illustrated in the chapter that maps the business model of the focal organization in the case study in chapters 5.1 and 5.4.

Second, the morphology for future business models helps innovators and managers develop a deep appreciation and structured understanding of the configurational choices in new business model design (see chapter 5.3) and addresses concerns leveled at existing tools in terms of cognitive effectiveness (Henike et al., 2019). This is an important stepping stone toward designing organizational experiments and materializing future business models both from an innovation management perspective as well as justifying resource commitment and leeway to explore new ideas as top management (see chapters 5.4 and 6).

3 FUTURE MOBILITY AND BUSINESS MODELS

This chapter systematically reviews existing future mobility studies as well as existing literature that details future mobility business models. Based on these sources, drivers of mobility innovation were identified, reviewed, and clustered to understand what customers might expect from future mobility (see subchapter 3.1). In total, we identified six topical clusters of drivers, which affect future demand, supply, and their contingencies: innovations in materials and information technology, intensified cooperation and sharing of resources, urbanization and efficient use of land, shift towards sustainability and renewable resources, regulatory issues and the inclusion of minorities, as well as increasing flexibility and virtuality. A second review in subchapter 3.2 offers specific conclusions on future mobility business models. In short, most existing morphologies either emphasize characteristics of new technologies (e.g., electric or connected mobility) or focus on properties of new mobility modes (e.g., sharing and pooling).

3.1 Review of future mobility studies

3.1.1 Identification of drivers

Based on Google and Google Scholar search queries[1] on the *future of mobility* and *mobility business models* in January 2019, a wide range of recent studies and reports from think tanks, research institutes, consulting firms, mobility tool providers, government agencies, and NGOs have been identified. Table 1 summarizes the number of publications identified by year and in total. While most authors of the collected studies are based in the Western world (especially in European countries such as Germany and Switzerland), half of the publications have a global scope. A total of 74 publications (see Appendix A1 – Sources of literature review on future mobility) with approximately 3,500 pages have been skimmed to identify 100 drivers for future mobility and for the underlying business models. In this context, *driver* refers to any entity or development providing an impulse for change in the mobility domain whereby change does presuppose any specific kind of trajectory for this change (e.g., it could be extending or restricting, enabling or prohibitive, revolutionary or evolutionary, etc.).

All studies and reports included have been published in the last ten years, with a majority dating from 2017 and 2018. The emphasis of these studies is on land-based transport. However, most publications do not focus on any specific mode but on mobility in general.

Table 1: Analyzed Studies per Year of Publication

	Year											
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	*Total*
No. of publications	1	3	2	0	6	3	13	8	21	16	1	*74*
No. of pages	99	192	27	0	300	149	755	394	847	779	8	*3550*

Source: Own analysis.

3.1.2 Topical clusters

The collected publications were manually screened for *drivers* of future mobility by two researchers. Among other things, the resulting list of 100 drivers included risk factors, different kinds of innovations as well as suggested mega- and demand trends. To establish order, we used the six dimensions of the PESTEL framework to group the initial list and identify political, economic, social, technological, environmental, and legal drivers. This initial coding procedure resulted in two conclusions: First, many drivers cannot be allocated to a single PESTEL category as their nature and consequences stretch multiple PESTEL dimensions. For example, decarbonization and electrification of mobility are not just related to the environmental dimension, but also based on technological, economic, political, and legal developments. Second, many drivers that stretch across PESTEL categories belong to similar topical clusters. For instance, climate change is highly related to a cultural change towards sustainability, but also to demand for more ecological transport and advancements in battery and charging technology.

Those observations from the initial coding informed a second round of interpretive coding that made sense of the 100 drivers in terms of their topical relatedness. As with any qualitative categorization effort, the goal was to create topical clusters that are distinct from one another while uniting drivers that share high interpretive relatedness within each cluster. Six distinct clusters of drivers for future mobility and its business models emerged from this coding procedure.

The following paragraphs contain short descriptions of the six identified topical clusters (in ***bold italics***) with included drivers (in *italics*) ordered by frequency of mentions of included drivers. To keep the descriptions legible, a single exemplary source is indicated for each driver.

Materials and information technology: Advancements in materials sciences allow for *stronger and lighter materials* (Corwin, 2015) and facilitate the development of *new vehicles (sizes or modes)*

(Dornier Consulting, 2017). Pods, *drone technology* (Arthur D. Little, 2018), but also *hyperloops* (Arup, 2014) and *high-speed rail networks* (Amadeus, 2011) are suggested to be elements of future transport systems. Next generation information technology boost *autonomous applications* (Accenture, 2018). With the help of *5G infrastructure* (Seiberth & Gründinger, 2018), studies expect the realization of the *internet of things* (Mosa, 2015) and the deployment of *connected cars* (Shaheen, Totte, & Stocker, 2018) at scale. As a result, *platooning (truck and car-trains)* (Continental, 2016) becomes possible and leads to *reduced traffic jams and crashes* (McKinsey & Company, 2016b). This progress is based on *HD maps* (Seiberth & Gründinger, 2018) and *big data with advanced analytics* (Arthur D. Little, 2018) to optimize traffic on an aggregate but rolling basis. The availability of increasing amounts of data and processing power allows for corresponding *business model innovation* (Accenture, 2018). In transportation systems, *open data or APIs* (Shaheen et al., 2018) and *ecosystem platforms* (Arthur D. Little, 2013) facilitate *data-driven services* (Clarke, 2015) such as *mobility as a service (MaaS)* (Goodall, Dovey Fishman, Bornstein, & Bonthron, 2017) with customer-specific *service level differentiation* (Froböse & Kühne, 2013). Furthermore, *AI, bots, and avatars* (Arthur D. Little, 2018) help create *public individual on-demand transportation* (Bundesamt für Raumentwicklung (ARE), 2017), based on *new pricing or payment models* (EPTA, 2018) and *ticketless systems* (PWC, 2017).

Cooperation and sharing: Due to the network logic of mobility services, *inter- and multimodality* (Bundesamt für Strassen, 2015) are often advisable for hassle-free door-to-door travel experiences. *Cross-sectoral collaboration and public-private partnerships (PPP)* (WBCSD, 2018) might be required to create seamless integrations of various forms of transportation. Very often, *coopetition* (McKinsey & Company, 2016a) rather than competition is key to efficient solutions because cooperation is a necessary precondition to establish, for example, *timed or pulsed rail schedules* (Shaheen et al., 2018). In the future, *blockchain* (Seiberth & Gründinger, 2018) applications might facilitate or even eliminate intermediation between the different actors. Population density and technological advancements facilitate the establishment of *sharing economy* models (EY, 2015), especially in the mobility sector. *Using instead of owning* (Zukunftsinstitut, 2017) is becoming a viable business model pattern. Services such as *ridesharing, micro-transit, paratransit* (Shaheen et al., 2018) or *ride-sourcing* (Briggs, 2015) enable *reduced vehicle ownership* (EY, 2015) and *increasing utilization of assets* (McKinsey & Company, 2016b), which might result in *reduced trip cost* (Corwin, 2015).

Urbanization and land use: At a global level, *urbanization* (Arthur D. Little, 2014) is expected to continue along with a *rural exodus* (IGES Institut, 2017) in many regions. Dependent on transportation systems and spatial planning policies, the *population growth* (Weidmann, Kupferschmid, Riegel, Stölzle, & Klaas-Wissing, 2015) in urban areas can either manifest as monocentric megacities, *polycentric settlements* (Bundesamt für Raumentwicklung (ARE), 2017) or *urban sprawl* (Bundesamt für Strassen, 2015). Lack of space and *scarcity of funding* (Avenir Mobilité, 2015) are often limiting upgrades and extensions of transportation systems. Hence, fighting *increased congestion* (Rieck, Machielse, & van Duin, 2017) will require measures to *reduce traffic peaks* (Roland Berger, 2013) using *mobility demand management* (Arthur D. Little, 2014) and *demand response management* systems (McKinsey & Company, 2016b). These might be based on *mobility credit systems with crypto currency* (Froböse & Kühne, 2013) or they might be extensions of traditional *road pricing* (Anker Nielsen, 2018) and *mobility pricing* schemes (EPTA, 2018). These solutions will aim to *internalize external costs* (Weidmann et al., 2015) they might also *increase user costs* (Stettler, 2018). The trend towards *online shopping* (WBCSD, 2018) and demand for *higher speeds of deliveries* (Corwin, 2015) require highly efficient *consolidation centers/load pooling* (McKinsey & Company, 2017b) to optimize the inner-city distribution. At central locations, *parcel lockers at click and collect* stations (McKinsey & Company, 2017a) may service new needs. However, as transportation capacities become increasingly scarce in certain places, the *equality of passenger and cargo traffic* (Münchner Kreis, 2017) might become increasingly contested.

Sustainability and renewables: *Climate change* (Greenpeace, 2016) has become a major driver of behavior and change relevant to the transportation sector. *Demand for ecological mobility and renewables* (European Parliament, 2010) from both customers and regulators will boost *decarbonization and electrification* efforts (BASF, 2015). This trend will go hand in hand with improvements in *battery and charging technology* (PWC, 2016) as well as the deployment of *smart grids* (Müller, Cometta, & von Siebenthal, 2013), which enable *energy decentralization* (Weiller & Neely, 2013) in the future. Furthermore, *biofuels and alternative fuels* (Zmud, Ecola, Gu, Phleps, & Feige, 2017) are trialed to develop a more *circular economy* (Froböse & Kühne, 2013). In many countries, the precursors of a *cultural change towards sustainability* (European Parliament, 2010) can be observed for significant parts of society. At the same time, *active modes of transportation* (Bracewell, 2018) (such as cycling and walking) are experiencing a revival.

These are not just benefiting public health, they also address *increased sensitivity towards noise* (Weidmann et al., 2015) and congestion.

Regulation and inclusion: Worldwide interdependencies as a result of *internationalization and globalization* (Linden & Wittmer, 2018) are fostering growing awareness for *technological risks* (AIG, 2017) and for *cybersecurity issues* (RSG, 2018). This might result in *increasing regulation* efforts (Roland Berger, 2017), both at a national and an international level. Concerns about *safety, trust, and data security* (RSG, 2018) need to be addressed with *intellectual property protection* (Reiner & Nienhaus, 2017) and effective *data and platform regulation* (Clarke, 2015). This also matters because of a shift toward global digital platform monopolies or oligopolies that concern the transportation sector too. However, *regulation of (new) mobility* (Dornier Consulting, 2017) and *changes in liability and traffic law* (Corwin, 2015) might tame these innovators while traditional modes of transportation could experience a contrary treatment, for example with *deregulation of rail services* (Amadeus, 2011) and infrastructure. Alongside these developments, increasing automation and digitization might *decrease the need for driver's licenses* (Stettler, 2018) and cause a *loss of jobs (drivers)* (Dornier Consulting, 2017). At the same time, more highly qualified personnel will be required and *skill gaps with a lack of technicians* (Rail Supply Group, 2016) are expected. Despite their potentially disruptive characteristics, new mobility services in combination with *merit-based or social business models* (Cohen & Kietzmann, 2014) could foster *transportation equity* (Watkins, 2018) as well as *gender shift and equality* (European Parliament, 2010) by making transportation safer and more accessible for everyone. Automation could facilitate the *inclusion of underserved areas* (RSG, 2018) and deal with *demographic change* (IGES Institut, 2017) by preserving everyone's mobility. While many services will be based on *transparency and open source* (Weidmann et al., 2015), specific offerings could address the *demand for anonymous trips* (Münchner Kreis, 2017) or the *need for deceleration* (Heß & Polst, 2017).

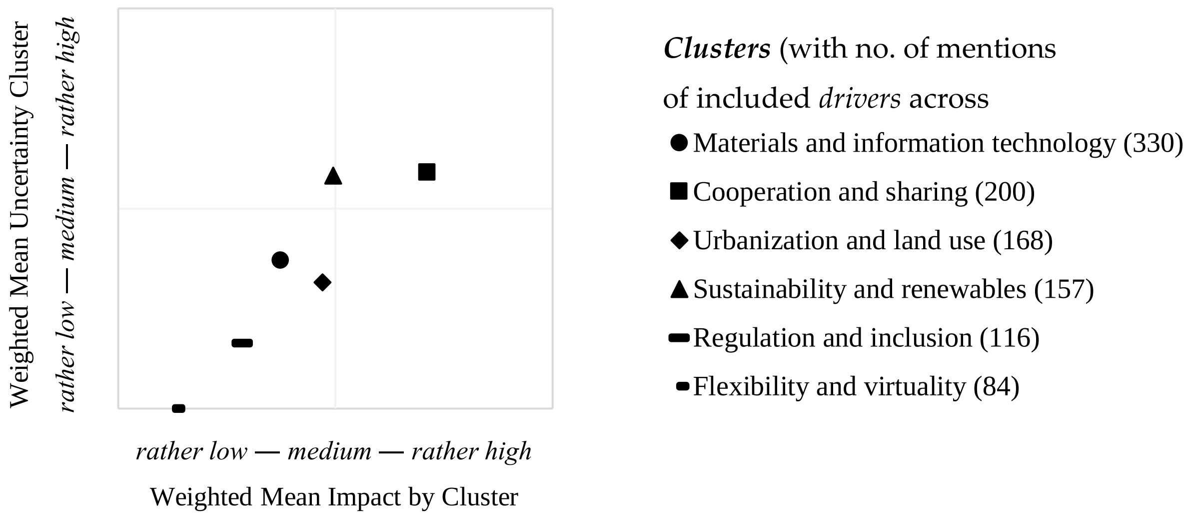
Flexibility and virtuality: Society is characterized by an increasing degree of *individualization* (Wittmer & Linden, 2017). In the future, more people will follow non-standardized career paths and pursue *mobile, part-time or gig economy* jobs (Zukunftsinstitut, 2017). They are *telecommuting and working from home offices* (Shaheen et al., 2018) or choose *third places like co-workings* (WBCSD, 2018) to collaborate and get things done. Technological advancements in *3D-printing and bio-printing* (BASF, 2015) as well as *virtual and augmented reality* (Münchner

Kreis, 2017) in combination with *handhelds or wearables* (Arthur D. Little, 2018) and *massive open online courses (MOOCs) for e-learning* (Heß & Polst, 2017) might reduce the need to travel for professional and educational reasons. Moreover, the spread of *social media* (Münchner Kreis, 2017) and *gamification* (Arthur D. Little, 2018) could promote this shift towards virtual worlds and possibly also the *24-hour society* (Bundesamt für Raumentwicklung (ARE), 2017). However, these potential changes are challenged by relatively *stable consumer behavior* (Fehr, 2016) and a *fear of technology* (Otto, 2017) among some people. Furthermore, the elimination of trips due to flexibility and virtuality could easily be overcompensated by *increasing leisure trips* (Bundesamt für Raumentwicklung (ARE), 2017).

3.1.3 Impact-Uncertainty Matrix

To prioritize the six clusters and associated drivers, we established an impact uncertainty matrix (Brands, Wulf, & Meissner, 2013) that rates the topical clusters on two dimensions, their perceived uncertainty and their perceived impact on the future of mobility. Since this procedure is inherently interpretative and suggestive, we resorted to a coarse three-point scale from one (low) to three (high) for both dimensions. The data points depicted in Figure 3 represent the weighted mean scores for uncertainty and impact for the six topical clusters discussed in the previous chapter.

Figure 3: Weighted Impact-Uncertainty Matrix with Topical Clusters



Source: Own analysis.

The interpretation of this matrix requires a coda: There is high inherent uncertainty attached to any prediction what customers will expect from future mobility services and whether the identified drivers will translate into demand trends. The importance of specific drivers (here the number of mentions of a specific driver) may well be influenced by a source authors' (commercial) interest in certain topics. In addition, public and academic discourse on the future of mobility has potentially elevated certain drivers to buzzword status and thus overstate their significance just because they were trending during the period of data collection (2009-2019).

With those caveats in mind, the impact-uncertainty matrix offers a tentative interpretation and associated qualification of relevant drivers and topical clusters that inform the construction of future mobility scenarios in later chapters.

Materials and information technology are driving innovation in mobility. Even though the advent of fully autonomous vehicles and public individual on-demand pods is not yet foreseeable, their arrival seem a matter of time. Large scale tests of new technologies like hyperloops and passenger drones, beta releases of autonomous drive and ticketless transit, and business model innovation focused on mobility as a service demonstrate are early signals of a probable future large scale deployment and adoption. If realized, these relatively predictable technological advancements will have considerable impact on actors in the field. They will drive opportunities for both new entrants and incumbent actors to satisfy mobility needs more efficiently and more conveniently. Another trend relatively foreseeable is *urbanization and use of land*, which must be optimized. To reduce congestion and other negative externalities from passenger and freight traffic, it seems clear in the projections of existing future mobility studies that – along with technological advancements – economic solutions (e.g., mobility pricing) need to be implemented across the different modes to efficiently manage demand (and supply).

While the reviewed reports suggest relatively clear trajectories for technology development and adoption, social innovation and behavioral change are more uncertain. Intensified *cooperation and sharing of resources* are reasonable to predict and trending in certain high-density urban settings. Also, the implementation of inter- and multimodality in various mobility tools can be foreseen as a trend. However, the reviewed literature is less certain about more fundamental changes in human behavior related to ownership in objects like cars. Along similar lines, the impact of a shift towards *sustainability and renewables* might be impactful for the mobility sector with decarbonization and electrification shaping the industry and potentially resulting in more environmentally friendly motorized transportation. Nevertheless, anecdotal evidence like the ever-increasing numbers of passenger flights and the lagging adoption of electric cars suggests that the net impact of those developments is still uncertain in many contexts.

The general direction of *regulation and inclusion* seems quite clear. Facilitated by technology, future mobility has the potential to be more inclusive as it addresses the needs of disadvantaged people in new and more effective ways, for example with autonomous services. In contrast, disruptive new mobility that threatens social contracts risk facing new regulation as has been the case for ride hailing services. Incumbents might still face increasing competition and deregulation in some markets. The more *flexibility and virtuality* of work-life patterns shift, the more will transportation be affected. People working from home offices and virtual conference rooms require less habitual physical mobility. The impact of these patterns linked to societal shifts is seen as relatively low because a large majority of people stills very much relies on real-life interaction with peers (in private and professional circles).

In sum, these considerations inform the construction of scenarios in chapter 5.2. Their influence in the research process is considered in chapter 4.2.

3.2 Review of future mobility business model work

3.2.1 Overview of identified work

Relevant existing work on future mobility business models has been identified following a similar process like for identifying drivers of future mobility. We searched *Google Scholar* with iterative queries including search terms such as *business model AND morphology OR mobility OR transport** and *urban morphology AND rail** and *spatial morpholog** systematically checking the first 100 search results for each iteration to identify existing morphological work on future mobility BMs. The results of this search process were complemented with BM morphologies from studies on the future of mobility identified in chapter 3.2 and snowball sampling on the basis of those publications. Our results indicate that there is a very small number of reports and working papers that discuss morphologies for business model innovation in general and an even smaller number specific to transportation. The following sections briefly present the identified work divided into literature focusing on new technology and literature focusing on new transportation modes. No previous study speaks to the focus of this study – the future of mobility business models and their innovation by means of scenario development and morphological analysis.

3.2.2 Literature with focus on new technology

Four existing studies propose existing morphologies for transportation with a technology focus: First, Hahnewald (2017) investigates business models for connected and automated driving. The author develops a morphological matrix with 16 design parameters and up to seven parameter values each that allows for more than 65 possible configurations. As connectivity and automation are the starting point of his work, most design parameters relate to specific technical properties such as sensors and communication options (Hahnewald, 2017). These elements are complemented by three typical business model elements (stakeholder benefit, value chain, profit model).

Second, Lerch (2010) develops an elaborate morphological matrix to identify new electric mobility. His "holistic instrument" (Lerch et al., 2010, p. 16) consists of three combined matrices: vehicle with battery, infrastructure, and systems services. All three sub-matrices consist of six to seven parameters with up to five possible parameter values. While there are some characteristics of typical BM descriptions (asset ownership, type of billing and compensation), most parameters exclusively refer to technological characteristics such as the type of power used, or the type of power connection employed.

Third, Meyer and colleagues (2018) focus on freight and logistics services in mapping new transportation BMs in a morphology with eleven dimensions and up to five parameter values each. The authors combine the collected BMs to create a heat map that shows dominant and neglected elements (Meyer et al., 2018). The parameters of the morphology are not just based on business model elements but also contain technical features such as degree of digitalization.

Finally, Zolnowski and colleagues (2016) focus on data driven innovation of BMs but are not industry-specific in their work. The authors' morphology contains different effects of data-driven innovations (e.g. reduction of internal costs) as identified per BM element and perspective (customer, company, partner). This approach allows for the identification of different data driven innovation patterns across industries (Zolnowski et al., 2016) but does not directly apply to transportation.

3.2.3 Literature with focus on new transportation modes

Four published reports propose morphologies for future mobility centered on different new transportation modes: First, Arthur D. Little (2013, p. 15) presents a morphological box of transport modes and services. The authors of this professional services firm relate the morphology to different business model roles of automotive OEMs (core business, integrator, aggregator). The morphology is of limited generalizability and its main purpose seems to make a case for integrated mobility platforms.

Second, Accenture (2018, p. 5) introduces a simple morphology that sorts mobility services on a continuum from owning (buy, lease, shared owning, etc.) to pure usership (public transport). The report's purpose is to present possible fields of play for automotive OEMs that go beyond car sales and adopt some form of mobility as a service.

Third, EY (2015, p. 7) identifies six distinct mobility business models that are placed in a morphology-like matrix, which is based on typical business model dimensions (value proposition, customer segments, resources). The main goal of the report is to emphasize differences between asset-heavy, assetlight and corporate-focused business models for OEMs in the automotive industry.

Finally, Frost & Sullivan (2017) present a morphology-like matrix that sorts different mobility modes and services according to their cost and convenience as well as the typical distance travelled. These configurations of possible mobility offerings are complemented by supporting services and integrated mobility applications. The report aims to motivate automotive OEMs to explore opportunities in the competitive space between private car ownership and public transport.

The subsequent chapter elaborates how existing work serves as an input to the development of future mobility scenarios as well as the development of a morphology for future mobility business models in context of the overall research design and methodology.

4 RESEARCH DESIGN AND METHODOLOGY

4.1 Overall design

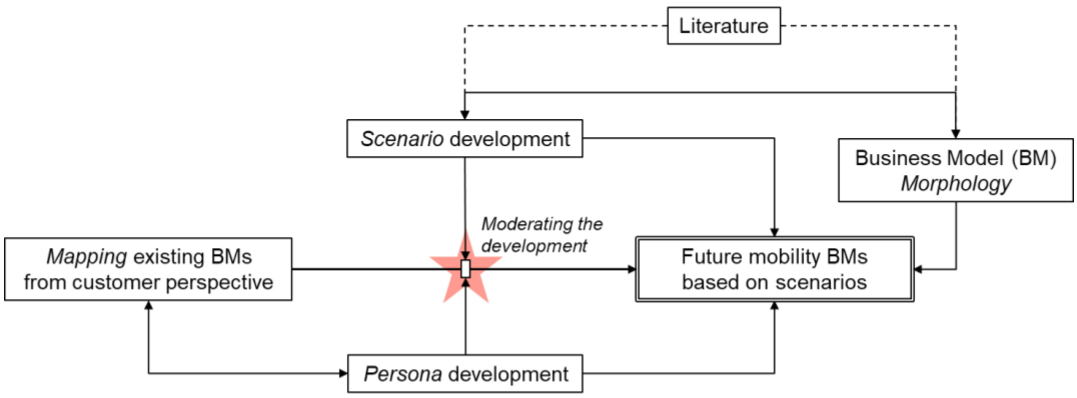
This study follows a *case study* research design as "the intensive […] analysis of a single unit or a small number of units (the cases), where the researcher's goal is to understand a larger class of similar units (a population of cases)" (Seawright & Gerring, 2008, p. 297). The *case* researched is the Swiss mobility landscape and its integrated national railway undertaking.

This focus is justified on theoretical grounds (Eisenhardt & Graebner, 2007; Tsoukas, 2009). SBB represents the class of integrated incumbent railway undertakings looking to position their portfolio of mobility business models for the future. As an incumbent firm, SBB is bound by legacy infrastructure and rolling stock commitments with amortization periods measured in multiple decades. Likewise, existing incentive structures, resource designations, organizational routines, and public mandates for service provision risk locking discussions of future business development into discussions dominated by a technology- and supply-dominated logic rather than future demands and jobs-to-be-done for different kinds of customers. Unlike other national transportation contexts, its political and regulatory environment is characterized by extensive public and government commitment to public transportation, multifaceted regulatory limitations to and support for service provision across modes of transportation, and wide use of public transportation services by customers independent of social status.

Within scope of the case study research design, multiple sources of evidence and analytical strategies have helped design scenarios for future mobility in Switzerland and enable the construction of a morphology for future mobility business models:

First, we used exiting future mobility studies and reports (see chapter 3.1) as well as conceptual literature to develop the eight *scenarios* for the Swiss transportation scape in 2040, four of which we detail in chapter 5.2. To this end, we followed an exploratory, intuitive logic variant of the scenario technique modeled on Börjeson and colleagues (2006) and Amer, Daim, and Jetter (2013). Second, we mapped the present interests of different stakeholders in the Swiss transportation system. Third, we used corporate material cleared by the sounding board and public archival information to *map existing business model* for SBB in the Business Model Canvas template (Chesbrough, 2010; Osterwalder & Pigneur, 2009) and engaged in limited sense-testing them with members of the corporate development team, the corporate finance division, and the passenger division's offer planning (Reinhold, 2014; Voelpel, Leibold, Tekie, & von Krogh, 2005). Fourth, we drew upon existing work on business model architectures, business model cognition in innovation settings, future mobility studies, and future mobility business model literature to develop a *morphology* (Ritchey, 2011) for future mobility business models, which we tested using *persona* (that is customer profiles representing selected customer journeys and potential jobs-to-be-done) with a selected group of senior SBB staff in charge of innovation, finance, and foresight projects from different corporate divisions in a full day ideation workshop. Finally, we pulled those different contributions together in suggesting five *future mobility business models* with a rail focus that relate to the original mapping, the morphology, and business model innovation themes. Figure 4 summarizes the research plan for this study.

Figure 4: Illustration of research design



The subsequent sections describe the methodological steps and trade-offs for the individual outputs presented in this research report in more detail.

4.2 Scenario development

Scenario development might seem like the "Swiss pocket knife" (Masini & Vasquez, 2000, p. 49) of future studies or a single consulting tool. However, more accurately, it refers to a multiplicity of techniques "enhancing understanding […] of the causal processes, connections and logical sequences underlying events – thus uncovering how a future state of the world may unfold" (Wright, Cairns, & Bradfield, 2013, p. 640).

Academic literature offers abundant typologies to classify these techniques (e.g. Börjeson et al., 2006). The subsequent scenario development process was informed by two of those typologies: First, Börjeson and colleagues (2006) identify three different *types of scenarios* based on what kind of question the method seeks to answer (predictive – “what is going to happen”; exploratory – “what can happen”; normative – “how can a specific target be reached”). As outlined in chapter 2.2, this study develops exploratory scenarios for the future of mobility in Switzerland focusing on external factors developing (mostly) beyond the control of the focal case organization.

Second, Amer, Daim, and Jetter (2013) distinguish three different development *techniques*: The Intuitive Logics (IL) methodology, the La Prospective (LP) methodology, and the Probabilistic Modified Trends (PMT) methodology. A key differentiator among the three techniques is the use of quantitative simulation methods: While LP and PMT rely on those, the intuitive logics method relies on qualitative methods and limited quantifications (Amer et al., 2013; Wright et al., 2013) – not mathematical algorithms. This study uses the IL methodology that enables the development of “flexible and internally consistent scenarios” (Amer et al., 2013, p. 27) acknowledging that “even the most likely scenario is unlikely to occur” (Coates, 2016, p. 102) and matching the exploratory character of the target scenario type for the future of mobility in Switzerland.

There is no one-size-fits-all prescription of steps for the IL methodology (Amer et al., 2013). Hence, this study designed a six-stage process grounded in the three tasks for scenario development identified by Börjeson and colleagues (2006) and the eight stages of the IL scenario process discussed by Wright, Branfield, and Cairns (Wright et al., 2013). Table 2 summarizes their respective contribution for reference.

Table 2: Recommendations for scenario development

Börjeson et al. (2006)	*Wright et al. (2013)*
Generate ideas, knowledge, and views	Set agenda
	Determine drivers
Integrate different parts in model	Cluster drivers
	Define cluster outcomes
	Impact/uncertainty matrix
Ensure consistency within and between scenarios	Frame scenarios
	Scope scenarios
	Develop scenarios

Source: Adapted from indicated sources.

The agenda for this scenario development was set by the goals outlined for this study in the introduction in relation to the call for funding by the SBB Fund for Research into Management in the Field of Transport (short: SBB-FF). The remainder of this section outlines the process and methodological considerations that produced the exploratory intuitive logic scenarios detailed in chapter 5.2.

Stage 1 – Identify drivers

First, we identified existing studies and reports from extant academic literature and industry sources that study and discuss the future of mobility and the future of mobility business models on Google and Google Scholar. The details of this search are outlined in chapter 3.1.1. This resulted in 73 publications published between 2009 and 2019. The inclusion of a broad range of existing work helped integrate a broad spectrum of different ideas, views, and knowledge from subject experts and stakeholders (Börjeson et al., 2006) – albeit with a self-selection bias (i.e., authors of reviewed work having written about the subject). We did not use the Delphi method as it has served as the input to source material referenced (Börjeson et al., 2006). Manual screening by two researchers resulted in list of 100 distinct drivers for future mobility and for the underlying business models with a driver referring to any entity or development providing an impulse for change in the mobility domain whereby change does presuppose any specific kind of trajectory for this change (e.g., it could be extending or restricting, enabling or prohibitive, revolutionary or evolutionary, etc.).

Stage 2 – Cluster drivers

Second, we used the PESTEL framework (Politics, Economy, Society, Technology, Environment, and Law) as first round top-down coding structure to establish order among the list of 100 drivers of future mobility as suggested in previous work (Wright et al., 2013). However, the multifaceted nature and implications of identified drivers rendered a clear designation to a single PESTEL category inconclusive. In result, we used a second-round interpretative coding procedure (Saldana, 2009) to establish six topical clusters to make sense of the drivers of future mobility. They are: (1) Materials and information technology; (2) Cooperation and sharing; (3) Urbanization and land use; (4) Sustainability and renewables; (5) Regulation and inclusion; and (6) Flexibility and virtuality. For a more detailed description of the coding procedure and clusters, refer to chapter 3.1.2.

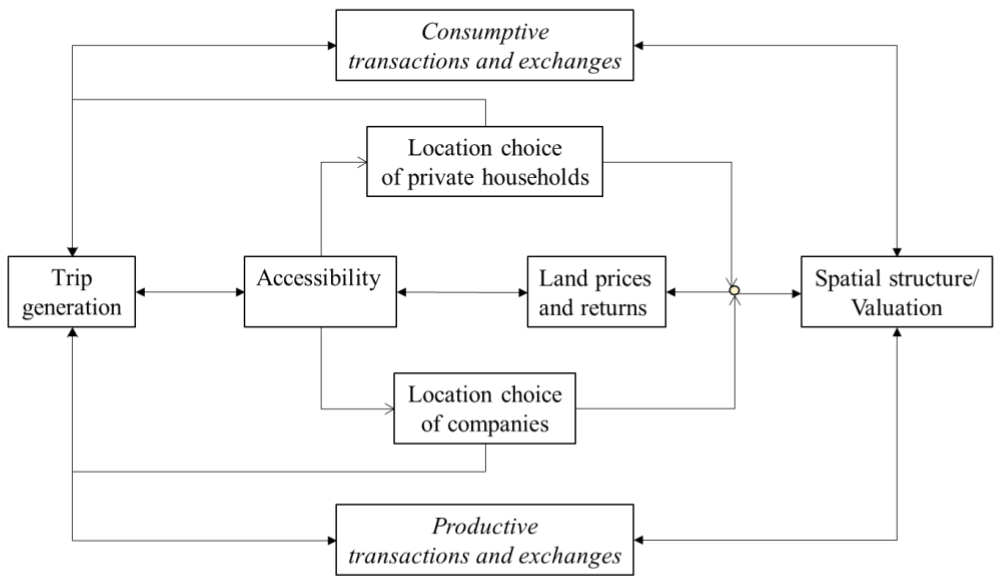
Stage 3 – Impact-uncertainty matrix

Third, to determine what developments and drivers to prioritize, we established an impact-uncertainty matrix (Brands et al., 2013; Wright et al., 2013). The matrix rates the topical clusters on two dimensions: Their perceived uncertainty and their perceived impact on the future of mobility using the weighted mean scores of clustered drivers. Clusters "Cooperation and sharing" and "Sustainability and renewables" ranked highest in terms of uncertainty and potential impact; "Urbanization and land use" as well as "Materials and information technology" ranked toward the middle of both axes, while "Regulation and inclusion" as well as "Flexibility and virtuality" ranked toward the low end of both perceived uncertainty and expected impact on the future. For a more detailed description of the ranking, graphical representation of the matrix, and interpretation of cluster positions, refer to chapter 3.1.3.

Stage 4 – Model key aspects of the mobility system

Fourth, we modeled the key aspects of the study's "universe of concern" (Coates, 2016, p. 100), that is, mobility as a consequence of demand- and supply-sided actors. Specifically, we identified a normative model of mobility, measured as the number of trips, as a consequence of consumptive and productive transactions and exchanges. Figure 5 depicts the model's key relationships.

Figure 5: Mobility-space system model

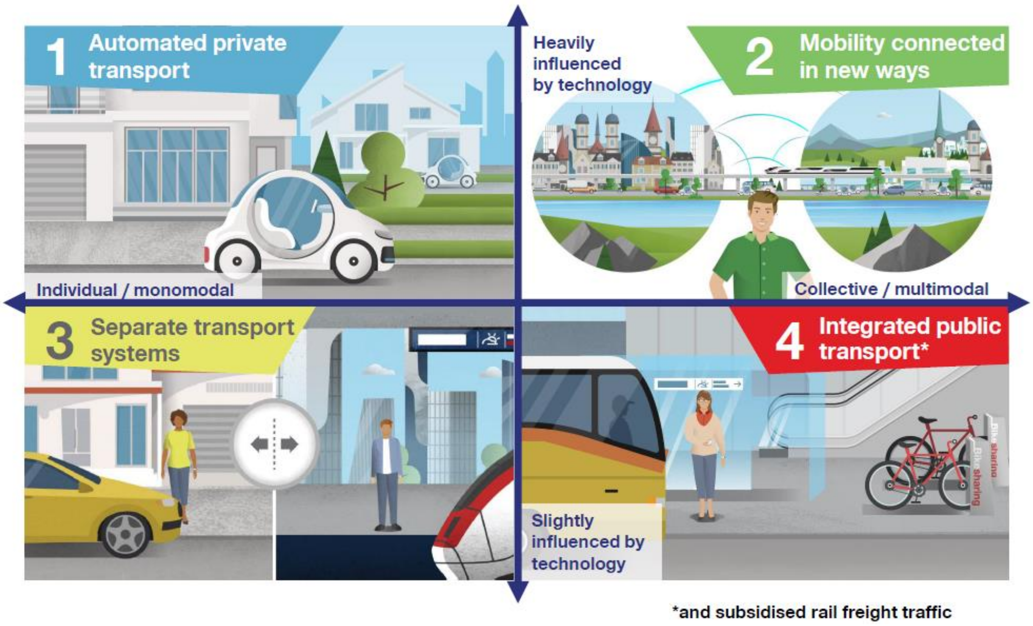


Source: Adapted from (Laesser, 1996).

In this model (cf. Aberle, 2013; Kaspar, 1977; Kaspar, 2018), accessibility, realized by means of mobility and measured in *trips*, is the basis for *accessibility*, while accessibility, in turn, is the basis for productive, consumptive, or social *transactions and exchanges* and determines the *location choices* of private and corporate actors. The higher the potential for exchange relationships as well as the more productive the domain of the exchange, the higher will be the valuation of a location (disaggregated level) or space (aggregated level) as measured in *land prices and returns* (also known as agglomeration effects). In this system, the social *structure* and social cohesion (individual *vs* collective) are both an input and an output as they interact with the tolerance of/threshold for specific levels of accessibility and desired/resulting minimal potential for exchange. In consequence, changes in the nature or extent of mobility production interact with changes in the use of space and vice versa.

The use of this model has two implications: First, the drivers from the identified clusters are expected to interact differently – both active (i.e., drivers affecting the configuration of entities in the model) and passive (i.e., entities affecting the drivers in the model). Second, when comparing the list of drivers of future mobility to the elements of the model, spatial structure is rarely considered. Instead, existing work emphasizes new forms of mobility and associated technologies as well as their implications for the potential within the mobility system and directly related locations (disaggregated level). The scenarios developed within the case company, depicted in Figure 6, are a good testimony to this widespread view. They identify an overall/national perspective with technology and the mobility phenomenon as key differentiators of four competitive scenario quadrants[2].

Figure 6: Scenarios "Future Mobility" by SBB



Source: SBB (2019).

The scenarios developed for this study address this gap that relates to spatial structure in reference to the mobility-space system model and provide a complementary perspective on the future of mobility.

Stage 5 – Determine of variables for the scenario

Fifth, we identified the variables that will be important (Coates, 2016) to the mobility of the future in relation to the clustered drivers (from stage 3) and the underlying model for the mobility system (from stage 4). Specifically, they included: Population, Technology, Economy and social matters, Land use, Mobility demand, Mobility supply, Mobility tools and utilization, Policy, and Traffic (as a material outcome). We operationalized those variables as 43 parameters with respective values in a Zwicky table (Ritchey, 2011). The values are not specific in terms of a specific predicted future (that is, a particular field configuration in morphological terminology) but allow users to describe a range of potential future states for a given parameter. The full table is included as factor-level array in chapter 5.2.

Stage 6 – Specify the scenarios

Finally, we determined the axes for the scenario matrix and identified scenarios in relations to extreme values for the different axes. The vertical y-axis is the same as in the SBB scenarios and relates to the *degree of technology diffusion* (low to high) in future mobility. It relates to the medium impact and uncertainty cluster of drivers labeled "Materials and information technology". The horizontal x-axis refers to spatial structure characterized as the *density of potential interaction points* (low to high) that serves as a proxy for the potential productive and consumptive transactions and exchanges in space. It relates to the key assumptions about mobility supply and demand in the mobility-space system model as well as the medium impact and uncertainty cluster of drivers labeled "Urbanization and land use". Chapter 5.2 elaborates on the relationship of the two axes in more detail.

Within each quadrant, we identified two levels of spatial interaction density relating to either high or low technology diffusion. In total, this produced *eight different scenarios*, for which we specified a field configuration, that is, we identified the value for the 43 parameters operationalized in the factor level array. We then wrote short descriptive texts characterizing the Swiss mobility landscape within the scenarios for a horizon 2040. An artifact of the selected x-axis (density of potential interaction points) is the non-mutually exclusive nature of scenarios. We do not assume that Switzerland will be dominated by a single nation-wide interaction density. The scenarios can co-exist in different spatial settings in Switzerland in 2040. In consequence, a trip might take a hypothetical traveler through multiple contexts that match the specifications of different scenarios that exist in parallel.

The final scenarios detailed in chapters 5.2.1 to 5.2.4 were sense-tested with the project sounding board, including two members that had contributed to SBB's own scenario development efforts that had resulted in Figure 6. In subsequent activities, the scenarios served as input to test the morphology for future mobility business models.

4.3 Stakeholder interest mapping

To understand potential present and future core needs and requirements of mobility stakeholders, we identified and mapped stakeholders and their interest. These actual and potential jobs-to-be-done are important to understand in context of an evaluation of present and future rail business models. The process included three stages. First, we identified existing stakeholders. Next, we identified four perspectives around which the interests coalesce. Finally, we identified and listed the different interests based on the aforementioned sources and coded the level of fulfillment. The detailed results are detailed in chapter 5.1.1.

Stage 1: Identify stakeholders

The subsequent list of stakeholders and stakeholder roles were included in the stakeholder mapping:

- *Customer/ citizens* in their role as transport purchasers and co-producers (e.g. time) either constrained or discretionary, taxpayers as well as constituents of members of parliaments and executives;
- *Companies/ the "economy"* in their role as private collective institutional actors (in contrast to individuals);
- *Federal executive (council)* in the role of (potential) owner and concession vendor or service purchaser;
- *Federal parliament* in the role of legislator (aggregate) and costumer (disaggregate);
- *(Executive) federal regulators*, in the role of (potential) owner and concession vendor or service purchaser executing and applying law on behalf of the federal executive;
- *Cantons and communes (executive)* in the role of (potential) owner and concession vendor or service purchaser;
- *Cantonal and communal parliaments* in the role of legislator (aggregate) and costumer (disaggregate).

Stage 2 – Identify perspectives

In interaction between the mobility user's freedom of choice (constrained, non-constrained) and SBB's divisional structure, the following perspectives were defined:

- Long haul passenger transportation;
- Short and medium haul passenger transportation;
- Infrastructure (stationary and rolling);
- Overall system.

Stage 3 – List and code

We listed the stakeholder interests in relation to the four perspectives in reference to Summermatter (2011), Weidmann (2009), Bieger (2001), Laesser (1996), and SBB corporate documents cleared for this project. Finally, the listed interests and their directionality desired in fulfillment were coded with three different levels: MAX (stakeholder is interested in maximizing), MIN (stakeholder is interested in minimizing), OK (stakeholder is interested in optimizing). Those codes enabled the coder to identify potential challenges or even conflicts between different interests, e.g., maximizing public transportation offered *vs* minimizing the cost of public transportation.

The resulting list of interests informed the business model mapping (specifically the determination of key partners and resources/activities) and scenarios (projecting change in mobility systems related to those actors and their interests) as well as, to a lesser extent, the construction of the morphology of future mobility business models.

4.4 Business model mapping

Business models represent an institutionally comprehensive logic of thought and action to crate and capture value (cf. chapter 2.1), mostly independent of a divisional localization. For the purpose of this study, and in agreement with the project sounding board, we limited ourselves to an analysis of business models related to passenger transport and its directly associated services from infrastructure and real estate (such railway stations) in a broadest sense. The identified status quo served as starting point to discuss alternative and future business model in context of scenarios and stakeholder interests.

We used *business model mapping*, a cartography-like approach (Chesbrough, 2010) to identify how different rail business models serve various, different mobility needs. A business model *map* captures how a company, or parts thereof, independently or in cooperation with external partners, creates value for its customers by means of products or services and skims off the created value in the form of earnings for the company and its stakeholders (Reinhold, 2014). Hence, it makes use of the business model as a conceptual representation in a *template* to describe and illustrate material aspects and key decisions of value creation and value capture.

Most map-based approaches suggest a predefined selection of business model *elements* to be analyzed to understand the interaction of mechanisms for value creation and value capture (Bieger & Reinhold, 2011; Reinhold, 2014). The overall configuration is known as the business model *architecture*. Relationships between business model elements in this architecture can fall into one of three categories: aligned (mutually reinforcing); conflicting (decreasing or counteracting effect); or ambiguous (uncertain effect). In practice, templates such as the popular Business Model Canvas (Osterwalder & Pigneur, 2010) or the Value-based Business Model (Bieger & Reinhold, 2011) connect the elements following an intuitive input-throughput-output logic in a visual template. While they highlight choices in business model elements, they provide limited pointers to the nature of relationships and consistency of choices in the overall architecture.

The three subsequent steps detail how existing rail business models were mapped in reference to specific customer needs. We explicitly avoided starting from a focal firm's perspective or divisional logic to draw on the business model concept's strength, that is the focus on value creation from a process perspective for particular jobs-to-be-done across organizational boundaries. The results of this process are summarized in chapter 5.1.2.

Step 1 – Identification of relevant customer segments and jobs-to-be-done

The service logic (Vargo & Lusch, 2008) inherent to mobility behavior and its associated contingencies, particularly the co-presence of provider and customer in service production, require a strong customer focus (Heinonen et al., 2010). With reference to Aberle (2013), Laesser (1996), McInerney (2013), and Schuppan (2014), we structured customer needs according to a hierarchy of four potential differentiators: (i) the trip purpose; (ii) the spatial extension of a trip; (iii) behavioral characteristics (e.g., is it habitual or non-habitual behavior); and (iv) the services-in-demand. Table 3 lists the result.

Based on those four needs, we identified eight second-order segments for which we mapped existing rail business models: (1) Resident commuting short haul; (2) Resident commuting long haul; (3) resident business long haul; (4) Resident leisure domestic (day tripping); (5) Resident shopping domestic; (6) International visitor leisure; (7) International visitor business; and (8) Central locations (such as stations). While a more fine grained segmentation of relevant customer groups based on their jobs-to-be-done would have been possible, those eight groups and associated business model provided sufficient diversity to discuss future mobility business models and test a methodology to develop novel mobility business model configurations for the future.

Table 3: Trip purpose structuration with spatial and behavioral characteristics

COMMUTER DEMAND *Characteristics:* • Between home and work locations • Highly habitual • Self-pay • Subscription type purchase • Highly place- and time-constrained • Induces daily demand peaks (high) • Comparably high share of demand for public transport *Segments:* • Resident commuter short haul • Resident commuter long haul	SHOPPING DEMAND *Characteristics:* • Between home and goods supply locations • Habitual • Self-pay • Somewhat time- and place-constrained • Induces weekly (e.g. Saturday) and daily (Wednesday afternoon; early evening) high peaks • High share of demand for individual transport *Segments:* • Resident shopping domestic
BUSINESS DEMAND *Characteristics:* • Between points of service provision • Mostly non-habitual • Others pay • Situational purchase • Highly place and time constrained • Non-peaked • Even modal split *Segments:* • Resident business long haul • (International) visitor business	LEISURE DEMAND *Characteristics:* • Between home/ leisure locations and leisure locations • Mostly non-habitual • Self-pay • Situational purchase or part of bulk purchase • Somewhat time constrained • Periodical/ seasonal high peaks • High share of demand for individual transport *Segments:* • Resident leisure domestic (day tripping) • (International) visitor leisure

Source: Own compilation.

Step 2 – Mapping business models with template

We used the Business Model Canvas (Osterwalder & Pigneur, 2010) to map the elements and architecture of existing business models of the case organization, SBB. This template has been the best fit for our mapping purposes as it provided conceptual categories that made intuitive sense to the industry professionals we engaged with. What this specific template lacks in theoretical undergirding, we complemented with insights from complementary business model conceptualizations.

The source material for the business model mapping consisted of SBB corporate material (cleared for the project but not individually referenced for confidentiality reasons) as well as material from public sources (including but not limited to SBB website, promotional material, past and present services on offer, etc.).

Step 3 – Validating business model maps

While we tried to maximize the SBB-internal feedback from experts and key decision-makers on those business model maps with the help of the project's sounding board, access and scheduling proved challenging. Ultimately, we resorted to exclusively relying on the feedback as well as checks and balances provided by the sounding board to validate the drafted business model maps.

While not having operational responsibility for the mapped aspects of value creation and capture, the sounding board included individuals from different units of SBB corporate development (consulting a broad cross-section of divisional aspects on matters of business and market development) and corporate finance (being involved in matters of project finance and financial modelling) with several decades of tenure in the mobility sector and within the case organization. Moreover, several members of the sounding boards could draw on expertise from earlier initiatives within the organization aimed at mapping the changing landscapes of value chains in mobility services and at evolving existing business models.

The resulting business model maps were subsequently used to test the morphology and derive implications as to how combinations of the different research outputs can inform strategic processes aimed at exploring future mobility business models.

4.5 Morphological analysis

Like other recent efforts to connect business models and morphological reasoning (Lüdeke-Freund, Gold, & Bocken, 2019), we ground our methodological process to establish a morphology for future mobility business models with a rail focus in Ritchey's (2011) understanding of general morphological analysis (see chapter 2.3). Its purpose is to establish a morphological model to discuss configurational options (i.e., parameters and values as represented by individual morphological fields) and patterns (i.e., the recurrent logic of specific field configurations) for a structured discussion of future mobility business models.

While the resulting morphology cannot predict what future mobility business models will materialize for certain or which ones will come to dominate specific markets, it helps to explore potential future logics of value creation and value capture. As such it is a basis to explore normative scenarios (Börjeson et al., 2006) to start answering questions like:

- What if we want to change our business model A to business model B by 2040? How could a potential timeline and strategic action look like?
- How can we preserve the unique value created by and the benefits resulting from our existing business model in case we are confronted with new business model C by 2040?

The morphology is thus a step toward connecting efforts to understand the future of the mobility system with organizational efforts to navigate and enact those future scenarios in strategic processes.

The three subsequent stages illustrate how we developed and tested the morphology for future mobility business models by means of the SBB case study. They draw on the results of the methodological procedures described in previous chapters. To highlight but the two most relevant ones, the review of existing drivers of future mobility informed the reconstruction of the business model as morphological model (stage 2) and the future scenarios were a necessary input to testing the morphological model (stage 3).

Stage 1 – Deconstruction of business model concept

First, we operationalized the individual dimensions of the business model concept in reference to sub-dimensions representing important design choices. Specifically we used the nine elements of the Business Model Canvas (Osterwalder & Pigneur, 2009; Osterwalder, Pigneur, Bernarda, & Smith, 2014) as second-order parameters and identified first-order parameters from existing literature (incl. Bieger & Reinhold, 2011; Remane, Hanelt, Tesch, & Kolbe, 2016; Wirtz, Pistoia, Ullrich, & Göttel, 2016). Those sources discuss the business model's ontological properties in detail and link it to different theoretically motivated concepts. Beyond those universal items, we specified additional first-order parameters specific to the consumption and production transactions and exchanges in the mobility system (e.g., spatial structure to describe customer segments or mode of transportation in the value proposition). To this end, we drew on insights from the construction of the different mobility scenarios as well as the literature review on future mobility perspectives. In sum, we deconstructed the business model concept to identify its context adequate sub-concepts representing parameters in a morphological model to discuss future mobility business models.

Stage 2 – Reconstruction of business model as morphological model

Second, we identified a set of values for each parameter that would enable different configurational options in the conceptualization of different future business models. To be included, values had to be meaningful, non-overlapping, and – where possible – collectively exhaustive. To this end, we consulted with existing literature specific to individual parameters in the business model domain or specific sub-fields of research in the social sciences and industry specific publications reviewed for the creation of the future mobility scenarios. To sense-test (Reinhold, 2014; Voelpel et al., 2005) parameters and values, we mapped morphological field configurations for different kinds of business models from simple (e.g., selling fruit to hungry travelers at transportation hubs) to complex (multi-mode, multi-sided integrated mobility-as-a-service platform models) in our morphology. This created an iterative cycle that helped us extend the number of relevant values for different parameters and resulted in the first version of the morphology to be tested with prospective users of the morphology (for the role of the user see Coates, 2016).

Stage 3 – Application and test of morphological model

Finally, we conducted a one-day innovation and ideation workshop with 12 senior organizational representatives of different divisions of our case organization. All of them had in some professional capacity responsibility for innovation and future-oriented initiatives within the company. Be it in line functions or in consulting or support roles, respectively. The purpose of the workshop was to test the morphology and the associated strategic process to systematically develop novel mobility business model configurations to provide value-added from future mobility services. Respondents were given purposefully designed personas (that is descriptions of 2040 customers with specific jobs-to-be-done) that the workshop participants projected into one of the scenarios developed for the future mobility landscape of Switzerland. In different teams, the workshop participants sketched several draft business models by going through the configurational options of the morphology. As a result of the process, they provided feedback on the use and value of the morphology as well potential additions and extensions of existing parameters and parameter values. In processing this feedback, we created the second and final version of the morphology for future mobility business models. It is presented and discussed in detail in chapter 5.3.

4.6 Limitations

Every study is subject to limitations. In this subsection we acknowledge those three, that represent a-prior decisions limiting the scope of this research project. First, given the considerable volume of existing future mobility studies drawing on expert opinions, projections, and Delphi assessments, we decided to use a technical threshold (e.g., number of mentions) and our own expert rater judgment to create the impact-uncertainty matrix that informs the scenario development. We acknowledge this limitation in chapter 3.1.3 as a caveat to the matrix's interpretation.

Second, given the scope of access to internal resources and information within the case company within scope of this project, we decided with the sounding board to limit the mapping, discussion of, and development efforts for future mobility business models to those centered on passengers. Freight and cargo considerations were only included to the extent that they featured as a side-consideration of a passenger job-to-be-done.

Finally, while we had originally planned to sense-test the business model maps, stakeholder interest, and scenarios with a broader scope of case company stakeholders, access and scheduling proved more difficult than anticipated – despite generous support from sounding board members. We are, however, positive that the scope of the project sounding board and the expertise its members represent have provided us with adequate grounds to identify major weaknesses or shortcomings in our intermediate research artifacts. The previous discussion of the individual methodological steps in subchapters 4.2 to 4.5 identifies at what stages in the process the sounding board provided input and feedback.

5 RESULTS

This chapter introduces the key results in four areas. First, it details the existing SBB rail business models and stakeholder interests that serve as a baseline understanding of the case organization's passenger transport related business model portfolio at the time of the analysis. Second, the scenarios for the Swiss mobility landscape in 2040 detail the context for future mobility business model discussions and serve as input to the testing of the business model morphology, which is specified in the subsequent sub-chapter. Finally, we outline a selection of future rail business models based on the previous result sections as a precursor to the discussion in chapter 6.

5.1 Existing SBB rail business models

The following sections map existing SBB business model related to passenger transport (for explanation, see chapter 4.4) and related stakeholder interests. The latter serves as backdrop to the former.

5.1.1 Stakeholder interests

The results of the stakeholder interest analysis are depicted in Table 4. The table identifies the following list of six stakeholder types (see rows of first column) and map associated perspectives in the subsequent columns based on their different roles:

- *Customer/ citizens* in their role as transportation purchasers and co-producers (e.g., time) either constrained or discretionary, taxpayers as well as constituents of members of parliaments and executives;
- *Companies/ the "economy"* in their role as private collective institutional actors (in contrast to individuals);
- *Federal executive (council)* in the role of (potential) owner and concession vendor or service purchaser (incl. the role as a regulator)
- *Federal parliament* in the role of legislator (aggregate) and costumer (disaggregate);
- *Cantons and communes (executive)* in the role of (potential) owner and concession vendor or service purchaser;
- *Cantonal and communal parliaments* in the role of legislator (aggregate) and costumer (disaggregate).

In terms of perspectives, we distinguish between *distances* (long haul vs. short haul), *usage decisions* (constrained, e.g. commuting vs. business or non-constrained, e.g. leisure reasons), *infrastructure* (stationary, e.g. train stations vs. rolling stock, e.g. vehicles), and an *overall systemic perspective*:

- Long haul passenger transportation; constrained;
- Long haul passenger transportation; non-constrained;
- Short & medium haul passenger transport; constrained;
- Short & medium haul passenger transport; non-constrained;
- Infrastructure stationary;
- Infrastructure rolling;
- Entire system.

In essence, the table demonstrates that *users* have a high interest in a reliable, frequented, inexpensive, and convenient transportation service and, if need be, in additional value-added services. The *public sector*, in contrast, as a service purchaser of local transportation and as a concession awarding authority in long-distance transportation, is initially interested in cost-efficient service provision and good upkeep and utilization of an expensive infrastructure. However, these interests largely mediate higher order policy goals, for example, one that relate to regional economic issues as well as social and environmental domains (Summermatter & Laesser, 2011).

Table 4: Stakeholder interests

Perspective	Long haul passenger transportation; constrained	Long haul passenger transportation; non-constrained	Short & medium haul passenger transportation; constrained	Short & medium haul passenger transportation; non-constrained	Infrastructure stationary	Infrastructure rolling	Entire system
Customer/ citizens	OK punctuality (reliability) MAX frequency MAX direct ridership MAX size of job market (accessibility) MAX reliability	OK punctuality (reliability) MIN price OK convenience	MAX punctuality (reliability) MAX frequency MIN travel time OK price MAX convenience MAX size of consumptive market area (accessibility)	OK punctuality (reliability) MIN price OK convenience	Stations = physical platforms for MAX different needs	OK comfort MAX space (MIN spatial stress) MAX virtual accessibility	MAX convenience (cf. "Direkter Verkehr") Productive means of transportation 50% subsidization by public (
	Integrated multi-level network with free choice of type of frequently available connections, and by this providing • a flexible and resourceful transportation arrangement • Accessibility				Providing attractive meeting and consumption locations	Modern rolling stock for regional and national mass transit	Cost cutting programs

(cont.)

Please note:

MAX (maximizing), MIN (minimizing), OK (optimizing) denote the directionality desired in the fulfillment of the corresponding attributes/ features.

RED: requirement by stakeholders; BLUE: response/ action by railway companies.

Perspective	Long haul passenger transportation; constrained	Long haul passenger transportation; non-constrained	Short & medium haul passenger transportation; constrained	Short & medium haul passenger transportation; non-constrained	Infrastructure stationary	Infrastructure rolling	Entire system
Companies (customers)	MAX national and international accessibility MAX size of labor market MIN of mobility costs	MAX of size of labor market (accessibility)	Participation due to potential leverages	OK comfort MAX space (MIN spatial stress) MAX virtual accessibility	MAX productivity of system MIN public costs of system MAX accessibility of prod. PoP and consume. PoS MAX agglomeration effects by mobility		
	Integrated multi-level network with free choice of type of frequently available connections, and by this providing • a flexible and resourceful transportation arrangement • Accessibility				Providing attractive meeting locations	Modern rolling stock for regional and national mass transit	Cost cutting programs

(cont.)

Please note:

MAX (maximizing), MIN (minimizing), OK (optimizing) denote the directionality desired in the fulfillment of the corresponding attributes/ features.

RED: requirement by stakeholders; BLUE: response/ action by railway companies.

Perspective	Long haul passenger transportation; constrained	Long haul passenger transportation; non-constrained	Short & medium haul passenger transportation; constrained	Short & medium haul passenger transportation; non-constrained	Infrastructure stationary	Infrastructure rolling	Entire system
Federal parliament	Create equal chances of accessibility Promoting border/edge regions Balancing between (language) regions				Investments according to cost-benefit considerations	-	Shift road-rail/public transport promote/safeguard Create / maintain jobs
	Integrated multi-level network with free choice of type of frequently available connections, and by this providing • a flexible and resourceful transportation arrangement • Accessibility				Providing knowhow and other resources for investments planning	Modern rolling stock for regional and national mass transit	Cost efficient transport provision at fair/ acceptable prices
Federal executive (council)	Create equal chances of accessibility Promoting border/edge regions Balancing between (language) regions				Investments according to cost-benefit considerations	-	MAX positive externalities MIN negative externalities
	Integrated multi-level network with free choice of type of frequently available connections, and by this providing • a flexible and resourceful transportation arrangement • Accessibility				Providing knowhow and other resources for investments planning	Modern rolling stock for regional and national mass transit	Cost efficient and attractive (effective) public transport system

(cont.)

Please note:

MAX (maximizing), MIN (minimizing), OK (optimizing) denote the directionality desired in the fulfillment of the corresponding attributes/ features.

RED: requirement by stakeholders; BLUE: response/ action by railway companies.

Perspective	Long haul passenger transportation; constrained	Long haul passenger transportation; non-constrained	Short & medium haul passenger transportation; constrained	Short & medium haul passenger transportation; non-constrained	Infrastructure stationary	Infrastructure rolling	Entire system
Cantonal and communal parliaments	Create/ ensure accessibility of their constituency (possibly create equal chances of accessibility)		Create/ ensure accessibility of their constituency (possibly create equal chances of accessibility) MAX supply of regional and local transport services		Develop and leverage station areas as hubs/ centers MAX federal financial resources for infra investments	-	Shift road-rail/public transport promote/safeguard
	Providing reasonably priced public transport		Providing cost-efficient public transport		Providing knowhow and other resources for development	Modern rolling stock for regional mass transit	Cost efficient transport provision at fair/ acceptable prices
Cantons and communes (executive)	MAX national and international accessibility		MIN subsidization		Develop and leverage station areas as hubs/ centers	-	Shift road-rail/public transport promote/safeguard
	Providing reasonably priced public transport		Providing cost-efficient public transport		Providing knowhow and other resources for development	Modern rolling stock for regional mass transit	Cost efficient transport provision at fair/ acceptable prices

Please note:

MAX (maximizing), MIN (minimizing), OK (optimizing) denote the directionality desired in the fulfillment of the corresponding attributes/ features.

RED: requirement by stakeholders; BLUE: response/ action by railway companies.

5.1.2 SBB business models

The subsequent paragraphs and pages are concerned with the existing SBB business models for specific customer segments. We have purposefully refrained from taking the perspective of what different divisions of the case organization offer as business models (see chapter 4.4) and instead focused on the jobs-to-be-done (or needs) of particular customers to consider mobility beyond the limits of divisional structures and organizational boarders – which is one of the strengths of the business model concept (Zott & Amit, 2010).

In total, we mapped eight business models for different customer groups. We have given them the subsequent descriptive titles:

- BM "Resident Commuting short haul" (Figure 7)
  Support people in getting to their workspace quickly and conveniently. Short haul would include distances up to 80 kms and/ or the predominant use of mass transit/ predominantly regional means of collective transport (S, RE).
- BM "Resident Commuting long haul" (Figure 8)
  Support people in getting to their workspace quickly and conveniently, allowing for "productive" use of time.
- BM "Resident Business long haul" (Figure 9)
  Get people to business locations and back; provide free time for value added tasks and conversations with people that matter.
- BM "Resident Leisure domestic (day tripping)" (Figure 10)
  Get people to leisure activities and back; make journey part of activity.
- BM "Resident Shopping domestic" (Figure 11)
  Get people to the shops and them with their shopping goods back safe, convenient, reliable; door-to-door connections.
- BM "(International) Visitor Leisure" (Figure 12)
  Getting visitors in and around the country to all sites that matter and back; transport their luggage; assist them; perhaps make travel part of the experience (e.g., scenic ride); help people discover sites they did not plan for in advance.
- BM "(International) Visitor Business" (Figure 13)
  Combination of domestic business and international leisure traveler.

- BM “Center and central stations” (Figure 14)

  For passengers: Connect people to different modes of transportation; convenient one-stop-shop for on the go needs, meeting space; help point for travel problems. For businesses: Maximize contact to attractive shopper mix with high willingness to pay for local and instant services.

The corresponding maps are summarized in the figures on the subsequent pages before we discuss specific cause-effect links essential to value creation in each of the business models. As is the nature of short-hand visual representation of business models, the descriptions may seem generic. However, the depth of the underlying understanding and discussion can be inferred from the number of parameters (52) and values (312) considered in the morphological analysis.

Figure 7: Business Model "Resident Commuting short haul"

Key Partners

Regulatory and financial context
- Cantonal and communal constituency (mediated)
- Cantonal governments (SLA)

Resources for connectivity
- PT companies (upstream/ downstream PT; pricing)
- Suppliers (rolling stock)

Partners for service augmentation
- F&B
- mobile connectivity
- …

Key Activities

- Carrier logic: Management and operation of rolling stock on a network to an extent and level of quality according to negotiations with cantons and RTAs.
- Capacity to negotiate contracts and long term relationships with cantonal/ communal authorities.

Key Resources

- Rail network management-knowhow and technology.
- Dedicated rolling stock for short haul connections.

Value Proposition

- Job to be done: Support people in getting to their workspace quickly and conveniently
- Functional values: high frequency at peaks, (optional) frequencies off-peak, seat availability, reliable, punctual, safe, clean
- Cost sacrifice values: opportunity cost of alternative transport
- Price properties: affordable to low-price (as defined by income of traveller)
- Network properties: centric short haul transit lines (S, R, RE)

Customer Relationships

- Auto renewal of passes of RTAs.
- Perks and discounts based on auto renewals.
- Vouchers.

Channels

- RTAs
- Any type of PT subscription (Swiss Pass)
- Own sales/communication infrastructure and services at stations

Customer Segments

Types
- Commuters (productive)
- Commuters (education)
- Habitual, long-term behaviour
- Coupling constrained (time and place)
- Single ridership
- Self pay
- Bulk purchase

Prevalent directionality of flows
- Concentric and transit
- Peaks
  1st In to centre,
  2nd out of centre

Cost Structure

- CapEx for rolling stock
- OpEx for personnel, energy, rolling stock
- Track utilisation costs
- Transaction costs for tenders, key accounts relationship, etc.

Revenue Streams

- Income from SLA with cantons
- Income from tariff associations and associated PT subscriptions
- Income from direct O&D ticket sales
- Income from ancillary services

Figure 8: Business Model "Resident Commuting long haul"

Key Partners

Regulatory and financial context
- Cantonal and federal constituency (mediated)
- Federal government (long haul regulator)
- Cantonal governments(SLA)

Resources for connectivity
- PT companies (upstream/ downstream PT; pricing)
- Suppliers (rolling stock)

Partners for service augmentation
- F&B

Key Activities

- (integrated) Service logic: providing state-of-the-art transport services including value adding complementary/ ancillary services (F&B, etc.)

Key Resources

- Rail network management-knowhow and technology
- Dedicated rolling stock for long haul connections

Value Proposition

- Job to be done: Support people in getting to their workspace quickly and conveniently, allowing for "productive" use of time

- Functional values: high frequency at peaks, (optional) frequencies off-peak, seat availability, reliable, punctual, safe, clean
- Cost sacrifice values: opportunity cost of alternative transport
- Ancillary service values: F&B

- Price properties: affordable (as defined by income of traveller)

- Network properties: centric and transit mid (RE, IR) - and long-haul lines (IR, IC)

Customer Relationships

- Auto renewal of General Pass subscriptions (Swiss Pass)
- Auto renewal of passes of RTAs
- Perks and discounts based on auto renewals
- Vouchers
- Interactions with subscribers independent of imminent reason

Channels

- Any type of PT subscription (Swiss pass)

Customer Segments

Types
- Commuters (productive)
- Commuters (education)
- Habitual, long-term behaviour
- Coupling constrained (time and place)
- Single ridership
- Self pay
- Bulk purchase

Prevalent directionality of flows
- Inter-regional and inter-city
- centric and transit on regional level
- centric, transit, and tangential on national level
- Peaks
  1st in to centre,
  2nd out of centre

Cost Structure

- CapEx for rolling stock
- OpEx for personnel, energy, rolling stock
- Track utilisation costs
- Transaction costs for tenders, key accounts relationship, etc.

Revenue Streams

- Income from annual PT subscriptions
- Income from direct O&D ticket sales
- Income from tariff associations
- Income from ancillary services

Figure 9: Business Model "Resident Business long haul"

Key Partners

Regulatory and financial context
- Cantonal and federal constituency (mediated)
- Federal government (long haul regulator)
- Cantonal governments (SLA)
- Large corporations (business partners)

Resources for connectivity
- PT companies (upstream/ downstream PT; pricing)
- Suppliers (rolling stock)

Partners for ancillary services
- F&B

Key Activities

- (integrated) Service logic: providing state-of-the-art transport services including value adding complementary/ ancillary services (F&B, seat assignments, etc.).
- Key account management for large corporate customers.

Key Resources

- Rail network management-knowhow and technology

Value Proposition

- Job to be done: Get people to business location and back; provide free time for value added tasks and conversations with people that matter.
- Functional values: high frequency at peaks, (optional) frequencies off-peak, seat availability, reliable, punctual, safe, clean.
- Cost sacrifice values: opportunity cost of alternative transport
- Ancillary service values: F&B
- Price properties: affordable (as defined by type of professional activity and business)
- Network properties: centric and transit mid (RE, IR) - and long-haul lines (IR, IC, EC)

Customer Relationships

- Auto renewal of Half Fare subscription (Swiss Pass)
- SBB business account (linked to Swiss Pass)
- Auto renewal of General Pass subscription (Swiss Pass)
- Perks and discounts based on auto renewals
- Vouchers
- Interactions with partners and subscribers independent of imminent reason

Channels

- Direct O&D tickets (online and stationary)
- General pass subscription (Swiss pass)

Customer Segments

Types
- Individuals or small groups travelling for business
- Only partially habitual behaviour
- Coupling constrained (time and place)
- Other pay
- Situational purchase

Prevalent directionality of flows
- Inter-regional and inter-city
- concentric, transit, and tangential on national (and partially international) level
- Lack of clear spatial directionality
- Peaked intercity

Cost Structure

- CapEx for rolling stock
- OpEx for personnel, energy, rolling stock
- Track utilisation costs
- Transaction costs for tenders, key accounts relationship, etc.

Revenue Streams

- Income from annual PT subscriptions
- Income from direct O&D ticket sales
- Income from tariff associations
- Income from ancillary services

Figure 10: Business Model "Resident Leisure domestic (day tripping)"

Key Partners

Regulatory and financial context
- Cantonal and federal constituency (mediated)
- Federal government (long haul regulator)
- Cantonal governments (SLA)
- Intermediaries for touristic offers

Resources for connectivity
- PT companies (upstream/ downstream PT; pricing)
- Suppliers (rolling stock)

Partners for service augmentation
- F&B
- (Touristic) activity providers

Key Activities

- (integrated) Service logic: providing state-of-the-art transport services including value adding complementary/ ancillary services (F&B, seat assignments, etc.)

Key Resources

- Rail network management-knowhow and technology
- Promotional and sales access to potential domestic visitors

Value Proposition

- Job to be done: Get people to activity and back; make journey part of activity; help people discover what they could do in their spare time (?); help people transport themselves and their leisure equipment door-to-door (?)
- Functional values: high frequency at peaks, seat availability, reliable, punctual, safe, clean.
- Cost sacrifice values: opportunity cost of alternative transport
- Ancillary and augmented service values: F&B, activities up and downstream (RailAway)
- Price properties: affordable to low-priced (as defined by income of traveller)
- Network properties: centric and transit mid (RE, IR) - and long-haul lines (IR, IC)

Customer Relationships

- Auto renewal of Half Fare subscription (Swiss Pass)
- Auto renewal of General Pass subscription (Swiss Pass)
- Perks and discounts based on auto renewals
- Vouchers
- Interactions with partners and subscribers independent of imminent reason

Channels

- Direct O&D tickets (online and stationary)
- Rail Away bundles
- Any type of PT subscription (Swiss pass)

Customer Segments

Types
- Individuals or small groups travelling for leisure
- Non-habitual behaviour
- Minimally constrained
- Single – group ridership
- Self pay
- Situational purchase

Prevalent directionality of flows
- Inter-regional and inter-city
- Concentric, transit, and tangential on national (and partially international) level
- Peaks
  1st out of centre,
  2nd in to centre

Cost Structure

- CapEx for rolling stock
- OpEx for personnel, energy, rolling stock
- Track utilisation costs
- Transaction costs for tenders, key accounts relationship, etc.

Revenue Streams

- Income from direct O&D ticket sales
- Income from Rail Away and other tour operator packages
- Income from tariff associations
- Income from ancillary and augmented services

Figure 11: Business Model "Resident (discretionary) Shopping domestic"

Key Partners

Regulatory and financial context
- Cantonal and federal constituency (mediated)
- Federal government (long haul regulator)
- Cantonal governments (SLA)

Resources for connectivity
- PT companies (upstream/ downstream PT; pricing)
- Suppliers (rolling stock)

Partners for ancillary services and service augmentation
- F&B
- Associations of shopping centres and shopping destinations with large pull

Key Activities

- (integrated) Service logic: providing state-of-the-art transport services including value adding complementary/ ancillary services (F&B, seat assignments, etc.)
- Logistic services (future?)
- Key account management for shopping destinations?

Key Resources

- Rail network management-knowhow and technology
- Promotional and sales access to potential customers

Value Proposition

- Job-to-be-done: Get people to the shops and them and their shopping goods back safe, convenient, reliable; door-to-door connections
- Functional values: high frequency at peaks, seat availability, reliable, punctual, safe, clean.
- Cost sacrifice values: opportunity cost of alternative transport
- Ancillary and augmented service values: F&B, shopping related activities up and downstream (in stations)
- Price properties: affordable to low-priced (as defined by income of traveller)
- Network properties: centric and transit mid (RE, IR) - and long-haul lines (IR, IC, EC)

Customer Relationships

- Auto renewal of passes of RTAs
- Auto renewal of Half Fare subscription (Swiss Pass)
- Auto renewal of General Pass subscriptions (Swiss Pass)
- Perks and discounts based on auto renewals
- Vouchers
- Interactions with partners and subscribers independent of imminent reason

Channels

- RTAs
- Direct O&D tickets (online and stationary)
- Any type of PT subscription (Swiss pass)

Customer Segments

Types
- Individuals or small groups travelling for shopping
- Non-habitual behaviour
- Minimally constrained
- Single – group ridership
- Self pay
- Situational purchase

Prevalent directionality of flows
- Inter-regional and inter-city
- Concentric, on national (and partially international) level
- Peaks
  1st into centre,
  2nd out of centre

Cost Structure

- CapEx for rolling stock
- OpEx for personnel, energy, rolling stock
- Track utilisation costs
- Transaction costs for tenders, key accounts relationship, etc.

Revenue Streams

- Income from tariff associations
- Income from direct O&D ticket sales
- Income from ancillary and augmented services
- Revenues fro promotional activities w/ shopping outlets ad destinations

Figure 12: Business Model "(International) Visitor Leisure"

Key Partners

Financial context
- International tour operators and travel agencies

Resources for connectivity
- PT companies (upstream/ downstream PT; pricing)

Partners for ancillary services and service augmentation
- F&B
- (Tourist) services and activities providers

Key Activities

- (integrated) Service logic: providing state-of-the-art transport services including value adding complementary/ ancillary services (F&B, seat assignments, etc.)
- Key account management for mediators (TO/ TA) and key service providers.

Key Resources

- Rail network management-knowhow and technology
- Promotional and sales access to potential international visitors

Value Proposition

- Job to be done: Getting visitors in and around the country to all sites that matter and back; transport their luggage; assist them; perhaps make travel part of the experience (e.g., scenic ride); help people discover sites they did not plan for in advance.

- Functional values: high frequency at peaks, seat availability, reliable, punctual, safe, clean.
- Ancillary and augmented service values: F&B, tourist activities up- and downstream

- Price properties: affordable to low-priced (as defined by income of traveller)

- Network properties: centric and transit mid (RE, IR) - and long-haul lines (IR, IC, EC)

Customer Relationships

- Monthly half fare subscription
- Swiss Travel Pass (general pass for a limited time)
- Perks and discounts based on purchase of the above
- Vouchers
- Interactions with partners (key accounts) and subscribers independent of imminent reason.

Channels

- Direct O&D tickets and subscription sales (online and stationary)

Customer Segments

Types
- Individuals or small groups travelling for leisure
- Non-habitual behaviour
- Partially coupling constrained (time and place)
- (mediated) self pay
- Situational purchase

Prevalent directionality of flows
- Downstream from and upstream to airport
- Inter-regional and inter-city
- Concentric, transit, and tangential on national level
- Peaks 1st out of centre, 2nd in to centre

Cost Structure

- CapEx for rolling stock
- OpEx for personnel, energy, rolling stock
- Track utilisation costs
- Transaction costs for tenders, key accounts relationship, etc.
- Promotion and distribution costs

Revenue Streams

- Income from direct O&D ticket sales
- Income from Swiss Travel Pass
- Income from tariff associations
- Income from ancillary and augmented services, such as accommodation and F&B

Figure 13: Business Model "(International) Visitor Business"

Key Partners

Financial context
- International corporations.

Resources for connectivity
- PT companies (upstream/ downstream PT; pricing).

Partners for ancillary service and service augmentation
- F&B..

Key Activities

- (integrated) Service logic: providing state-of-the-art transport services including value adding complementary/ ancillary services (F&B, seat assignments, etc.).
- Key account management for large corporate customers and key service providers.

Key Resources

- Rail network management-knowhow and technology.

Value Proposition

- Job-to-be-done: Combination of domestic business and international leisure traveler.
- Functional values: high frequency at peaks, (optional) frequencies off-peak, seat availability, reliable, punctual, safe, clean.
- Ancillary and augmented service values: F&B
- Price properties: affordable (as defined by type of professional activity and business).
- Network properties: centric and transit mid (RE, IR) - and long-haul lines (IT, IC, EC).

Customer Relationships

- Monthly half fare subscription.
- Swiss Travel Pass (general pass for a limited time).
- Perks and discounts based on purchase of the above.
- Vouchers.
- Interactions with partners (key accounts) independent of imminent reason.

Channels

- Direct O&D tickets and subscription sales (online and stationary).

Customer Segments

Types
- Individuals or small groups travelling for business.
- Only partially habitual behaviour.
- Coupling constrained (time and place).
- Others pay.
- Situational purchase.

Prevalent directionality of flows
- Downstream from and upstream to airport.
- Inter-regional and inter-city.
- centric, transit, and tangential on national (and partially international) level.
- Lack of clear spatial directionality
- Non-peaked.

Cost Structure

- CapEx for rolling stock
- OpEx for personnel, energy, rolling stock
- Track utilisation costs
- Transaction costs for tenders, key accounts relationship, etc.
- Promotion and distribution costs

Revenue Streams

- Income from direct O&D ticket sales
- Income from ancillary and augmented services, such as work space access and residency

Figure 14: Business Model "Center and central stations"

Key Partners

- City authorities
- Anchor customers/ key accounts (immediate)

Key Activities

- Planning and operation of stations and its visitor flows
- Planning for and allocating an attractive retail mix (maximise potential network effects)
- Visitor flows properties: maximize duration of contact for those willing to spend)

Key Resources

- Monopolisable locations for economic activities
- Throughput of high number of passengers and meet and greeters
- Supplementary business within the larger conglomerate of SBB activities that augments the mix

Value Proposition

- Job-to-be-done
  FOR PASSENGERS:
  Connect people to different modes of transport; convenient one-stop-shop for on the go needs, meeting space; help point for travel problems.
  FOR BUSINESSES:
  Maximize contact to attractive shopper mix with high willingness to pay for local and instant services.

- Functional value: maximum network effects for both immediate and mediated customers (based on retail mix)
- Cost sacrifice values: Alternative locations for consumption

- Price properties: market price (rental)
- Rail network properties: station specific

Customer Relationships

- Rental contracts and associated activities with shops and F&B
- Relations and transactions with mediated customers according to transport relation
- Special relational activities to drive local business (benefitting local business and communities alike - political, relational, and monetary goals attached)

Channels

- Direct B2B
- Mediated by real estate admin companies

Customer Segments

Immediate customers:

- Shops
- F&B providers
- other

Mediated customers:

- Arrival passengers
- Departure passengers
- Transit passengers
- Meet and greet

Cost Structure

- CapEx for infrastructure
- OpEx for personnel, energy, infrastructure

Revenue Streams

- Income from rental contracts (fixed and variable according to turnover)
- Income from stationary tickets sales

The purpose of business model maps is not just to highlight specific design decisions. They are as much about the meaningful relationships of individual decisions in elements that make up the overall business model architecture. Ideally, this architecture results in positive self-reinforcing effects that increase the overall value created and captured over time (Bieger & Reinhold, 2011). The subsequent paragraphs describe key relationships per business model identified and highlight potential for future (evolutionary) business model development.

Resident Commuting short haul: A main part of the value proposition of short haul commuter services is to support people in getting to their workspace quickly and conveniently. This requires frequent and reliable travel connections. The higher the frequency and reliability, the higher the value for customers. Services are based on concentric and transit flows with a morning peak into and an evening peak out of the (economic) centers. As income from service level agreements with cantonal governments is vital to the provision of such services, it is crucial to build and maintain capacities to negotiate contracts and long-term relationships with regional authorities. From the regional authorities' perspective, the better the provision of public transportation service, the higher is arguably authorities' acceptance by their constituencies.

Resident Commuting long haul: Key to the value proposition for long haul commuter services is the promise to support people in getting to their workspace both quickly and conveniently. To this end, rail services offer frequent and reliable connections with seat availability and infrastructure that allows for a productive use of travel time. The higher the frequency and reliability and the better the provision for a productive use of time, the higher the value for customers. Hence, there are additional functional value dimensions compared to the short haul model. Services for long haul are based on inter-regional and inter-city transport flows with morning and evening peaks. To be able to compete with alternative transportation modes, it will be essential to adopt an integrated service logic with state-of-the-art transportation services, that is including value adding complementary/ancillary services.

Resident Business long haul: The value proposition of business long haul services promises to get people to business locations and back while freeing travel time to be used for value added tasks such as conversations with the people that matter as well as potential preparatory work. Hence, the higher the reliability and the better the provisions for a productive use of time (for work and conversations), the higher the value for customers. This business model is based on individuals or small groups with only partially habitual behavior. There is no clear directionality of trips except for certain peaked inter-regional and inter-city connections between major business centers. To address and satisfy these customers, it is critical to address large corporations as business partners and engage in key account management practices tailored to the needs of large corporate customers. The more corporate customers commit to specific long-haul travel arrangements, the higher the potential yield per available capacity.

Resident Leisure domestic: Resident leisure domestic travel services transport people (with their equipment/luggage) to their free time activity and back. Ideally, the journey is turned into part of the activity (adding value instead of being a necessary "evil"). An integrated service logic can help to win individuals or small groups as customers when competing with alternative modes of transportation. Integration aims to facilitate door-to-door travel with complementary/ancillary services. According to the business model map, it is key to partner with intermediaries for touristic offers but also with touristic activity providers to augment services. Consequently – and considering future business model development, the higher the degree of service integration and augmentation, the higher the value for customers.

Resident Shopping domestic: Resident (discretionary) shopping domestic travel services bring people to the shops and back (with their purchases). Door-to-door connections based on an integrated service logic (possibly including logistics services and key account management for shopping destinations) are key to ensure convenience for customers and to compete against alternative modes. As this service is mainly targeting individuals with non-habitual behavior, there is no dominant pattern of passenger flows.

(International) Visitor Leisure: International leisure visitor services transport tourists to all important sights and back in and around the country. Ideally, the trip is part of the experience and provides serendipitous adventures. Services in this business model may also include luggage transport and further assistance – should it be required. Customers are mainly individuals or small groups that enter the country by plane. To reach the end customer, it is key to establish collaboration with international tour operators and travel agencies that mediate interaction. As a result – and considering future business model development, the higher the degree of service integration and augmentation, the higher the value for customers.

(International) Visitor Business: International business visitor services combine elements of domestic business and international leisure services with international corporations as key partners and distinct element of the business model.

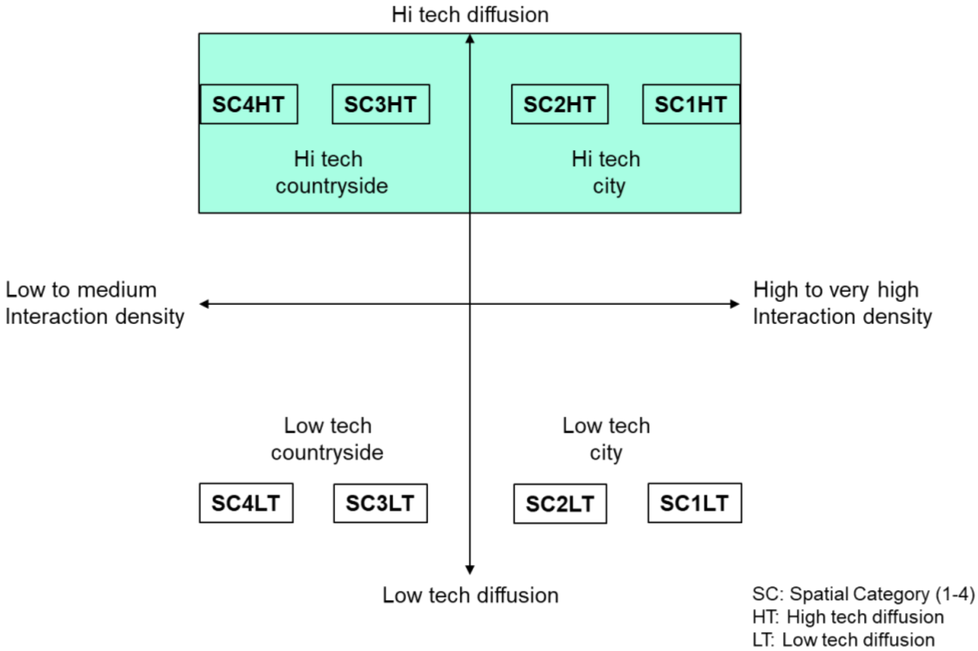
Central locations: The business model of central stations is that of a physical platform connecting people (passengers and others frequenting those locations) and businesses. For passengers, it connects to different modes of transportation and provides a one-stop-shop for all kinds of "on-the-go-needs". For businesses, it provides an attractive mix of customers with high willingness to pay for local and instant services. Key partners are city authorities and anchor customers (businesses) to ensure the ongoing attractiveness of the (city) center. The more options according to specific customer segment needs, the higher the value for both customers and businesses.

An overall take across these key relationships in represented business models suggests that the self-reinforcing nature of the present business model architectures is rather weak. Many of the models covered rely on either a privilege to exploit certain resources (e.g., location of transportation hubs, concession to run travel services on connections between business centers, existing transportation infrastructure that cannot be paralleled for environmental, land-use and other concerns) or inherent production limitations of alternative modes of transportation (e.g., limitation in road and highway capacities; need to dedicate attention to driving to get from origin to destination) to create customer lock-in. Consequently, we used the outputs of the current SBB divisional structure, and the business models associated with them as a "resource" for future business models and mobility ecosystems. Considering the long investment cycles associated with rail-based transportation, this implies a focus on evolutionary business model development staring with an extension of the understanding of the currently operated business models. This does not, however, negate the possibility of new complementary mobility business models of more revolutionary nature. To determine if they should be associated with or located within integrated railway undertakings is beyond the scope of this study.

5.2 Switzerland 2040 scenario

For the four spatial categories and two levels of technology outlines in our structuration of the mobility scenarios (see chapter 4.2), we developed eight parallel scenarios (see Figure 15) labeled with the following acronyms:

Figure 15: Scenarios



- Very high density of points of interaction with high technology diffusion (SC1HT)
- High density of points of interaction with high technology diffusion (SC2HT)
- Medium density of points of interaction with high technology diffusion (SC3HT)
- Low density of points of interaction with high technology diffusion (SC4HT)
- Very high density of points of interaction with low technology diffusion (SC1LT)
- High density of points of interaction with low technology diffusion (SC2LT)
- Medium density of points of interaction with low technology diffusion (SC3LT)
- Low density of points of interaction with low technology diffusion (SC4LT)

To specify those scenarios' properties, we conceptualized a factor-level array with a total of 43 factors (cf. Table 5, p. 57 et sq.). For illustration purposes, Figure 16 presents the factor levels of SC1HT (i.e., the scenario of high interaction density and with high technology diffusion). The detailed factor levels for all scenarios as a set are available as supplementary data file[3].

Table 5: Factor-level array for scenario building

Driver	Perspective	Time	Relation to mobility system	Category	Level 1	Level 2	Level 3	Level 4	Level 5
Applicable scenario perspective: Spatial structure (and economic structure in applicable space)	none	static	exogenous	00 Scenario perspective	all (entire country)	very high interaction density center of a large agglomeration center of a medium sized agglomeration (3rd sector; predominantly highly productive professional and commercial services)	high interaction density agglomeration of such a center center of a small agglomeration or outside agglomeration periurban municipality (3rd sector, with some 2nd sector)	medium interaction density periurban medium density municipality; rural central municipality. medium interaction density (2nd sector with some 3rd sector)	low interaction density periurban community of low density; rural centrally located municipality; rural peripheral municipality. low interaction density (2nd sector and 1st sector)
Applicable scenario perspective: Actors	none	static	endogenous	00 Scenario perspective	system (holistic); nonspecific	government and regulator	customers and citizens	infrastructure providers (construction, maintenance, etc.) and its necessary value chains	transport providers (transport services and ancillaries) and its necessary value chains
Size of population	macroscopic	dynamic	exogenous	01 Population	unchanged (as of 2020)	Increasing (due to immigration)	Decreasing (due to greying of the population and potential emigration)		
Size of productive population	macroscopic	dynamic	exogenous	01 Population	unchanged (as of 2020)	increasing (due to immigration and retirement work)	decreasing (due to greying of the population and obsolescence of skills)		
Dispersion of family and social network nodes	macroscopic	dynamic	exogenous	01 Population	unchanged (as of 2020)	increasing (compared to 2020)	decreasing (compared to 2020)		

Driver	Perspective	Time	Relation to mobility system	Category	Level 1	Level 2	Level 3	Level 4	Level 5
Dispersion of nodes for stationary work	microscopic	static	exogenous	01 Population	unchanged (as of 2020)	increasing i.e. decreasing centralization (compared to 2020)	decreasing, i.e. increasing centralization (compared to 2020)		
Available maximum level of automatization of individual vessels for land transport	microscopic	static	endogenous	02 Technology	assisted driving	partial automated driving (large range of assistant supporting systems)	conditionally automated driving (with driver readiness for interference)	highly automated driving	fully automated driving
Maximum level of automatization of collective vessels for land transport (untracked)	microscopic	static	endogenous	02 Technology	assisted driving	partial automated driving (large range of assistant supporting systems)	conditionally automated driving (with driver readiness for interference)	highly automated driving	fully automated driving
Maximum level of automatization of collective vessels for land transport (tracked; smart rail)	microscopic	static	endogenous	02 Technology	conditionally automated driving (with driver readiness for interference)	Highly automated driving	Fully automated driving		
Real disposable income	microscopic	dynamic	exogenous	03 Economy and Social	stagnating (as of 2020)	increasing (compared to 2020), according to consensus opinion	decreasing (compared to 2020), due to an increase in mandatory levies and/ or economic slowdown and/ or decrease in value-added from traditional big contributors to Swiss GDP		
Attributed share of disposable income for discretionary	microscopic	dynamic	exogenous	06 Mobility demand	unchanged (as of 2020)	decreasing (utility in decentralized society)	increasing (recognition of externalities and		

Driver	Perspective	Time	Relation to mobility system	Category	Level 1	Level 2	Level 3	Level 4	Level 5
spending for mobility solutions							luxury of face-to-face interactions given digital co-presence options)		
Share of overall urban population in Switzerland	macroscopic	dynamic	exogenous	04 Land use	unchanged (as of 2020)	Decreasing (urban sprawl increasing), due to compacted building at already sprawled locations and according policies	Increasing (compacted urbanization, with stagnating or decreasing urban sprawl) due to one of the expected results of the current spatial planning legislation		
Overall/ predominant spatial structure in Switzerland	macroscopic	static	exogenous	04 Land use	Centric, with about 6 key hexagonal market and catchment areas	poly-centric, with multiple, overlapping market and catchment areas, without too much urban sprawl in-between (as of today)	poly-centric, with multiple, overlapping market and catchment areas with urban sprawl in-between the major centers		
Functional allocation of space (land use)	mesoscopic	static	exogenous	04 Land use	completely segregated according to functionality (residential, consumptive, productive)	partially segregated according to functionality (residential, consumptive, productive)	intermixed with different functionalities		
Resource exploitation (productivity of resource use, i.e. services out of resource use)	macroscopic	dynamic	exogenous	03 Economy and Social	balanced	increase	decrease		

Driver	Perspective	Time	Relation to mobility system	Category	Level 1	Level 2	Level 3	Level 4	Level 5
Population density in usable space (Mittelland) per sq. km	macroscopic	static	exogenous	05 Land use & population	<400	400 (as of 2020)	400-450	500	
Coupling constraints with regard to work activities and mobility	microscopic	dynamic	endogenous	06 Mobility demand	more or less unchanged (as of 2020), as a result of a lack of change in conditions	increasing (compared to 2020), due to one or more of the following reasons: more fractioned work portfolio, presence conditionalities, less home office, lack of third places	decreasing (compared to 2020), due to one or more of the following reasons: less fractioned work portfolio, less presence conditions, more home office, work at nearby third places		
Coupling constraints regarding leisure activities and mobility	microscopic	dynamic	endogenous	06 Mobility demand	unchanged (as of 2020)	increasing (compared to 2020), due to an increase in social (network) obligations	decreasing (compared to 2020), due to a decrease in social (network) obligations		
Composition of individual mobility demand (and decisions)	microscopic	dynamic	endogenous	06 Mobility demand	increasing share of habitual decisions/ decreasing share of situational discretionary decisions, due to an increasing share of coupling constraints	no/ minimal change from today's composition	decreasing share of habitual decisions/ increasing share of situational discretionary decisions, due to a decreasing share of coupling constraints		
Aggregated composition of mobility demand (reasons)	macroscopic	dynamic	endogenous	06 Mobility demand	increasing share of commuter mobility/ decreasing share of leisure mobility,	no/ minimal change from today's composition (50/50)	decreasing share of commuter mobility/ increasing share of leisure mobility,		

Driver	Perspective	Time	Relation to mobility system	Category	Level 1	Level 2	Level 3	Level 4	Level 5
					due to an increasing share of the working population		due to an increasing share of the retired population		
Mobility demand in general	macroscopic	dynamic	endogenous	06 Mobility demand	unchanged (as of 2020)	increasing (compared to 2020), due to increase in population resulting in a spread of activity locations	increasing (compared to 2020), due to increase in incomes resulting in a higher demand for activities.	decreasing (compared to 2020) due to stagnation in population.	decreasing (compared to 2020) due to stagnation in incomes.
Mode split between collective and individual means of motorized transport	macroscopic	dynamic	endogenous	06 Mobility demand	unchanged (as of 2020)	increasing share of collective means of motorized transport, due to an increase of the urbanized population.	decreasing share of collective means of motorized transport, due to an increase of sprawl and potentially the availability of automatic individual vessels		
Stops density with collective transport (technical feasibility assumed)	macroscopic	dynamic	endogenous	07 Mobility supply	unchanged (as of 2020)	increasing (compared to 2020), due to an increase in population in served areas	decreasing (compared to 2020), due to a decreasing population and increasing sprawl in spatial development, resulting in less concentration of demand		
Line/ routing density with collective transport	macroscopic	dynamic	endogenous	07 Mobility supply	unchanged (as of 2020)	increasing (compared to 2020), due to an increase in population in served areas	decreasing (compared to 2020), due to a decreasing population and increasing sprawl in spatial development,		

Driver	Perspective	Time	Relation to mobility system	Category	Level 1	Level 2	Level 3	Level 4	Level 5
							resulting in less concentration of demand		
Service frequency of collective transport	macroscopic	dynamic	endogenous	07 Mobility supply	unchanged (as of 2020)	increasing (compared to 2020), due to an increase in population and therefore increased demand	decreasing (compared to 2020), due to a decreasing population and increasing sprawl in urban development, resulting in less concentration of demand		
Prevalent type of production of individual transport	macroscopic	static	endogenous	07 Mobility supply	own/ private production on demand (ownership = operatorship = usership)	commercial 3rd party production of mobility supply on demand (individual mobility as a service) (ownership = operatorship // usership)	commercial 3rd party provision of mobility tools on demand (ownership // operatorship = usership	own/ private production on demand + ride share opportunity/ ride share opportunity with 3rd party private production	hybrid
Cost awareness of economic subjects by mobility pricing	microscopic	static	endogenous	07 Mobility supply	mostly unchanged (50/50), with persistent perception biases, prospective accounting, and sunk costs fallacies	full scale mobility pricing (100/0), maximizing the share of variable and marginal costs for mobility participation, minimizing potential sunk costs (pay as you travel)	partial mobility pricing (80/20), increasing the share of variable and marginal costs	hybrid forms of mobility pricing	
Production costs for transport services as a macro aggregate of	macroscopic	dynamic	endogenous	07 Mobility supply	balanced (unchanged because gains and	increasing	decreasing		

Driver	Perspective	Time	Relation to mobility system	Category	Level 1	Level 2	Level 3	Level 4	Level 5
technology implications					losses at par)				
Transportation infrastructure	macroscopic	static	endogenous	07 Mobility supply	just enough to cover demand (which remains non-managed); internal costs mostly covered	insufficient to cover demand, resulting in perpetual infrastructure investments to accommodate demand	insufficient to cover demand, resulting in demand management measurements to allocate scarce capacities more efficiently	overcapacity, resulting increasingly in uncovered costs	
Type of prevalent stops for collective transportation (tracked and non-tracked)	macroscopic	static	endogenous	07 Mobility supply	All types (e.g. IC, IR, RE, S, tracked (e.g. tram), non-tracked (e.g. bus); metropolitan "main station" type)	IC, IR, RE, S, some tracked (e.g. tram), non-tracked (e.g. bus); city "main station" type	IR, RE, S, non-tracked (e.g. bus)	RE, S, non-tracked (e.g. bus)	some S; non-tracked (e.g. bus)
Share of use of highly or fully automated individual vessels (capsules) for land transport	macroscopic	static	endogenous	08 Mobility tools utilization	more than 75%	50-75%	25-50%	less than 25%	
Share of use of highly or fully automated collective vessels for land transport	macroscopic	static	endogenous	08 Mobility tools utilization	more than 75%	50-75%	25-50%	less than 25%	
Share of own physical (feet) and wearable mobility tools (skateboard, scooter, possibly bicycle)	macroscopic	dynamic	endogenous	08 Mobility tools utilization	unchanged (as of 2020)	increasing (compared to 2020)	decreasing (compared to 2020)		

Driver	Perspective	Time	Relation to mobility system	Category	Level 1	Level 2	Level 3	Level 4	Level 5
Prime domain of competition of collective transport	macroscopic	static	endogenous	09 Policy	Open access	for specific geographic perimeters (canton, city)	for specific lines/ routes (slot allocation)	for specific type of connection (e.g., profitable vs. non profitable, long haul vs. Short haul, etc.)	for specific times of day
Type of access for rail (collective) transport companies	macroscopic	static	endogenous	09 Policy	Open access	Service level agreement	Concession	hybrid	
Prime domain of competition for the provision of individual transport (owner = operator // user)	macroscopic	static	endogenous	09 Policy	Open access	Restricted access (for a specific geographic perimeter), e.g. communities tendering supply, mostly due to limited traffic circulation area (flowing and parking)	Restricted access (for a specific route), for multiple reasons (capacities, regulation, etc.)	hybrid	
Road infrastructure use allocation (except pedestrian)	macroscopic	static	endogenous	09 Policy	one for everyone and everything	separation between "normal speed" collective and individual means of transport	separation between low speed individual and normal speed means of transport	separation between "normal speed" collective and individual means of transport; individual means of transport separated between low and normal speed	
Degree of subsidies for collective transport in regional transport	macroscopic	dynamic	endogenous	09 Policy	unchanged (as of 2020)	increasing, due to increasing costs/ political will	decreasing, due to decreasing costs/ political will		

Driver	Perspective	Time	Relation to mobility system	Category	Level 1	Level 2	Level 3	Level 4	Level 5
Expected degree of economic self-sufficiency of mobility companies	macroscopic	dynamic	endogenous	09 Policy	unchanged (as of 2020)	increasing, due to a decrease in subsidies and/ or decrease in costs/ and/ or increase in revenues	decreasing, due to an increase in subsidies and/ or increase in costs and/ or decrease in revenues		
Land resource use policy	macroscopic	dynamic	exogenous	09 Policy	unchanged (as of 2020)	rather consolidation and compaction	rather scattering and partition		
General access to competition	macroscopic	static	endogenous	09 Policy	CH (domestic) companies (cabotage enforcement)	EU companies	all		
Mobility pricing perimeter	macroscopic	static	endogenous	09 Policy	none	for specific geographic perimeters (canton, city)	for specific lines/ routes	for specific type of connections	for specific times of day
Traffic peaks (time and location)	macroscopic	dynamic	endogenous	10 Traffic (phenomenon)	unchanged (as of 2020)	increasing (compared to 2020)	decreasing (compared to 2020)		

Figure 16: Example of specific level characteristics for the scenario SC1HT

Driver	Perspective	Time	Relation to mobility system	Category	Level 1	Level 2	Level 3	Level 4	Level 5
Applicable scenario perspective: Spatial structure (and economic structure in applicable space)	none	static	exogenous	00 Scenario perspective	all (entire country)	very high interaction density center of a large agglomeration center of a mediumsized agglomeration (3rd sector; predominantly highly productive professional and commercial	high interaction density agglomeration of such a center center of a small agglomeration or outside agglomeration periurban municipality (3rd sector, with	medium intercation density periurban medium density municipality; rural central municipality. medium interaction density (2nd sector with some 3rd sector)	low interaction density periurban community of low density; rural centrally located municipality; rural peripheral municipality. low interaction density (2nd sector and
Applicable scenario perspctive: Actors	none	static	endogenous	00 Scenario perspective	system (holistic); non specific	government and regulator	customers and citizens	infrastruture providers (construction, maintenance, etc.) and ist necessary value chains	transport providers (transport services and ancilliaries) and ist necessary value chains
Size of population	macroscopic	dynamic	exogenous	01 Population	unchanged (as of 2020)	Increasing (due to immigration)	Decreasing (due to greying of the population and potential emigration)		
Size of productive population	macroscopic	dynamic	exogenous	01 Population	unchanged (as of 2020)	increasing (due to immigration and retirement work)	decreasing (due to greying of the population and obsolesence of skills)		
Dispersion of family and social network nodes	macroscopic	dynamic	exogenous	01 Population	unchanged (as of 2020)	increasing (compared to 2020)	decreasing (compared to 2020)		
Dispersion of nodes for stationary work	microscopic	static	exogenous	01 Population	unchanged (as of 2020)	increasing i.e. decreasing centralisation (compared to 2020)	decreasing, i.e. increasing centralisation (compared to 2020)		
Available maximum level of automatisation of individual vessles for land transport	microscopic	static	endogenus	02 Technology	assisted driving	partial automated driving (large range of assistent supporting systems)	conditionally automated driving (with driver readiness for interference)	highly automated driving	fully automated driving
Maximum level of automatisation of collective vessles for land transport (untracked)	microscopic	static	endogenous	02 Technology	assisted driving	partial automated driving (large range of assistent supporting systems)	conditionally automated driving (with driver readiness for interference)	highly automated driving	fully automated driving
Maximum level of automatisation of collective vessles for land transport (tracked; smart rail)	microscopic	static	endogenous	02 Technology	conditionally automated driving (with driver readiness for interference)	Highly automated driving	Fully automated driving		

Real disposable income	microscopic	dynamic	exogenous	03 Economy and Social	stagnating (as of 2020)	increasing (compared to 2020), according to consensus opinion	decreasing (compared to 2020), due to an increase in manadory levies and/ or economic slowdown and/ or decrease in value-added from traditional big contributors to Swiss GDP		
Attributed share of disposable income for discretionary spending for mobility solutions	microscopic	dynamic	exogenous	06 Mobility demand	unchanged (as of 2020)	decreasing (utility in decentralized society)	increasing (recognition of externalities and luxury of face-to-face interactions given digital co-presence options)		
Share of overall urban population in Switzerland	macroscopic	dynamic	exogenous	04 Land use	unchanged (as of 2020)	Decreasing (urban sprawl increasing), due to compacted building at already sprawled locations and according policies	Increasing (compacted urbanisation, with stagnating or decerasing urban sprawl) due to one of the expected results of the current spatial planning legislation		
Overall/ predominant spatial structure in Switzerland	macroscopic	static	exogenous	04 Land use	Centric, with about 6 key hexagonal market and catchment areas	poly-centric, with multiple, overlapping market and catchment areas, without too much urban sprawl inbetween (as of today)	poly-centric, with multiple, overlapping market and catchment areas with urban sprawl inbetween the major centers		
Functional allocation of space (land use)	mesoscopic	static	exogenous	04 Land use	completely segregated according to functionality (residential, consumptive, productive)	partially segregated according to functionality (residential, consumptive, productive)	intermixed with different functionalities		
Ressource exploitation (productivity of ressource use, i.e. services out of resource use)	macroscopic	dynamic	exogenous	03 Economy and Social	balanced	increase	decrease		
Population density in usable space (Mittelland) per sqkm	macroscopic	static	exogenous	05 Land use & population	<400	400 (as of 2020)	400-450	500	
Coupling constraints with regard to work activities and mobility	microscopic	dynamic	endogenous	06 Mobility demand	more or less unchanged (as of 2020), as a result of a lack of change in conditions	increasing (compared to 2020), due to one or more of the following reasons: more fractioned work portfolio, presence conditionalities, less home office, lack of third places	decreasing (compared to 2020), due to one or more of the following reasons: less fractioned work portfolio, less presence conditions, more home office, work at nearby third places		
Coupling constraints with regard to leisure activities and mobility	microscopic	dynamic	endogenous	06 Mobility demand	unchanged (as of 2020)	increasing (compared to 2020), due to an increase in social (network) obligations	decreasing (compared to 2020), due to a decrease in social (network) obligations		
Composition of individual mobility demand (and decisions)	microscopic	dynamic	endogenous	06 Mobility demand	increasing share of habitual decisions/ decreasing share of situational discretionary decisions, due to an increasing share of coupling constraints	no/ minimal change from todays composition	decreasing share of habitual decisions/ increasing share of situational discretionary decisions, due to an decreasing share of coupling constraints		

Aggregated composition of mobility demand (reasons)	macroscopic	dynamic	endogenous	06 Mobility demand	increasing share of commuter mobility / decreasing share of leisure mobility, due to an increasing share of the working population	no/ minimal change from todays composition (50/50)	decreasing share of commuter mobility / increasing share of leisure mobility, due to an increasing share of the retired population		
Mobility demand in general	macroscopic	dynamic	endogenous	06 Mobility demand	unchanged (as of 2020)	increasing (compared to 2020), due to increasse in population resulting in a spread of activity locations	increasing (compared to 2020), due to increasse in incomes resulting in a higher demand for activities.	decreasing (compared to 2020) due to stagnation in population.	decreasing (compared to 2020) due to stagnation in incomes.
Mode split between collective and individual means of motorised transport	macroscopic	dynamic	endogenous	06 Mobility demand	unchanged (as of 2020)	increasing share of collective means of motorised transport, due to an increase of the urbanised population.	decreasing share of collective means of motorised transport, due to an increase of sprawl and potentially the availability of automatic individual vessels		
Stops density with collective transport (technical feasiblity assumed)	macroscopic	dynamic	endogenous	07 Mobility supply	unchanged (as of 2020)	increasing (compared to 2020), due to an increase in population in served areas	decreasing (compared to 2020), due to a decreasing population and increasing sprawl in spatial development, resulting in less concentration of demand		
Line/ routing density with collective transport	macroscopic	dynamic	endogenous	07 Mobility supply	unchanged (as of 2020)	increasing (compared to 2020), due to an increase in population in served areas	decreasing (compared to 2020), due to a decreasing population and increasing sprawl in spatial development, resulting in less concentration of demand		
Service frequency of collective transport	macroscopic	dynamic	endogenous	07 Mobility supply	unchanged (as of 2020)	increasing (compared to 2020), due to an increase in population and therefore increased demand	decreasing (compared to 2020), due to a decreasing population and increasing sprawl in urban development, resulting in less concentration of demand		
Prevalent type of production of individual transport	macroscopic	static	endogenous	07 Mobility supply	own/ private production on demand (ownership = operatorship = usership)	commercial 3rd party production of mobility supply on demand (individual mobility as a service) (ownership = operatorship // usership)	commercial 3rd party provision of mobility tools on demand (ownership // operatorship = usership	own/ private production on demand + ride share opportunity / ride share opportunity with 3rd party private production	hybrid
Cost awareness of economic subjects by mobility pricing	microscopic	static	endogneous	07 Mobility supply	more or less unchanged (50/50), with persistent perception biases, prospective accounting, and sunk costs fallacies	fullscale mobility pricing (100/0), maximizing the share of variable and marginal costs for mobility participation, minimizing potential sunk costs (pay as you travel)	partial mobility pricing (80/20), increasing the share of variable and marginal costs	hybrid forms of mobility pricing (tbd)	
Production costs for transport services as a macro aggregate of technology implications	macroscopic	dynamic	endogenous	07 Mobility supply	balanced (unchanged because gains and losses at par)	increasing	decreasing		
Transportation infrastructure	macroscopic	static	endogenous	07 Mobility supply	just sufficient to cover demand (which remains non-managed); internal costs mostly covered	insufficient to cover demand, resulting in perpetual infrastructure investments to accommodate demand	insufficient to cover demand, resulting in demand management measurements to allocate scarce capacities more efficiently	overcapacity, resulting increasingly in uncovered costs	

Type of prevalent stops for collective transportation (tracked and non-tracked)	macroscopic	static	endogenous	07 Mobility supply	All types (e.g. IC, IR, RE, S, tracked (e.g. tram), non-tracked (e.g. bus); metropolitan "main station" type)	IC, IR, RE, S, some tracked (e.g. tram), non-tracked (e.g. bus); city "main station" type	IR, RE, S, non-tracked (e.g. bus)	RE, S, non-tracked (e.g. bus)	some S; non-tracked (e.g. bus)
Share of use of highly or fully automated individual vessels (capsules) for land transport	macroscopic	static	endogenous	08 Mobility tools utilisation	more than 75%	50-75%	25-50%	less han 25%	
Share of use of highly or fully automated collective vessels for land transport	macroscopic	static	endogenous	08 Mobility tools utilisation	more than 75%	50-75%	25-50%	less han 25%	
Share of own physical (feet) and wearable mobility tools (skateboard, scooter, possibly bicycle)	macroscopic	dynamic	endogenous	08 Mobility tools utilisation	unchanged (as of 2020)	increasing (compared to 2020)	decreasing (compared to 2020)		
Prime domain of competition of collective transport	macroscopic	static	endogenous	09 Policy	Open access	for specific geographic perimeters (canton, city)	for specific lines / routes (slot allocation)	for specific type of connection (e.g., profitable vs. non profitable, long haul vs. Short haul, etc.)	for specific times of day
Type of access for rail (collective) transport companies	macroscopic	static	endogenous	09 Policy	Open access	Service level agreement	Concession	hybrid	
Prime domain of competition for the provision of individual transport (owner = operator // user)	macroscopic	static	endogenous	09 Policy	Open access	Restricted access (for a specific geographic perimeter), e.g. communities tendering supply, mostly due to limited traffic circulation area (flowing and parking)	Restricted access (for a specific route), for multiple reasons (capacities, regulation, etc.)	hybrid	
Road infrastructure use allocation (except pedestrian)	macroscopic	static	endogenous	09 Policy	one for evryone and everything	seperation between "normal speed" collective and individual means of transport	seperation between low speed individual and normal speed means of transport	seperation between "normal speed" collective and individual means of transport; individual means of transport seperated between low and normal speed	
Degree of subsidies for collective transport in regional transport	macroscopic	dynamic	endogenous	09 Policy	unchanged (as of 2020)	increasing, due to increasing costs / political will	decreasing, due to decreasing costs / political will		
Expected degree of economic self-sufficiency of mobility companies	macroscopic	dynamic	endogenous	09 Policy	unchanged (as of 2020)	increasing, due to a decrease in subsidies and/ or decrease in costs / and/ or increase in revenues	decreasing, due to an increase in subsidies and/ or increase in costs and/ or decrease in revenues		

Land ressource use policy	macroscopic	dynamic	exogenous	09 Policy	unchanged (as of 2020)	rather consolidation and compaction	rather scattering and partition		
General access to competition	macroscopic	static	endogenous	09 Policy	CH (domestic) companies (cabotage enforcment)	EU companies	all		
Mobility pricing perimeter	macroscopic	static	endogenous	09 Policy	none	for specific geographic perimeters (canton, city)	for specific lines/ routes	for specific type of connections	for specific times of day
Traffic peaks (time and location)	macroscopic	dynamic	endogenous	10 Traffic (pheanomenon)	unchanged (as of 2020)	increasing (compared to 2020)	decreasing (compared to 2020)		

For the project at hand, we decided to focus on the high tech-diffusion scenarios only (see green highlight area in Figure 15) because these are the ones we deem likely to become effective based on the processed future mobility literature. Because those scenarios have informed the workshop and discussed implications for present rail business models and for future mobility business models, we present the high-tech scenarios as individual profiles and contrast them below (cf. Figure 17):

5.2.1 Scenario SC1HT

Very high density of points of interaction with high technology diffusion:

- In 2040, Switzerland will have, among other spatial structures, densely populated urban areas with thriving urban centers. A large part (approximately 30%) of the population of this country will live in such centers, notably centers of work, housing, and consumption. The economy is driven by the 3rd sector, with dominant professional and commercial services sectors.
- The working population will have grown strongly since 2020 (immigration, retirement age). So will have real disposable income (due to productivity gains; of which an unchanged share is spent on mobility). Social and professional networks will have spread further and farther (nationally and internationally). Work, however, will be more decentralized and more flexible. On average, the number of routine mobility decisions will decrease (e.g. commuting); mobility will, however, increase overall, but primarily via non-routine decisions (due to the variability in social and professional networks).
- Level 5 automatic road vehicles will be available, but only 20-50% of the vehicle fleet will be equipped with such technology yet. The supply of collective mobility will increase (stops, lines, frequencies, etc.) because demand will have increased, and the productivity of collective transports will have increased too. Human powered transport and alternative last-mile (automatic) individual and small collective vehicles will be important additions to collective mass transport. Offers of individual mobility (such as automatic vehicles) will be increasingly offered through commercial provider-operator business models with MaaS.
- In macroeconomic terms, the production costs of mobility and subsidies will be decreasing. Economic sustainability will be politically expected. Offers of commercial MaaS will be

controlled by regulated monopolies in specific perimeters. Mobility services and offers will be put out for public tender, whereby competition will be predominantly national.

5.2.2 Scenario SC2HT

High density of points of interaction with high technology diffusion:

- In 2040, Switzerland will have, among other spatial structures, densely populated urban areas with agglomerations as well additional periurban areas. A large part of the population (approximately 35%) of this country will be living in such agglomerations, notably centers of housing, work, and consumption. The economy will be driven by the (professional) services sector (3rd sector), mixed with some production sector industries (2nd sector).
- The working population will have grown strongly since 2020 (immigration, retirement age); as will the real disposable income (due to productivity gains; of which an unchanged share will be spent on mobility). Social and professional networks will have spread further and farther (nationally and internationally). Work, however, will be more decentralized and more flexible. On average, the number of routine mobility decisions will decrease (e.g. commuting); mobility will, however, still increase overall, but primarily via non-routine decisions (due to the variability in social and professional networks).
- Level 5 automatic road vehicles will be available, but only 20-50% of the vehicle fleet will be equipped with this technology yet. The supply of collective mobility will be stagnating (stops, lines, frequencies, etc.) because demand will have stagnated. Self-produced individual transport will be the prevalent supplementary means of transport, supported by some MaaS offers in the form of commercial business models.
- In macroeconomic terms, the production costs of mobility and subsidies will be decreasing. Economic sustainability will be politically expected. The offer of commercial MaaS will be controlled by regulated monopolies in specific perimeters. Mobility services and offers will be put out to public tender, whereby competition will mainly occur at a national level.

5.2.3 Scenario SC3HT

Medium density of points of interaction with high technology diffusion:

- In 2040, Switzerland will have, among other spatial structures, medium density periurban municipalities and rural central municipalities. A small part (20%) of the population of this country will be living in such spaces, with functions of housing, work, and consumption.

The economy will be driven by the 2nd sector with some 3rd sector and very little agricultural production (1st sector).

- The working population will have stagnated since 2020 as will the real disposable income (of which an unchanged share of will be spent on mobility). Social and professional networks will have spread further (both nationally and internationally). Work will be – due to high shares of the 2nd sector – rather space and time constrained. On average, the number of routine mobility decisions have increased (e.g. commuting), due to these constraints; mobility however will have stagnated overall and will be primarily "supported" via non-routine decisions (due to the variability in social and professional networks).
- Level 5 automatic road vehicles will be available, but only 20-50% of the vehicle fleet will be equipped as such yet. The supply of collective mobility will be stagnant (stops, lines, frequencies, etc.) because demand will have stagnated. Self-produced individual transport will be the prevalent supplementary means of transport. There will be some rare commercial MaaS offers.
- In macroeconomic terms, the production costs of mobility and subsidies will be decreasing. Economic sustainability will be politically expected. There will be an open access policy/ regulation regarding the offer of commercial MaaS.

5.2.4 Scenario SC4HT

Low density of points of interaction) with high technology diffusion:

- In 2040, Switzerland will have, among other spatial structures, periurban communities of low density, rural centrally located municipalities, and rural peripheral municipalities. A small part (15%) of the population of this country will live in such spaces, with functions of housing, work, and some consumption. The economy will be driven by the 2nd and 1st sector.
- The working population will have decreased since 2020 and real disposable income will have stagnated (of which an unchanged share of will be spent on mobility). Social and professional networks will be stagnant (nationally and internationally). Work will be – due to dominant shares of the 2nd and 1st sector – rather space and time constrained. On average, the number of routine mobility decisions will have increased (e.g. commuting), due to these constraints; mobility, however, will be stagnant overall.

- Level 5 automatic road vehicles will be available, but only 20-50% of the vehicle fleet will be equipped as such yet. The supply of collective mobility will decrease (stops, lines, frequencies, etc.) because demand will have decreased. Self-produced individual transport will be the prevalent supplementary means of transport. There will hardly be any commercial MaaS offers.
- In macroeconomic terms, the production costs of mobility and subsidies will have decreased. Economic sustainability will be politically expected. There will be an open access policy/ regulation regarding the offer of commercial MaaS.

5.2.5 Implications across the four scenarios

Across the four listed scenarios, there are *six major discriminators* (and input factors):

- The spatial structure (perspective);
- The demand for mobility within and between spatial categories;
- The degree of coupling constraints (lack of degrees of freedom) of agents and the share of habitual decisions;
- The quantity and quality of collective mobility supply (lines, stops, frequencies, etc.);
- The production type of individual mobility supply and provision of individual mobility tools;
- The type of access to markets for providers of MaaS (regulatory competitive scheme).

To conclude, Figure 17 sums up the comparison of the four high-tech diffusion scenarios along the criteria outlined and highlights the six major discriminators in color.

Figure 17: Comparison of scenario profiles

Scenario SC1HT

- Increasing size of (productive) population, increasing dispersion of network nodes (private and professional), increasing real disposable income
- Fully automated vessels for road transport available, with max. 20-50% of vessel stock having high levels of automation
- **Partially segregated land use** (different functions at different locations), with consolidation tendencies
- Decreasing coupling constraints with regard to professional life; increasing coupling constraints with regard to leisure life
- Decreasing share of habitual decisions; increasing share of discretionary decisions
- Increasing demand for mobility, with decreasing shares of commuter mobility demand
- Increasing collective mobility supply (stops, lines, frequency, etc.) due to increasing demand and productivity gains; **human** and slightly **powered mobility** as key supplementary means of transport
- Individual mobility or mobility tools increasingly provided commercially, with owner=operator//user and owner//operator=user models respectively (cf. appendix)
- Restricted competitive access (geographic/ political perimeter) to provide commercial transport services or mobility tools (tenders)

Scenario SC2HT

- Increasing size of (productive) population, increasing dispersion of network nodes (private and professional), increasing real disposable income
- Fully automated vessels for road transport available, with max. 20-50% of vessel stock having high levels of automation
- **Partially segregated land use** (different functions at different locations), with consolidation tendencies
- Increasing coupling constraints with regard to professional life; increasing coupling constraints with regard to leisure life
- Stagnating share of habitual and discretionary decisions
- Increasing demand for mobility, with decreasing shares of commuter mobility demand
- Stagnating collective mobility supply (stops, lines, frequency, etc.) due to stagnating demand; **individual transport** (motorized, non motorized) as prevalent supplementary means of transport
- Individual mobility or mobility tools mainly produced individually; some commercial mobility provision with owner=operator//user and owner//operator=user models respectively (cf. appendix)
- Restricted competitive access (geographic/ political perimeter) to provide commercial transport services or mobility tools (tenders)

Scenario SC3HT

- Stagnating size of (productive) population, increasing dispersion of network nodes (private and professional), stagnating real disposable income
- Fully automated vessels for road transport available, with max. 20-50% of vessel stock having high levels of automation
- **Intermixed land use** with consolidation tendencies
- Increasing coupling constraints with regard to professional life; increasing coupling constraints with regard to leisure life
- Increasing share of habitual decisions; decreasing share of discretionary decisions due to constraints.
- Stagnating demand for mobility, with decreasing shares of commuter mobility demand
- Stagnating collective mobility supply (stops, lines, frequency, etc.) due to stagnating demand; **individual transport** (motorized, non motorized) as prevalent supplementary means of transport
- Individual mobility or mobility tools mainly produced individually; some rare commercial mobility provision with owner=operator//user and owner//operator=user models respectively (cf. appendix)
- Open access to provide commercial transport services or mobility tools

Scenario SC4HT

- Decreasing size of (productive) population, increasing dispersion of network nodes (private and professional), stagnating real disposable income
- Fully automated vessels for road transport available, with max. 20-50% of vessel stock having high levels of automation
- **Intermixed land use** with consolidation tendencies
- Increasing coupling constraints with regard to professional life; increasing coupling constraints with regard to leisure life
- Increasing share of habitual decisions; decreasing share of discretionary decisions due to increasing constraints
- Stagnating demand for mobility, with decreasing shares of commuter mobility demand
- Decreasing collective mobility supply (stops, lines, frequency, etc.) due to stagnating demand; **individual transport** (motorized, non motorized) as prevalent supplementary means of transport
- Individual mobility or mobility tools mainly produced individually; some rare commercial mobility provision with owner=operator//user and owner//operator=user models respectively (cf. appendix)
- Open access to provide commercial transport services or mobility tools

5.3 Business model morphology

This subchapter details the final version of the morphology for future mobility business models, whose purpose, design process, practical testing, and limitations are explained in chapter 4.5.

The morphology features *10 second-order parameters (2ndP)*, mostly equivalent to the main elements of the Business Model Canvas (Osterwalder & Pigneur, 2010) to connect to the practice of strategic corporate development processes frequently making use of this common template; *52 first-order parameters (1stP)* to operationalize the second-order parameters in terms of key choices and design decisions for future mobility business models; and *312 parameter values* detailing the options for the design decisions that pertain to the first-order parameters. The subsequent section details the morphology's constituent parts.

5.3.1 Customers

The first second-order parameter labeled *customers* (2ndP1) identifies who is to be addressed with a specific BM configuration. *Customers* is operationalized by means of seven first-order parameters:

The first, *jobs-to-be-done* (1stP1), identifies the basic needs of customers (including individual person, group of people, and institutional entities such as businesses or authorities) that are relatively stable over long periods of time and slow to change (Kotler & Keller, 2009; Osterwalder et al., 2014; Page, 2015). It answers the questions what problem the BM is solving for a specific (group of) customer(s).

Table 6: Parameter values for jobs-to-be-done

1. Feed self/family	2. Earn living	3. Interact with family and friends	4. Educate and raise children
5. Spend leisure time	6. Break free from everyday	7. Learn something new	8. Stay healthy
9. Age in dignity	10. Emigrate	11. Earn recognition	12. Create attractive livable environment
13. Earn sustainable rent	14. Feel well	15. Self determination	16. Self-optimization

The second, *regularity* (1stP2), specifies with what regularity customers make decisions about a specific job-to-be-done (Wood & Neal, 2009). This is an important proxy to understand the involved level of information processing, range of options considered, amount of mental and physical energy and effort involved in decision processes that pertain a specific need. It also provides clues regarding other aspects such as what might be valued in solutions that address a job-to-be-done and the willingness to accept particular revenue models and payment modalities.

Table 7: Parameter values for regularity

1. Habitual	2. Non-habitual – situational (spontaneous, self-motivated)	3. Non-habitual – activity driven (planned, self-motivated)	4. Non-habitual – emergency/disruption (spontaneous, exogeneous influence)

The third, *pain points* (1stP3), outlines the different restrictions and limitations involved in the nature of the job-to-be-done for the customer (Osterwalder et al., 2014). The choice of solutions to address specific needs involves specific cost-sacrifice trade-offs that this first-order parameter addresses (Smith & Colgate, 2007). Those trade-offs include physical and immaterial resources as well as endogenous (that is, inherent to or within the customer) and exogenous (that is, external to the customer) limitations and restrictions.

Table 8: Parameter values for pain points

1. Time restraint (in-/ extrinsic)	2. Monetary restraint	3. Geographic restraint (borders)	4. Split attention (multi-tasking)
5. Access to mobility resources	6. Negative social signals	7. Physical discomfort	8. Emotional stress
9. Sensory limitation	10. Physical limitation	11. Normative limitation	12. Risk tolerance
13. Tolerance for complexity	14. Legal limitations	15. Information deficiency (access, search, orientation)	-

The fourth, *gains* (1stP4), addresses the potential benefits customers can gain by means of engaging with the solution that a BM offers in response to a specific job-to-be-done of theirs (Osterwalder et al., 2014). In more abstract terms, those benefits relate to the functional, hedonic, and/or expressive value derived from a specific product-service combination, whatever its form in terms of unit of business (Smith & Colgate, 2007).

Table 9: Parameter values for gains

1. Physical recreation	2. Emotional recreation	3. Productivity (more in same time)	4. Productivity (better quality in same time)
5. Thrill of the new	6. Sense of justice/ contribution	7. Sense of achievement	8. Social recognition
9. Joy of use	10. Simplicity	11. Self-efficacy	12. Creativity from undirected attention
13. Sense of belonging	14. Sense of security (absolute, perceived)	-	-

The fifth, *spatial structure* (1stP5), contextualizes the environment of productive and consumptive exchanges (Besussi, Chin, Batty, & Longley, 2010; Kohler, Goebel, & Zecha, 2012). Because mobility BMs are inherently concerned with spatiality and the movement within and across spaces, this parameter encodes relevant proxy information as to the availability of potential alternative offers, complementary services as well as the absolute and relative availability of public resources for to fulfill the needs addressed.

Table 10: Parameter values for spatial structure

1. Urban (very high density)	2. Agglomeration (high density)	3. Peri-urban (medium density)	4. Rural (low density)

The sixth, *willingness to pay as a function of perceived value and/or service level* (1stP6), approximates how customers willingness to pay might change as a result of higher or lower perceived value derived from a particular solution addressing a job-to-be-done or the service level offered to address a particular need (Govindarajan & Trimble, 2004; Matzler & Sauerwein, 2002). This customer characteristic is relevant to understand options and justify decisions when it comes to the design of the revenue models that specify the potential to capture value from a specific mobility BM.

Table 11: Parameter values for willingness to pay as function of value/service

1. Linear (more service, higher willingness to pay 1:1)	2. Exponential concave (more service, steep increase in willingness to pay)	3. Exponential convex (more service, little more willingness to pay)	-

Finally, the seventh first-order parameter, *decision context* (1stP7), is concerned with the social embeddedness of decisions about what a mobility BM offers to address a specific need (Ben-

Akiva et al., 2012; Beritelli & Reinhold, 2018). The social context determines freedom of choice, provides clues regarding potentially deployed heuristics, and may help to identify coupling constraints that did not register as pain points.

Table 12: Parameter values for decision context

1. Isolated (independent)	2. Embedded (family)	3. Embedded (friends)	4. Embedded (business)
5. Embedded (administration)	-	-	-

Overall, in most scenario-based development processes for new BMs, we expect those first-order parameters (specifying *customers*) and most of their parameter values to be an input to the development process rather than something developed as the morphological analysis unfolds. Customer profiles (or persona) can, for example, result from the scenario development process as planners and scenario developers make sense of their future worlds and of the individuals and entities that populate them.

5.3.2 Value proposition

The second second-order parameter labeled *value proposition* (2ndP2) identifies how a specific BM configuration addresses the needs of specific customers. *Value proposition* is operationalized by means of nine first-order parameters:

The first, *performance characteristics* (1stP8), identifies the functional, hedonic, expressive and cost benefits offered by the unit of business offered to and exchanged with customers to convey the value the mobility offers in response to the job-to-be-done (Smith & Colgate, 2007). It answers the question what value the product-service combination resulting from the mobility BM offers. The parameter values for performance characteristic are not mutually exclusive but convey parallel options intended for purposeful combination in response to customer needs as well as associated pain points and potential gains sought.

Table 13: Parameter values for performance characteristics

1. Speed	2. Comfort	3. Convenience	4. Frequency
5. Variety	6. Offered added value (Multi-functionality)	7. Part- or complete solution	8. Fencing
9. Cleanliness	10. Locality and location	11. Materials	12. Friendliness
13. Empathy	14. Atmosphere	15. Safety	16. Social meaning (status, identity, privilege)
17. Availability	18. User friendliness	19. Cost (transaction cost, use cost, lifecycle cost)	20. Personal meaning
21. Value conservation	22. Flexibility/ modularity	23. Evoked emotions	24. Enable social interaction
25. Physical effort	26. Health consequences	27. Size (available space)	28. Substance (depth, comprehensiveness)
29. Automation	30. Sustainability	-	-

The second, *product form* (1stP9), lists different forms the unit of business could materialize in to fulfill the value proposition (Osterwalder et al., 2014; Zott & Amit, 2010). The range of parameter values is kept generic and broad on purpose to avoid locking in specific forms in the development process and have planners and designer think about a broad range of options.

Table 14: Parameter values for product form

1. Physical	2. Immaterial	3. Digital	4. Financial

The third, *product complexity* (1stP10), addresses how complex the solution is that a BM exchanges with customers as unit of business to embed the performance characteristics required to meet customers' jobs-to-be-done (Belz, 1997). Instead of a mere complexity indication, the parameter values for product complexity specify different levels of product-service integration.

Table 15: Parameter values for product complexity

1. Product	2. Product system	3. Product range	4. Integrated product-service bundle
5. Integrated project management	6. Emotional profile and customer experience	-	-

The fourth, *product materialization* (1stP11), is concerned with the geographical scope of the product materialization and the extent to which physical or digital accessibility is restrained (Hahnewald, 2017). In other words, this refers to where the value derived from the unit of business is available to customers and other key stakeholders. This first-order parameter is not referring to the geographical nature of source markets for suppliers or strategic resources – despite the potential overlap with the customer markets, for example, for location bound public resources dictating service access (e.g., transportation hubs in public ownership or on public ground).

Table 16: Parameter values for product materialization

1. Unlimited (location independent)	2. Limited – international	3. Limited – national	4. Limited – regional
5. Limited – local	-	-	-

The fifth, *product location* (1stP12), refers to the mobility of the unit of business in either physical and/or virtual space (Meyer et al., 2018). Together with previous first-order parameter, product location provides information to assess the ability to scale within the mobility BM.

Table 17: Parameter values for product location

1. Stationary	2. Mobile – real	3. Mobil - virtual	-

The sixth, *level of customization* (1stP13), specifies to what extent the unit of business is tailored to the needs of individual customers in contrast to more standardized solutions applying to different customer groups or one-size-fits-all solutions (Lampel & Mintzberg, 1996). The level of customization speaks to the complexity of the job-to-be-done being addressed as well at the pain points and gains involved and needs direct or indirect remuneration via the revenue model.

Table 18: Parameter values for level of customization

1. Standardized	2. Mass-customized	3. Customized	-

The seventh, *access exclusivity* (1stP14), identifies how exclusive the right to access and consumption of the unit of business is between private and public as well as limited to unrestricted (Lerch et al., 2010). Access exclusivity provides both a means of fencing for certain kinds of monetization in the revenue model as well to pursue certain performance characteristics.

Table 19: Parameter values for access exclusivity

1. Privat – limited	2. Private – unlimited	3. Half-private – limited	4. Half-private – unlimited
5. Public – limited	6. Public – unlimited	-	-

The eighth, *mobility mode* (1stP15), classifies the unit of business in terms of the kind of transportation mode involved in the fulfillment of the value proposition (Bardi, Coyle, & Novack, 2006). Choosing one of the parameter values does not necessitates that the BM is centered on the production of physical mobility for those services; it may also signify what modes of transportation the BM adds a valuable contribution to.

Table 20: Parameter values for mobility mode

1. Overground – road	2. Overground – rail	3. Land- other	4. Air
5. Water/Sea	6. Underground – rail	7. Underground – other	-

Finally, the ninth first-order parameter, *value promised* (1stP16), summarizes the value embedded in the unit of business in response to a set of pain points and gains identified in the customer profile (Osterwalder et al., 2014; Smith & Colgate, 2007). Conceptually, this parameter distinct from the pain points, gains, and performance characteristics because the single value promise or a combination of several promises can respond to multiple pain points and gains by building on multiple performance characteristics.

Table 21: Parameter values for value promised

1. Do it faster	2. Do it cheaper / more cost effective	3. Do more at once	4. Do it more frequently
5. Do it across larger geographic space	6. Do it in more style	7. Di it easier	8. Do it with less/without effort/pain
9. Do it without sorrow	10. Do it despite limitations	11. Do it with less/without risk	12. Do it with less/without externalities
13. Do it within the confines of the law	14. Do it with more pleasure	15. Do it for you	16. Do it for others
17. Do it to be seen by others	18. Do it better (quality, precision, dependability, safety)	-	-

5.3.3 Key activities

The third second-order parameter labeled *key activities* (2ndP3) identifies what activities are essential and (in-)valuable to a BM configuration. *Key activities* is operationalized by means of two first-order parameters:

The first, *valuable activities* (1stP17), identifies by means of what key activities a BM configuration creates value for customers and captures value for its stakeholders (Van de Ven & Poole, 1995). Activities can be essential because they provide or limit access to valuable resources (that is, within scope of a specific BM) or because they are hard to imitate or substitute.

Table 22: Parameter values for valuable activities

1. Coordinate	2. Connect	3. Choose	4. Design
5. Curate	6. Update/refine	7. Analyze	8. Manage
9. Produce	10. Stage (experience, service)	11. Judge	12. Offer (service)
13. Plan	14. Run/implement	15. Search	16. Join
17. Innovate	18. Train/educate	19. Refurbish	20. Sell/market
21. Lobby	22. Fund	23. Project/predict	24. Develop
25. Budget	26. Deal/negotiate	27. Apply/transfer	28. Arbitrate
29. Bundle	30. Communicate	31. Recycle	32. Measure

The second first-order parameter, *nexus of activity control* (1stP18), identifies to what extent the scope of those activities identified as essential to the BM are dominated by a focal organization or shared with and or dependent on any other stakeholder (Bieger & Reinhold, 2011).

Table 23: Parameter values for nexus of activity control

1. Focal organization (self)	2. Shared among partners	3. Others (private)	4. Others (public)

5.3.4 Key resources

The fourth second-order parameter labeled *key resources* (2ndP4) identifies what resources are essential and (in-) valuable to a specific BM configuration. *Key resources* is operationalized by means of three first-order parameters:

The first, *valuable resources* (1stP19), clarifies what resources provide a potential source of comparative competitive advantage as the basis for a BM configuration and could serve as a potential source of leverage in negotiating value dissemination to a focal organization partaking in this BM (Zott & Amit, 2010). In line with the resource-based view of the firm (RBV) (Barney, 1991; Dierickx & Cool, 1989), resources are essential to a BM if they are valuable, rare, inimitable, and non-substitutable.

Table 24: Parameter values for valuable resources

1. Know-what (un-/ protected)	2. Know-how (un-/ protected)	3. Money	4. Legitimacy (legal)
5. Legitimacy (relational)	6. Physical assets (location bound)	7. Physical assets (mobile)	8. Employees
9. Digital assets (un-/ protected)	-	-	-

The second, *rail resources* (1stP20), suggests potential rail resources for incumbent railway undertakings to consider how to leverage their existing resources within scope of new, changed, or existing BM configurations. While they can be used as supply-sided starting point for development efforts, development efforts need to consider potential a priori limitations in scope that would limit the range of considered new BM configurations.

Table 25: Parameter values for rail resources

1. Track network	2. Energy network	3. Information network	4. Customer data (person)
5. Customer data (behavior)	6. Technology (know-what)	7. Technology (know-how)	8. Rolling stock
9. Employees	10. Real estate (connection and exchange hubs)	11. Real estate (others)	12. Trust/ legitimacy

The third first-order parameter, *nexus of resource control* (1stP21), identifies to what extent those resources identified as most essential to the BM are dominated by a focal organization or shared with and or dependent on any other stakeholder (Bieger & Reinhold, 2011).

Table 26: Parameter values for nexus of resource control

1. Focal organization (self)	2. Shared among partners	3. Others (private)	4. Others (public)

5.3.5 Key partners

The fifth second-order parameter labeled *key partners* (2ndP5) identifies what partners are indispensable to a specific BM configuration. *Key partners* is operationalized by means of five first-order parameters:

The first, *strategic partners* (1stP22), identifies partners of strategic importance to the BM. Partners can either be valuable to a BM because of their direct contribution to productive processes or for their enabling or restrictive capacity to shape the value created, captured, or disseminated .

Table 27: Parameter values for strategic partners

1. Voters (customers)	2. Voters (non-customers)	3. Firms	4. National executive power
5. National legislative power	6. National regulator	7. Interest groups	8. Customers (non-voters)
9. Regional executive power	10. Regional legislative power	11. Regional legislator	-

The second, *partner role* (1stP23), specifies what role a specific partner assumes in a BM (Svejenova, Planellas, & Vives, 2010). The values of this first-order parameter justify why a specific partner is of strategic importance to a BM and thus link to the previous parameter.

Table 28: Parameter values for partner role

1. Investor	2. Supplier (broadest sense)	3. Owner (grant mandate, power)	4. Customer (B2B, B2C, B2A, B2B2C, etc.)
5. Recipient of positive externalities	6. Recipient of negative externalities	-	-

The third, *transaction arrangement* (1stP24), classifies the arrangement by which a focal firm and strategic partners interact in relation to transaction cost economics and game theory considerations (Bieger & Reinhold, 2011), where options range from simple, market-based short-term contracts to hierarchical integration by means of minority or majority stakes exchanged.

Table 29: Parameter values for transaction arrangement

1. None	2. Long-term supply contract	3. Service level agreement	4. Franchising contract
5. Strategic alliance / Joint venture	6. Informal collaboration	7. Minority stake	8. Strategy holding
9. Merger (integration)	-	-	-

The fourth, *balance of power* (1stP25), addresses the balance of power in the network of relationships in terms of distribution of power and diffusion of value captured (Bieger & Reinhold, 2011; Post et al., 2002). In other words, this first-order parameter asks to what extent the partner relationships are controlled by a focal firm, dominated by a single other strategic partner, or characterized by distributed power in some kind of balance or equilibrium.

Table 30: Parameter values for balance of power

1. Mono-centric ("us")	2. Mono-centric ("others")	3. Poly-centric (equal distribution)	4. Poly-centric (fractions)

Finally, the fifth first-order parameter, *alignment of interests* (1stP26), refers to the level of expected conflict based on the alignment of different (boundedly rational) interests of strategic partners involved in a particular BM (Besharov & Smith, 2014; Pache & Santos, 2010). Notions of conflict can either center on goals pursued or means used to achieve specific goals.

Table 31: Parameter values for alignment of interests

1. Aligned	2. Goal conflict	3. Means conflict	-

5.3.6 *Cost structure*

The sixth second-order parameter labeled *cost structure* (2ndP6) identifies key determinants of cost in a specific BM configuration. *Cost structure* is operationalized by means of three first-order parameters:

The first, *dominant cost type* (1stP27), identifies to what extent the key cost of value creation in a specific BM is driven by fixed cost, variable cost, or a specific hybrid combination thereof (Johnson et al., 2008). This first-order parameter enables discussions about the linear vs stepwise (Ger. "sprungfix") nature of cost in a BM.

Table 32: Parameter values for dominant cost type

1. Mostly variable cost	2. Mostly fixed cost	3. Hybrid	-

The second, *cost vs value focus* (1stP28), is concerned with a difference in focus and optimization of cost. Specifically, cost focus tries to optimize number of transactions at low cost while value focus tries to focus on relative cost to perceived value performance while maximizing share of wallet (Johnson et al., 2008; Porter, 1980).

Table 33: Parameter values for cost vs value focus

1. Cost focus (quantity)	2. Value focus (quality)	-	-

The third first-order parameter, *cost driver* (1stP29), identities what dominates cost in value creation and capture processes (Johnson, 2010; Johnson et al., 2008): input, throughput, or output. The kind of cost associated with this first-order parameter includes consideration of externalities materializing as indirect cost.

Table 34: Parameter values for cost driver

1. Input	2. Throughput	3. Output	-

5.3.7 Customer relationship

The seventh second-order parameter labeled *customer relationship* (2ndP7) identifies key characteristics of how interactions with customers are designed and lived in a specific BM configuration to achieve specific ends. *Customer relationship* is operationalized by means of six first-order parameters:

The first, *relationship focus* (1stP30), identifies to what extent customer relationships are focused on achieving long-term relationships and associated potential benefits such as co-specialization, loyalty, increased purchase frequency, higher share of wallet, etc. (Grönroos, 1997; Pels, Coviello, & Brodie, 2000).

Table 35: Parameter values for relationship focus

1. Transactional	2. Relational	-	-

The second, *relationship customization* (1stP31), specifies to what extent the interaction with a customer for relational purposes is customized vs standardized (Hart, 1995). Decisions that pertain to this first-order parameter have implication for the perceived value and monetization of the unit of business of a specific BM.

Table 36: Parameter values for relationship customization

1. Standardized	2. Mass-customized	3. Customized	-

The third, *customer journey interaction focus* (1stP32), addresses what stage(s) of the customer journey the interactions with customers targeted with a BM covers. While the parameter values cover three traditional linear steps, extensions for a more circular take on customer interactions could be considered as well, either by introducing additional parameter values or applying a broad perspective on what pre- and after-sales entail (Lemon & Verhoef, 2016).

Table 37: Parameter values for customer journey interaction focus

1. Pre-sales	2. Sales	3. After-sales	-

The fourth, *customer contribution* (1stP33), highlights that customer interaction is a mutual exchange process and acknowledged the different types of contributions a customer may contribute to the relationship (Zott & Amit, 2010). While this can be irrespective of the relationship focus, it is likely that a relational focus will require more in-depth consideration of different kinds of contributions and their importance in the overall BM.

Table 38: Parameter values for customer contribution

1. Physical	2. Immaterial	3. Digital	4. Financial (other than transaction price)

The firth, *customer contribution permanency* (1stP34), identifies the temporal stability and longevity of customer contributions to a BM. This first order parameter interacts with the others pertaining to customer relationship and can be a potential source of lock-in.

Table 39: Parameter values for customer contribution permanency

1. Temporary	2. Permanent	-	-

Finally, the sixth first-order parameter, *lock-in* (1stP35), lists different sources of potential customer lock-in to a potential BM (Amit & Zott, 2001). The parameter values refer to both to potential cost and loss of value from a disassociation with the value proposition and BM from the customer's perspective.

Table 40: Parameter values for lock-in

1. Cost of changing (technical)	2. Cost of changing (social)	3. Convenience (automatic renewal, etc.)	4. Exclusive advantages (higher comparative value, fun, etc.)
5. Cost of changing (financial)	6. Cost of changing (legal)	-	-

5.3.8 Channels

The eighth second-order parameter labeled *channels* (2ndP8) identifies key characteristics of how the value promised in the value proposition and embedded in the unit of business is exchanged with customers. *Channels* is operationalized by means of five first-order parameters:

The first, *channel materialization* (1stP36), distinguishes between physical and digital channel materializations. The respective form has implications for cost structure as well as the assessment of key resources and key partners (Kotler & Keller, 2009).

Table 41: Parameter values for channel materialization

1. Physical (Points of sales, etc.)	2. Digital (Web store, apps, etc.)	-	-

The second, *channel ownership* (1stP37), identifies the ownership structure of the channels used for exchanges with customers (Kotler & Keller, 2009) and thereby provides pointers to the level of control and dependency in exchanging value with customers.

Table 42: Parameter values for channel ownership

1. Own channels	2. Shared channels	3. Third-party channels	-

The third, *customer access* (1stP38), refers to whether a focal organization's access to the customers of a BM is direct or mediated by a third party (Kotler & Keller, 2009; Schweizer, 2005). Mediated access is both relevant in the discussion of key partners and the distribution of revenues generated from a BM.

Table 43: Parameter values for customer access

1. Direct	2. Indirect	-	-

The fourth, *buying cycle* (1stP39), pinpoints to what extent a BM is focused on individual steps of a buying cycle vs taking a holistic perspective (Lemon & Verhoef, 2016). This aspect of the BM bears coordination with the customer journey interaction focus, the identification of key partners, the value proposition, and the revenue model.

Table 44: Parameter values for buying cycle

1. Single steps (specialization)	2. Entire cycle (integration)	-	-

Finally, the fifth first-order parameter, *channel contribution* (1stP40), addresses the kind of value contribution the channels make to the value proposition and performance characteristics of the unit of business (Bieger & Reinhold, 2011).

Table 45: Parameter values for channel contribution

1. Functional contribution	2. Experiential contribution	3. Symbolic contribution	4. Cost/ sacrifice contribution

5.3.9 Revenue model

The nineth second-order parameter labeled *revenue model* (2ndP9) identifies key characteristics of how the value customers derive from a BM flows back to the focal organization in financial terms, that is, as revenues and profits. The *revenue model* is operationalized by means of eight first-order parameters:

The first, *revenue driver* (1stP41), designates whether revenues are driven by usage or (general) access to the unit of business (Bieger & Reinhold, 2011; Johnson et al., 2008). The selected parameter value needs to be consistent with the way the value proposition is specified and with the value inferred by customers.

Table 46: Parameter values for revenue driver

1. Access (usability)	2. Usage (kilometers, clicks, searches, etc.)	-	-

The second, *ancillary revenues* (1stP42), specifies whether the revenue model is generating any ancillary revenues and if so, to what extent the BM is dependent on these. This is particularly relevant for BMs financed indirectly via ad-sponsoring or any other third-party contributions (Bieger & Reinhold, 2011).

Table 47: Parameter values for ancillary revenues

1. Yes – dependent	2. Yes – only complementary	3. No	-

The third, *price variability* (1stP43), identifies to what extent the prices for the unit of business of a BM are fixed, that is independent of product, consumption, or customer characteristics, or vary to optimize yield and/or influence customer behavior (Bieger & Reinhold, 2011).

Table 48: Parameter values for price variability

1. Fixed prices	2. Variable prices	-	-

The fourth, *payment mode* (1stP44), refers to how customers contribute to revenues in terms of their payments as either single payments or in installments (Bieger & Reinhold, 2011). Accepted payment methods vary in customer expectations with different value propositions and considerations related to revenue drivers.

Table 49: Parameter values for payment mode

1. Single payment	2. Installments	-	-

The fifth, *ownership transfer* (1stP45), addresses if the exchange between customer and focal organization within scope of the BM results in a purchase, lease, or financing of the unit of business (Bieger & Reinhold, 2011). While this might be a lesser concern for public transportation at high volume, this is a relevant concern with reference to BM aimed at more individualized or personalized transportation.

Table 50: Parameter values for ownership transfer

1. Purchase	2. Financing	3. Leasing	-

The sixth, *due date* (1stP46), specifies at what point in time money is exchanged for the unit of business and its consumption (Bieger & Reinhold, 2011). Decisions pertaining this first-order parameter require specific alignment with decisions related to the cost structure, channels, and customer relationship.

Table 51: Parameter values for due date

1. Pre-financed	2. In-situ (upon consumption)	3. After consumption	-

The seventh, *means of payment* (1stP47), identifies by what financial or other means customers reimburse the receipt of the unit of business. This first-order parameter acknowledges that there might be shifting valuations of different kinds of contributions customers could potentially make to a BM. Non-monetary contributions should be reflected in the first-order parameters referring to key resources.

Table 52: Parameter values for means of payment

1. Effort (time, labor)	2. Money	3. Information (data)	-

Finally, the eighth first-order parameter, *cross funding* (1stP48), details to what extent the value proposition and corresponding unit(s) of business are cross funded by parties other than those directly consuming the value (Bieger & Reinhold, 2011; Casadesus-Masanell & Zhu, 2010). Parameter values here directly link back to the ancillary revenues parameter.

Table 53: Parameter values for cross funding

1. User financed	2. Financed via 3rd party	3. Financed via public (authorities)	-

5.3.10 Value distribution

Finally, the tenth second-order parameter labeled *value distribution* (2ndP10) how different partners and stakeholders in the BM are rewarded for their respective contributions. The *value distribution* is operationalized by means of four first-order parameters:

The first, *cost of partners* (1stP49), identifies what kinds of financial and other, non-monetary cost partners incur for their association with a specific BM (Kochan & Rubinstein, 2000; Post et al., 2002).

Table 54: Parameter values for cost of partners

1. Financial cost	2. Reputation cost	3. Other opportunity cost	-

The second, *risk of partners* (1stP50), addresses the kinds of financial and other, non-monetary cost partners face for their association with a specific BM (Kochan & Rubinstein, 2000; Post et al., 2002).

Table 55: Parameter values for risk of partners

4. Financial risk	5. Reputation risk	6. Other risks	-

The third, *bargaining power* (1stP51), approximates the estimated bargaining power among the focal organization and key partners in determining the value distribution of revenues and profits resulting from a BM (Ring & Van de Ven, 1992).

Table 56: Parameter values for bargaining power

1. Balanced	2. Unbalanced (our advantage)	3. Unbalanced (our disadvantage)	-

Finally, the fourth first-order parameter, *distribution key* (1stP52), specifies on what grounds value distribution is determined. The parameter value(s) for the distribution key are likely to reflect, the cost, risk and bargaining power of key partners and stakeholders involved in a BM as well as the specific of the overall value creation process to fulfil the value proposition (Bowman & Ambrosini, 2000; Lepak, Smith, & Taylor, 2007).

Table 57: Parameter values for distribution key

1. Input-based	2. Throughput-based	3. Output-based	4. Risk-based

5.4 Future rail business models

This subchapter discusses future rail business models in general and specific terms. The first section details how innovation themes for BMs can inspire development efforts and elaborates on a perspective to innovate BMs within the case company. This is followed by an illustration of five future rail BMs, developed with the scenarios introduced in chapter 5.2 and the morphology detailed in chapter 5.3, that apply this perspective to SBB BMs reviewed in chapter 5.1.2. We present them in synthesized form within the Business Model Canvas rather than as a morphological field configuration to keep the results legible[4].

5.4.1 Perspective

The business model literature knows four central innovation themes to develop novel BMs (Amit & Zott, 2012): Novelty, lock-in, complementarity, and efficiency. The subsequent paragraphs define them within scope of this study and illustrate how they might inspire future rail business models.

Novelty-centered BMs offer something new, and unprecedented or work in new ways compared to previous BMs. While absolute novelty is generally rare, it is either for customers or focal organizations to decide what the relevant subjective standard should be to assess a BMs degree of novelty. To harness novelty, future rail business models might shift from a supply perspective to total customer centricity and understand existing rail services primarily as a key resource to develop enriched or higher order products and services. To this end, development paths could be both expansion ("addition" logic) and enhancement ("ancillary" logic) to enrich and augment service chains according to specific customer needs and in line with specific customer journeys.

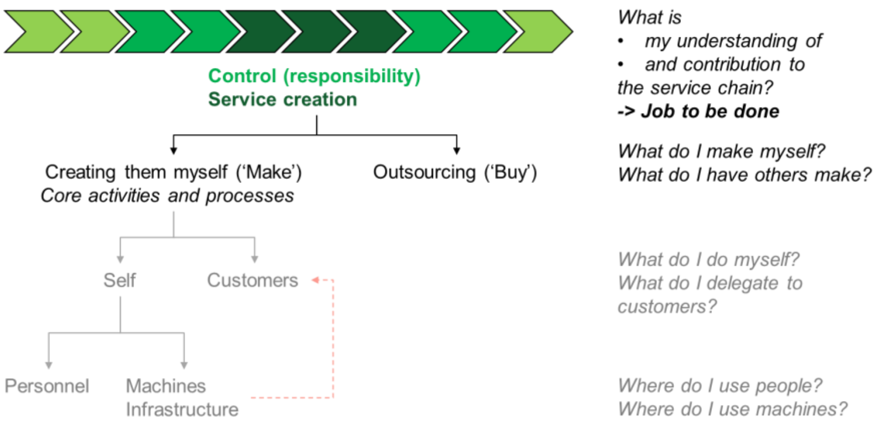
Lock-in-centered BMs create virtuous cycles for the focal organization, its customers, and its partners that establish network effects. In consequence, customers and partners are tied closely to a specific BM by means of increased value they derive from being associated with it as well as the different kinds of cost that would result from switching to alternatives (also see chapter 5.3.7). To build lock-in, future mobility business models could aim to configure their own virtual eco-system, which serves as exclusive access point and sales channel for all ancillary and additional services. This could also help address potential decision fatigue, a potential risk associated with unbundling and enriched, higher-order products and services. Furthermore, loyalty and relationship capital, as expressed through expenditure, should be rewarded instead of mere transactions. Any exit from the eco-system would involve high cost in the form of a loss in convenience.

Complementarity-centered BMs thrive because of their positive interactions with other business domains and positive contributions from other BMs. Future mobility business models with a focus on rail might expand on ancillary services along the core transportation chain (i.e., complementary to core transportation mode). Additional services might be added to "produce" a service chain and thus complement customer journeys in the form of separate BMs or even with their separate eco-system. Finally, a focus on complementarity understands (public) transportation stations and stops as physical, tangible, or stationary platforms that could potentially assume many different roles in alternative BM configurations.

Efficiency-centered BMs are built around notions such as resource efficiency and optimal price-to-performance. Future mobility business models might increase resource efficiency for customers and partners via easy access to information, decision making, and purchasing facilities for core, ancillary, and additional services via own eco-system following a platform logic. Furthermore, they might efficiently match transportation services with a range of travel and transportation inducing customer activities to assist completing customer journeys. Finally, they might offer dynamic bundling for mass-customized services offering transactional core services via multiple sales channels and relational added benefits via their own virtual eco-system.

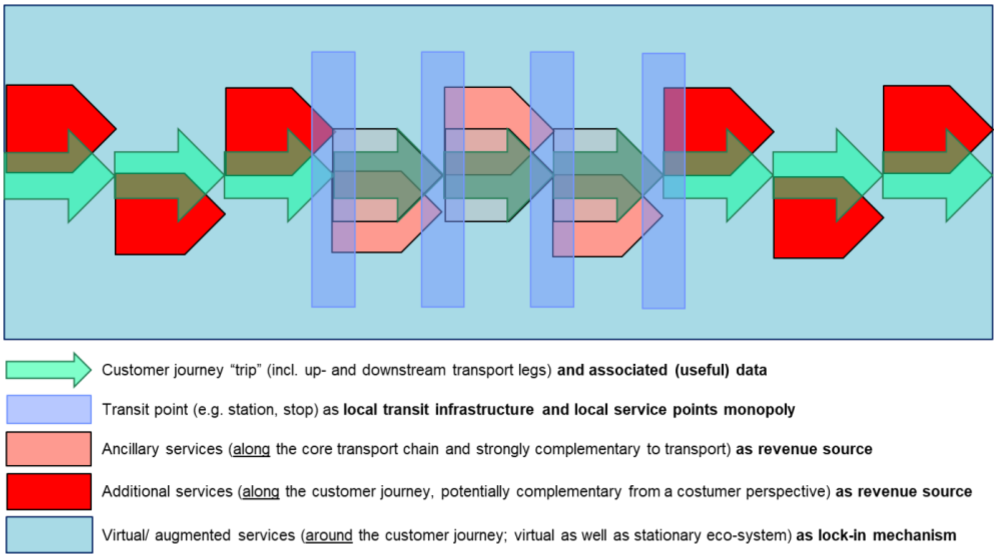
Across the four innovation themes, the suggested development paths for future rail business model enhance the existing supply-driven perspective with a focus on customer journeys and encourage building stationary (rolling) and virtual eco-systems around them (see Figure 18).

Figure 18: Focus on customer journeys and eco-systems



This has the potential to turn traditional railway companies into orchestrators for transportation and transportation-related ancillary up- and downstream value-added services.

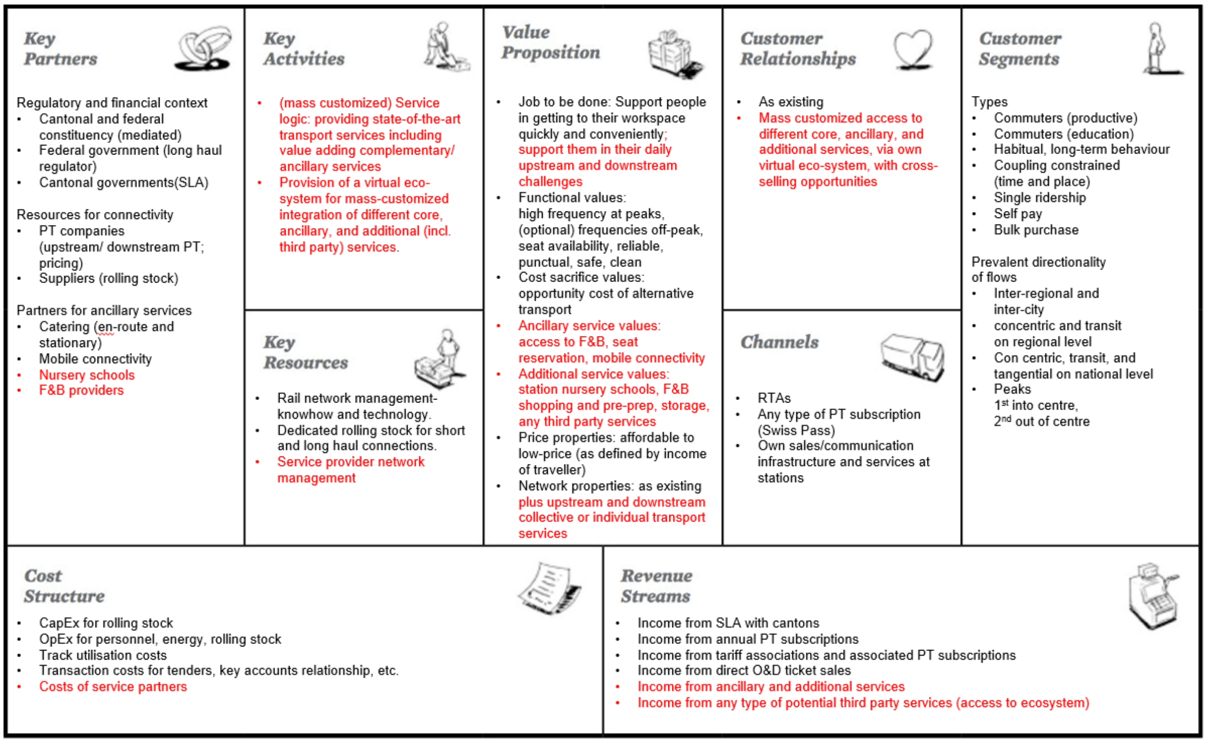
Figure 19: Service orchestration along customer journey



5.4.2 BM 1: Commuting

This first BM establishes an eco-system around transportation, childcare, and providing support for food and beverage related chores. Figure 20 details the BM in 9 elements of the BM canvas. The text printed in black refers to existing aspect of the traditional rail business model for commuter services offered by the case company. The additions in red are new additions to outline development potential toward a potential future rail business model that addresses up-and downstream challenges commuters face as part of their customer journeys in relation to a number of essential jobs-to-be-done. Key to this business model is the customization of complementary and ancillary services building potentially on all four innovation themes. However, this does not necessarily imply that a single legacy transportation provider will be the focal organization of this BM.

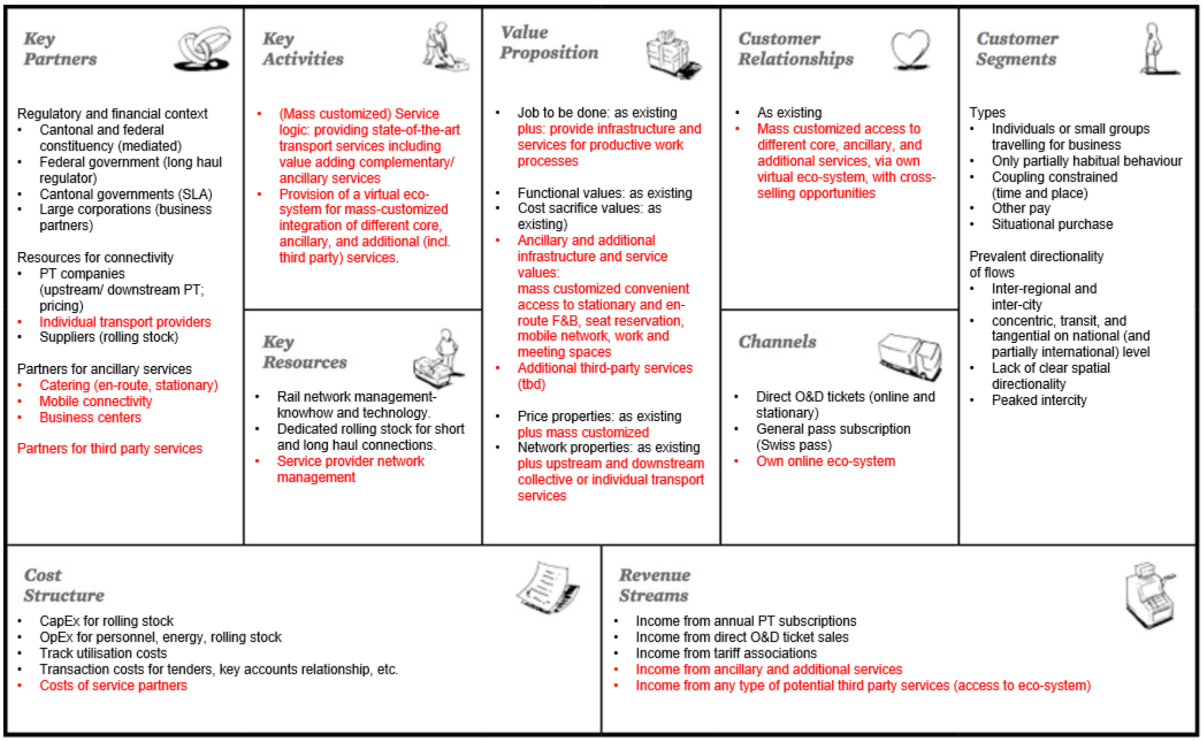
Figure 20: BM 1 – Commuting



5.4.3 BM 2: Business long haul travel

The second BM establishes an eco-system around transportation, work- and meeting spaces as well as ancillary services. Figure 21 details the BM in 9 elements of the BM canvas. The text printed in black refers to existing aspect of the traditional rail business model for business long haul travel services offered by the case company. The additions in red are new additions to outline development potential toward a potential future rail business model that seeks to augment the traditional benefit of work while traveling with ancillary services and infrastructure. Mass-customization and an integrated virtual eco-system matters for added value from new services as well as to create partner and customer lock-in to the new BM. Work while traveling refers to both work facilities and related services on board of different mobility vessels as well as multi-use flexible locations for business related functions as transportation stops and hubs in central and peripheral locations.

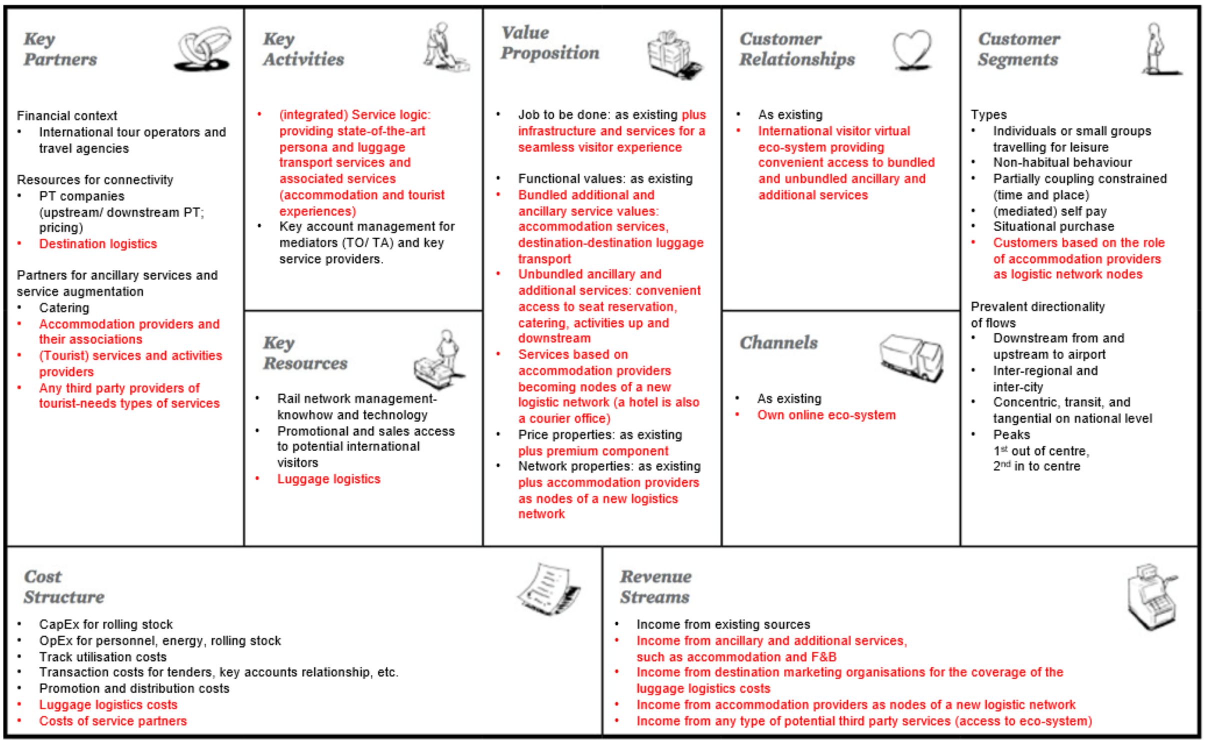
Figure 21: BM 2 – Business long haul



5.4.4 BM 3: (International) visitor leisure

The third BM establishes an eco-system around transportation (passengers and their luggage), accommodation, tourist experiences as well as ancillary services. Figure 22 details the BM in 9 elements of the BM canvas. The text printed in black refers to existing aspect of the traditional rail business model for international leisure travelers offered by the case company. The additions in red are new additions to outline development potential toward a potential future rail business model that aims to turn connections between different trip stages and sites into a seamless visitor experience along the entire customer journey. The overall benefit for the customer is in the reduction of undesired complexity and its negative implications (e.g., service incidents, misunderstandings, stress, etc.), for the context of the case company effectively turning Switzerland into "the largest theme-park in the world". The benefits of potential partners result from the added destination logistics that could also be used toward other ends and the additional control over pricing and yields in an international environment with intermediaries of high bargaining power and share of mind.

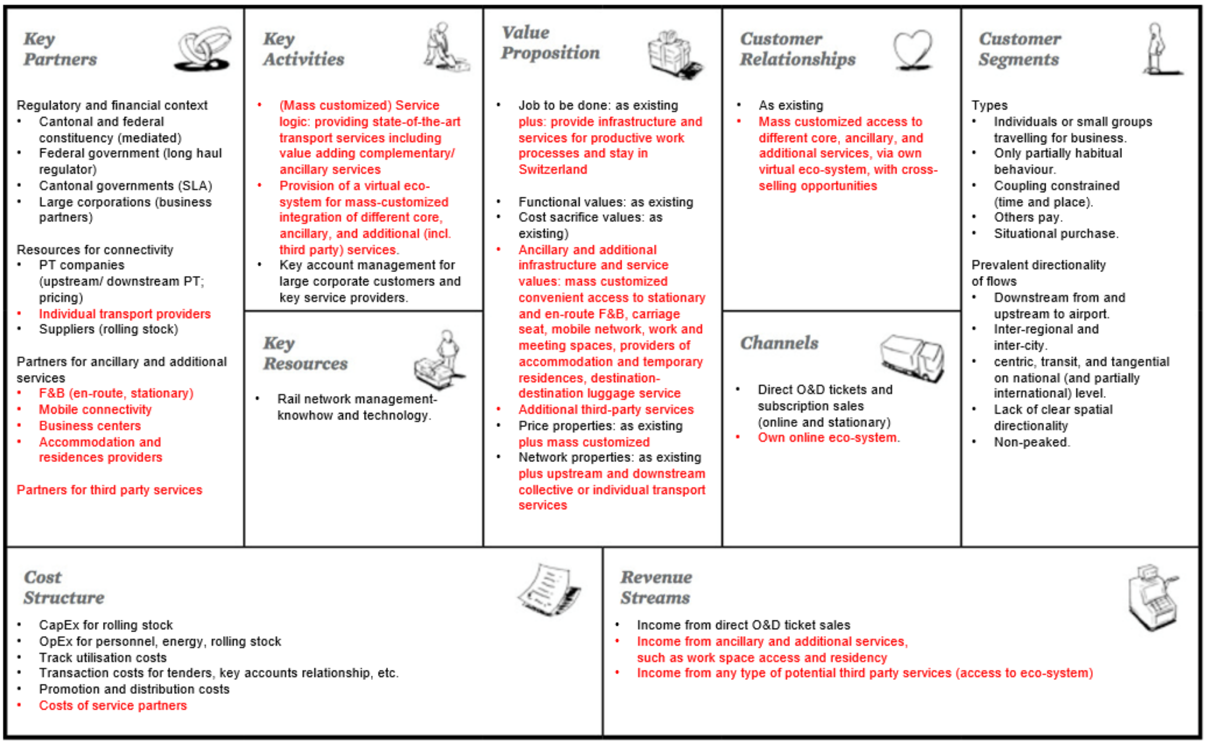
Figure 22: BM 3 – (International) visitor leisure



5.4.5 BM 4: (International) visitor business

The fourth BM establishes an eco-system around transportation, accommodation, work- and meeting spaces as well as ancillary services. Figure 23 details the BM in 9 elements of the BM canvas. The text printed in black refers to existing aspect of the traditional rail business model for international business visitors offered by the case company. The additions in red are new additions to outline development potential toward a potential future rail business model that combines aspects of the two preceding BMs, that is, it integrates transportation with services that handle complexity in international business travel concerning accommodation and work- as well as meeting spaces.

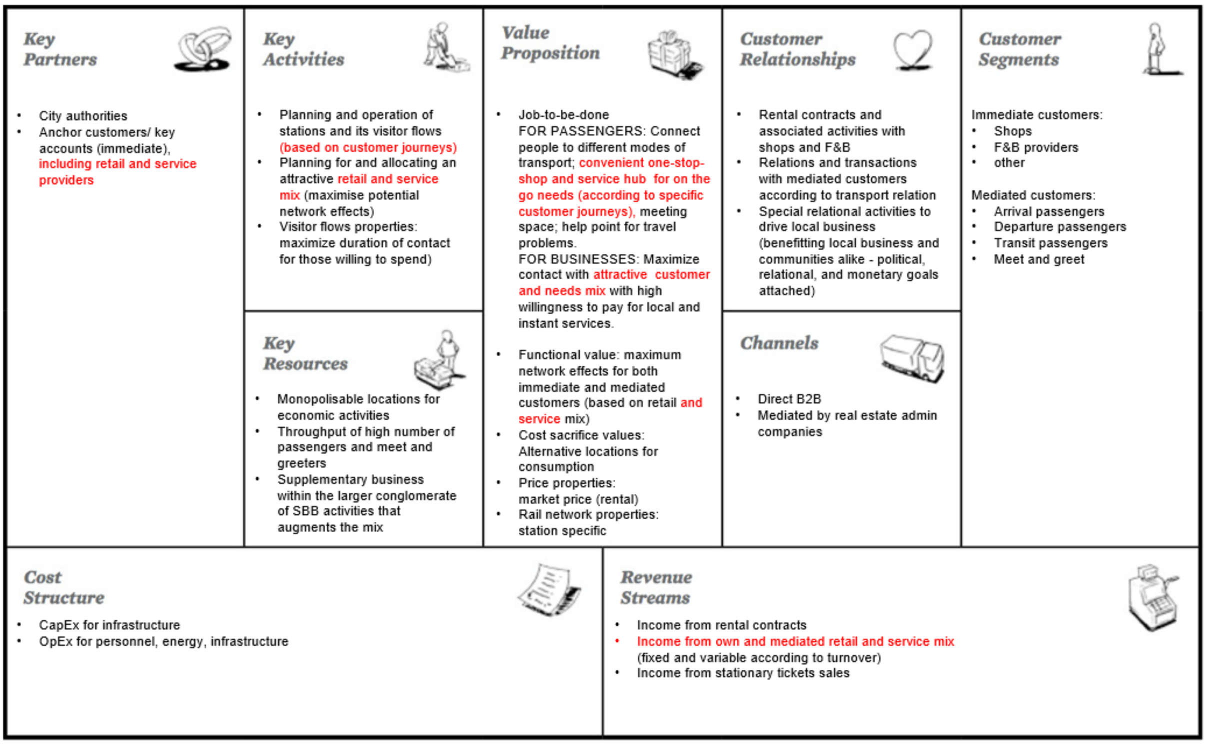
Figure 23: BM 4 – (International) visitor business



5.4.6 BM 5: Central stations

The fifth BM establishes center and central stations as service hubs and dominant stationary platforms for different customer journeys. Figure 24 details the BM in 9 elements of the BM canvas. The text printed in black refers to existing aspect of the traditional rail business model for central stations. The additions in red are new additions to outline development potential toward a potential future rail business model that seeks to turn connection points for different modes of transportation in central locations in to convenient one-stop-shop and service hubs for all needs on the go in correspondence with different customer journeys. This requires curated retail and service mixes that meet attractive customer (needs mix) with a high willingness to pay for local and instantaneous service delivery. This BM assumes a more proactive curation of customers and partners based on a deep understanding of customer journeys than present retail space concepts that could potentially build on all four innovation themes.

Figure 24: BM 5 – Central stations



6 DISCUSSION

6.1 Implications for current rail business models

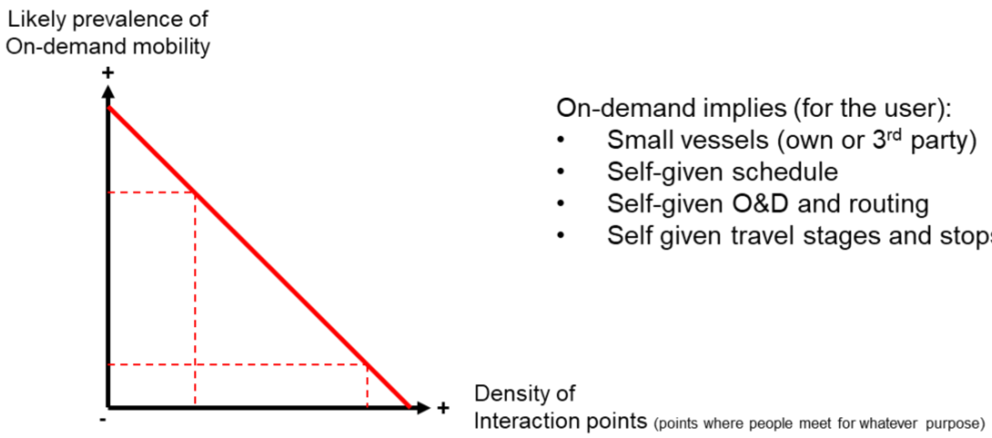
The scenario development and morphological analysis within scope of the present case study revealed four general conclusions regarding its implications for current rail BMs:

First, existing supply can be viewed as a resource and foundation to develop "enriched" customer-journey-centered business models and associated ecosystems that benefit both travelers and generate revenue as has been illustrated for the five BMs in chapter 5.4. Second, this does, however, necessitate to transform or at least supplement a divisional supply-perspective with a customer journey perspective to detect and to exploit future services and revenue potentials. A key reason for this is incumbent problems such as routine and resource rigidities (Gilbert, 2005).

Third, there is potential to differentiate future customer needs and journeys as well as corresponding supply according to different key drivers to assess the prosperity prospects of current rail BMs (see chapter 5.1.2) in different mobility futures introduced in context of the developed scenarios (see chapter 5.2). The most relevant ones include: (1) the spatial structure,

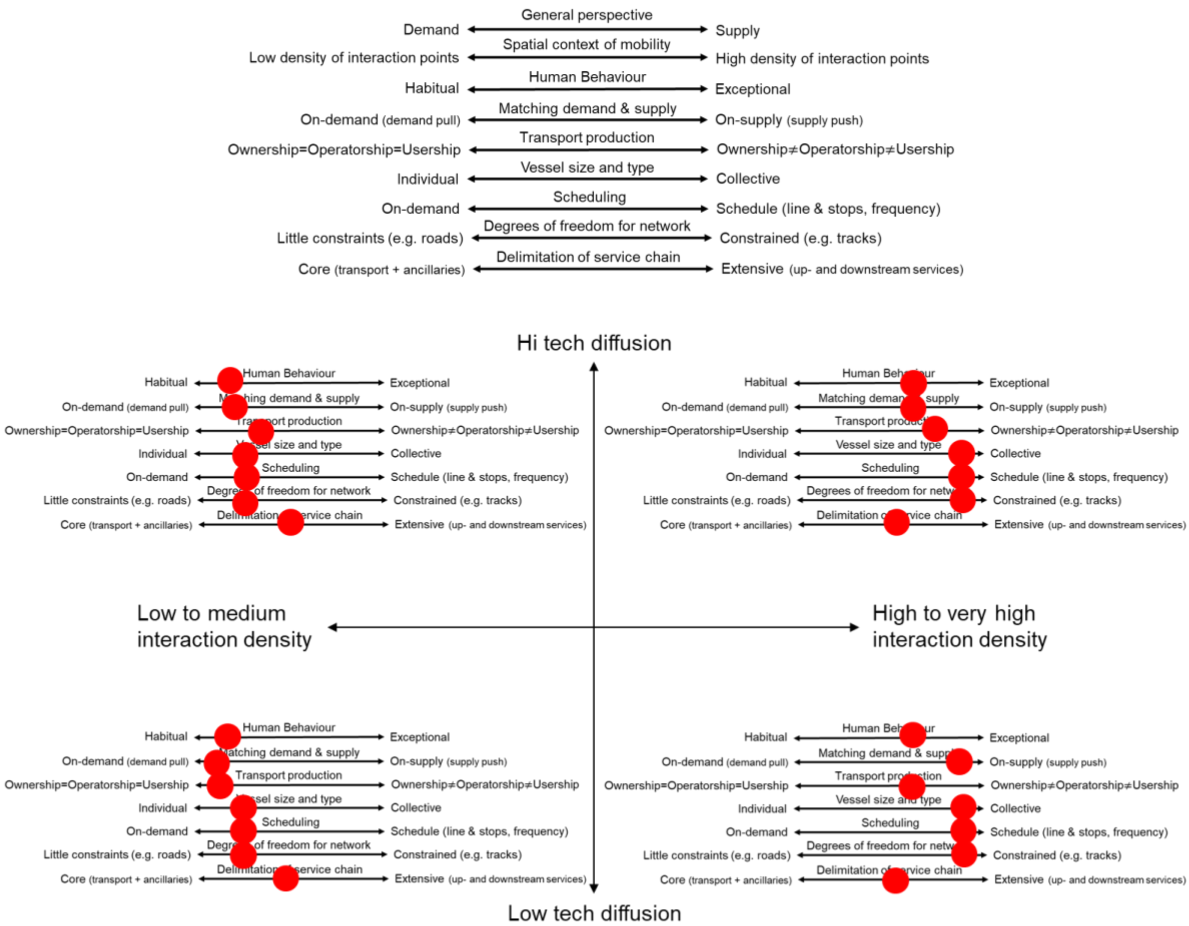
(2) the demand for mobility and specific mobility patterns as a function of mobility supply, which in turn is a function of the density of interaction points at the origin and destination of transportation (as summarized in patterns of spatial structure); (3) the quantity and quality of collective mobility supply (in terms of lines, stops, frequencies, etc.); (4) the production type of individual mobility supply and provision type of individual mobility tools; (5) the market access regime for providers of MaaS (as determined by the regulatory competitive scheme); and (6) the degree of coupling constraints (that is the lack of freedom) of agents and share of habitual decisions (because each decision is a chance for interaction and exchange and, in consequence, a potential foundation of a BM's revenue stream. There are different relationships to consider among those drivers and their likely constellations as Figure 25 illustrates for the relationship between on-demand mobility and the density of interaction points.

Figure 25: Relationship between on-demand mobility and interaction-point density



Those key drivers can be understood as different continua that enable the calibration of alternative competing or parallel mobility futures within which to project existing BM implementations and future BM ideas (see chapter 5.4). Figure 26 exemplifies this for the four scenarios explained earlier.

Figure 26: Continua profiling scenario quadrants



For example, the type of specific journeys and their decision points can provide the foundation for (additional complementary) services and revenues as well as potential justification for virtual eco-systems as platforms to organize such services.

Fourth, networked mobility (physical and virtual) should not be viewed as an end but as a means to enhance specific customer journeys – specifically, the non-habitual ones. Habitual behavior likely results in independent mobility integration by travelers, whereby individuals can benefit from relational, long-term bulk buying from specific buyers (for example, in the form of an access pass). In consequence, habitual behavior does not necessarily need networked mobility. Non-habitual behavior, in contrast, can benefit from combined purchases across different networks of different providers. It thus benefits from networked mobility.

Finally, the identification of and control over scarce resources in networked mobility will be key to how existing business models are affected by future developments. Customers have a finite amount of energy to make decisions each day and expanding the number of decision points causes fatigue. Virtual integration of decision points may create ease of use and can potentially create customer lock-in. Access to "rolling" transportation infrastructure as slots on rails in transit and in stations is limited. Paved traffic areas might be allocated to different transportation modes and functions in central exchange nodes or hubs. Different degrees of regulatory control of access and temporal or spatial exclusivity determine the earnings potential and viability of different BMs. Access to "stationary" transportation infrastructure is scarce as location for "standing" modes of transportation (such as parking for cars). This last type of infrastructure offers opportunities for services (and additional infrastructure) in and around such locations tailored to customer journeys.

In sum, these points suggest abstracting from the design of mobility systems to control for its complexity and variability. They call for an increasing focus on different customer journeys and associated needs with services targeting actual transportation as well as the upstream and downstream activities of travelers. The scenario development in this report does not suggest an outright replacement of existing BMs. However, it argues that incumbent integrated railway undertakings may assume different roles dependent on how the integration of the enhancement of existing transportation and customer journey happens. This might mean that they are in the lead as producers, act as orchestrators, or just serve as secondary partners.

6.2 The morphology as a concept in action

The morphology for future mobility business model is a disciplined innovation tool. It enables a thoughtful, reflexive approach to considering the configurational options in developing the business models for different future scenarios. As such, it can be used at least in three different ways:

First, it can be used to expand on and deepen existing ideas for future business models, no matter what their degree of detail. That is, from first idea how the behavior of certain customer groups might change their travel behavior, new technologies that change the production and quality of transportation services, or alternative control arrangements for key resources because of regulatory changes all the way to fully developed sketches of future business models that need more depth and sense-testing. When sense-testing is supposed to go beyond the consideration of isolated values and focuses on entire configurations instead, we suggest using a database of existing BM patterns that can be transferred and adopted across industries. Remane and colleagues (2017) identified 182 patterns in one of the most comprehensive efforts yet.

Second, it serves to map presently operated mobility business models that rail companies run in more detail than the birds-eye-view of the Business Model Canvas to challenge its configuration considering scenarios of alternative futures as well as to ponder complementary configurations in the form of different parameter values.

Finally, it enables development of new future mobility business models from scratch in combination with different tools such as scenarios, personas, or business model patterns. This is the approach we selected in the innovation and ideation workshop to sense-test the morphology and its application with potential users from the case company.

We first introduced the workshop participants to personas we had developed based on the different types of customer journeys and travel motives we identified within existing BMs and in relation to the future mobility scenarios for 2040. For workshop participants to lock-in to a customer (rather than supply) perspective, we asked them to work with the persona, that is, to develop these people's profiles (motivations, mobility) beyond initial descriptions, and sketch out a typical week in 2040, with some events as planned and somethings going wrong. Subsequently, on the basis of that week in 2040, workshop participants identified as many jobs-to-be-done for their personas as they could and started to explore the first-order parameters related to the customer second-order parameter in the morphology. Subsequently, the workshop participants discussed the different parameters of the morphology. They thus created different morphological field configurations (that is, a path from top to bottom through the morphological table), each of which represented an alternative business model. In the end, they summarized key decisions from the morphology they considered worth exploring in Business Model Canvases.

This process is no substitute for market intelligence, foresight, and creative thought. However, it enables users to explore alternative configurations in a disciplined fashion. Workshop participants from the case company shared three key conclusions with this regard: First, they considered the morphology a helpful tool to explore alternative BM configurations for different job-to-be-done. The focus on a specific week in a scenario future with practical events for persona they could imagine and relate to, had a disciplining effect in terms of maintaining customer focus. Second, being presented with the wealth of configurational options enabled more detailed and deeper discussions of alternative business models. However, engaging with its parameters and parameter values takes time to process. Third, workshop experiences and participant feedback suggest that there is less risk to produce superficial artifacts in the form of Business Model Canvases when working one's way through the morphology. We suggest combining the strength of the detailed future mobility business model morphology with the overview of value creation and value capture in the Business Model Canvas. The former to gain depth in discussion and justify decisions, the latter to summarize key relationships across the different second-order parameter and demonstrate how sets of choices produce virtuous cycles that result in value for both customers and the focal organization.

7 CONCLUSIONS

The present project combines different methodological approaches to achieve an innovation goal, namely, to find conceptual foundations for future alternative business models in the railway sector. The results build on three methodological cornerstones: The business model approach to delimit and describe the relevant analytical unit; scenario techniques to identify and evaluate possible mobility futures and thus the relevant context for (rail) transportation and corresponding business models; and morphological analysis to deconstruct and identify the potential building blocks for future mobility business models with a rail focus summarized as a morphological table.

While the literature thus far provided little information on business model innovation in the mobility and transportation sector, the general discussion on the future of mobility is much more extensive and comprehensive. Hence, the future visions identified here provide a consistent and coherent contextual background and thus orientation in discussion and development efforts. Essentially, six clusters of drivers are assumed to shape future developments: (1) materials and information technology, (2) cooperation and sharing, (3) urbanization and land use, (4) sustainability and renewables, (5) regulation and inclusion, and (6) flexibility and virtuality. The two most pertinent clusters with significant implications and active influence are "materials and information technology" and "urbanization and land use". They inspired the two dimensions (interaction density, technology diffusion) we used to structure our vision of future mobility for scenario development.

The resulting scenarios ground in the subsequent premises: Mobility is essentially a form of traversing and bridging geographical space. At the same time, different spatial structures (as signified by the economic and social potential resulting from the density of interaction points) determine the gestalt of this very mobility. Both spatial structure and mobility are, in turn, shaped by technology (and technology diffusion). To deal with the resulting complexity (combinations of spatial and technological conditions of mobility), we use the customer's point of view, their journeys and jobs-to-be-done, to discuss future mobility across different carriers and mobility types.

This view stands in contrast to many existing rail-based mobility business models and discussions. For incumbent railways, the present business models are essentially "production models" developed from a supply perspective to legitimize the organization of productive processes and use of mandated resources by means of effectiveness and efficiency. They are rarely "solution models" directly addressing customers' multifaceted jobs-to-be-done from a process perspective. With this report, we propose transitioning the "production models" into "solution models" in evolutionary terms. One way to achieve this is focusing on customer-centered orchestration of different mobility and related services. In "solution models", all things supply are to be understood as a resource to develop enriched and higher value services along clearly defined customer journeys.

It is beyond the scope of this project to predict what the new business models for future rail-based mobility will be. This is a limitation. What is clear, however, is that customers' multifaceted jobs-to-be-done cannot be met with a single new rail business model if we account for the variegated drivers of travel behavior. The customer journeys of the present and future enable an entire portfolio of potential new business models that railway companies can either shape and lead as focal organizations or in which they participate in subsidiary and supporting roles. It would, however, be a mistake to assume that yielding the lead in a customer-centric business model to another organization is automatically synonymous with unprofitable business. Consequently, incumbent railway corporations are advised to consider the trade-offs.

The combination of methods used in this project has proven effective. Morphological analysis and its associated tools helped to handle complexity in relation to both envisioning future mobility and business model development. Both contexts required simultaneous consideration of the "big picture" and generating detailed and detailed understanding to consider alternative configurations, ways to develop them, and different evolutionary trajectories.

Against the background of the above, several avenues for future work present themselves. These include (exemplary): Further development and adaptation of the proposed morphologies; reconfiguration of future mobility scenarios to account for future events; rethinking and further development of the proposed business model logic (orchestration) and the customer-oriented configurations proposed here; considerations regarding future system limitations or expansion to industries (e.g. energy) that are currently still disconnected from the core of the mobility system.

The landscape of future mobility is constantly unfolding and the scenarios we presented must be considered for what they are: Artifacts of the time they have been produced in and the inputs that inspired them. As well as a limitation, this is a chance to challenge existing results on an ongoing basis for anyone aspiring to enact the future of mobility.

APPENDIX

A1 – Sources of literature review on future mobility

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A2 – Recommendations for SBB

The results of this report and the associated research efforts offer the following five main recommendations for SBB:

First, while arguing that an integrated railway company has a (single) working, valuable business model is a meaningful argument to legitimize the existence of an integrated organization and to demonstrate the synergies as well as other benefits from different activities and business areas, it risks perpetuating a supply perspective on future mobility.

Second, considering integrated railway companies as portfolios of business models to which different parts of the companies make contributions in different roles, opens up scope to consider future mobility production and the jobs-to-be-done for customers decades from now from a broader stance. This might result in considering new alternative despite past investments and changing from a default integrator position for business activities to a broader consideration of different roles and responsibilities, creating and capturing value through orchestration or through specialized contribution to future mobility value chains run by other actors.

Third, spatial structure and the associated density of interaction points for productive, consumptive, or social transactions and exchanges deserve attention in modeling future mobility scenarios at a national or inter-regional level. Future passenger journeys will not just be bound to one such context and different business models might be suited to serve different spatial structures or leverage the differences across them. In addition, the density of interaction points at origin and destination can serve to approximate the presence of certain customer needs and jobs-to-be-done.

Fourth, the morphology for future mobility business models and the suggested innovation process it embeds helps deepen discussion and gain insight into complexity and interdependencies of choices in business model design. This should complement use of the Business Model Canvas that sometimes produce superficial considerations or lack customer-centricity. Moreover, the complementary week planner and personas help centering efforts on customer needs and journeys. While those tools are no substitute for market intelligence, foresight, and creative thought, they enable users in strategic and innovation processes to explore alternative configurations in a disciplined fashion.

Finally, the scenario development in this report does not suggest an outright replacement of existing business models. However, they call for an increasing focus on different customer journeys and associated needs with services targeting actual transportation as well as the upstream and downstream activities of travelers. To this end, incumbent railway companies should consider making use of existing assets as resource in business model development, the bottle necks resulting from control over scarce resources, and building (virtual) ecosystems for non-habitual travel.

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ENDNOTES

[1] For each iteration of the search query with different combinations of keywords *business model*, *mobility**, *transport**, and *future*, we systematically checked the first 100 search results on Google and Google Scholar. In addition, we used snowball sampling by cross-referencing studies mentioned in the reports the resulted from Google and Google Scholar search results.

[2] Note that the in-depth descriptions of the four SBB scenario quadrants elaborate on additional aspects and assumptions tied to the individual axes. Specifically, the horizontal axis with individual and collective mobility assumption implies that trend in future societal structure with be aligned with the respective ends of the collectivist vs individualist society continuum.

[3] The full scenario descriptions are available for download on www.alexandria.unisg.ch from the corresponding author's profile under the file name "Tables for report_Szenarios Factor Level Array.xlsx".

[4] The number of morphological fields render the morphology for future business models most suitable for a computer application with zoom and focus feature, for a physical poster, or smart screen. For the workshops, morphology posters were printed in DIN A0 format (that is, 841 mm × 1,189 mm).