Smart Mobility Usage Scenarios II

8

Barbara Flügge

Abstract

Usage scenarios are a good tool to manage the distinct viewpoints on Smart Mobility when investigating the topic, developing solutions, and piloting Smart Mobility. Regardless of the starting point or interest, usage scenarios give a head start for Program Management, Smart Services, Smart Data, Smart Products, or Smart Spaces. The following chapter puts personae into the focus. Examples are taken from the healthcare sector, intermodality concepts for personae living in the city and in the country side amongst others.

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8.1 Personae on the Road

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How does the Smart Service World with its four layers Smart Services, Smart Data, Smart Products, and Smart Spaces now apply to individual personae and consumer profiles? What are the key elements to manage projects properly? In the following we describe a selection of user oriented scenarios and introduce the critical project steps. The selection promotes a variety of personae, addressable application areas, and results to introduce the connecting element of mobility beyond the traditional mobility needs such as travel and delivery. Regardless of taking into account a private need or a business decision, mobility turns more and more into a central element of our living and economic spaces. We even postulate that the fundamental need of mobility is as equally important as nutrition and safety.

To better acquaint the readers browsing through the use cases the following structureand key elements as outlined in Table 8.1 are used in the sections below. Orientation gives the *Smart Mobility Basic Structure* as outlined in Fig. 8.1.

8.1.1 Medical Tourism and Travel-In-Company

What do healthcare scenarios look like in the in the context of Smart Mobility? The following examples give insights.

Medical Tourists and Other Tourists Medical tourists are defined as patients that by intention and purpose are seeking medical treatment or medical advice in a foreign country. The search for medical aid is motivated by the patients themselves [108]. The following considerations confront medical tourists as well as other tourists who require healthcare and emergency services such as transport services and support [109]:

- Search of qualified and highly experienced physicians
- Search of suitable, yet certified clinics and practices
- Price for medical and adjacent services
- Quality rating following external quality standards
- Effort related to preparatory measures, conduct, supply, transport, and aftercare
- Redemption of medical treatment, insurance relevant as well as mobility related efforts, and
- Involvement of further medical tourism relevant stakeholders that remain unknown to the patient, but are crucial to the above stated considerations.

Applying the significant design elements, the usage scenario with respect to mobility turns into the following, as outlined in Table 8.2.

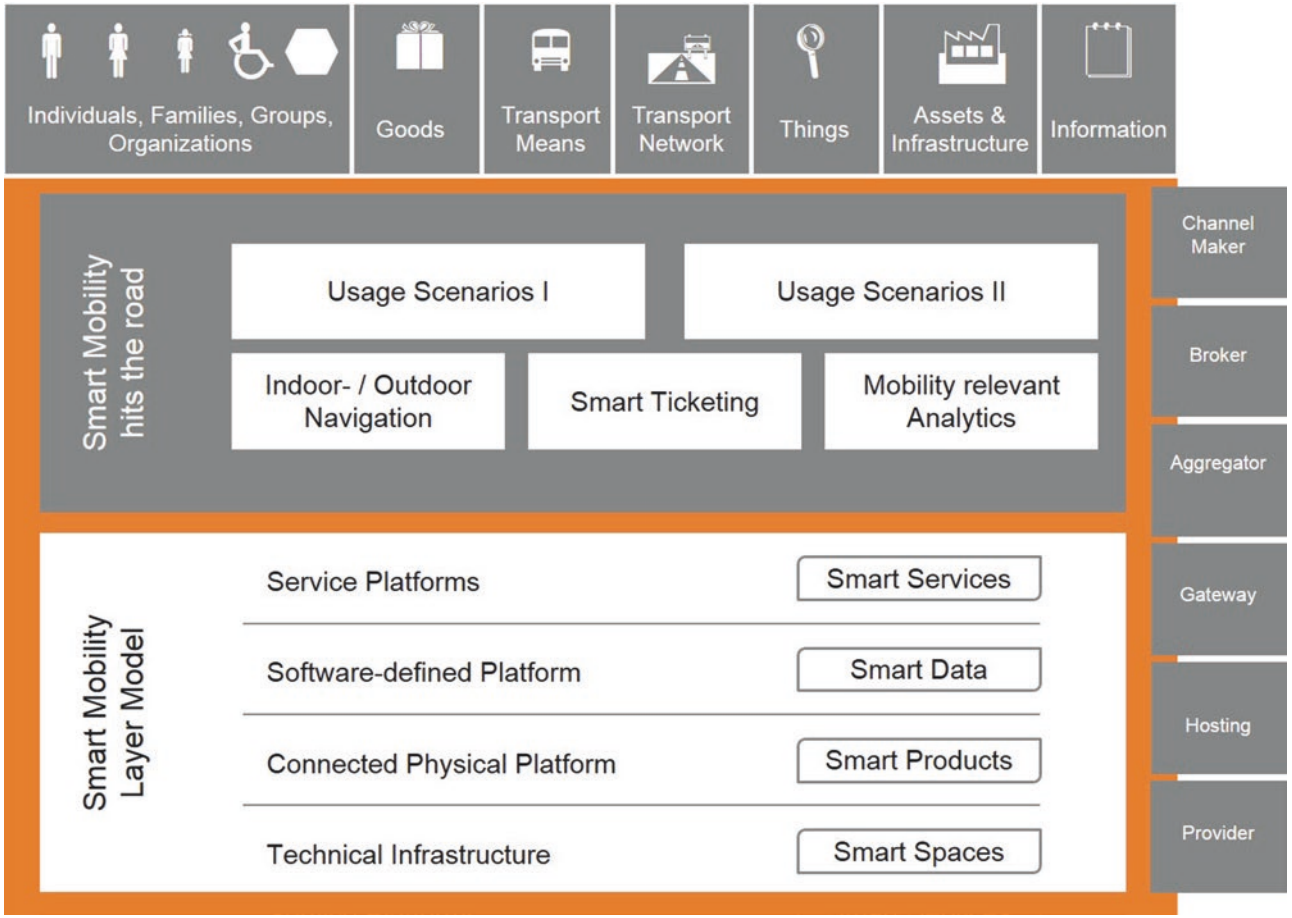

Fig. 8.1 Smart Mobility Basic Structure

Table 8.1 Template for use case structure

Elements	Describing the key elements and details
Addressees	Stating the investigated ecosystem(s)[a]
Motives	Status quo or situation that triggered the need for change
Value Drivers	Value driver
Owner	Owner and/or affected person of the encountered situation
Personae	Addressable target and user groups
Market Offerings	Existing and/or competing market offerings
Solution	Examples of market offerings and approaches where available or notable; listings could take place within the market offerings section
Degree of Deployment	To which degree the named market offerings have been deployed as a productive environment; notes will be made where feasible
Roadmap	Project stages and deployment options such as field trials

[a] Examples: airport site, port site and port city, community, region, city, city district, university campus, event location.

Table 8.2 Usage scenario for medical tourism

Elements	Detailing the key elements
Addressees	Tourist locations and regions with high numbers of casualties Locations with low medical coverage Locations with high need for nursing and auxiliary personnel
Motives	Mobile nursing and healthcare services and service relevant information bundling
Value Drivers	Event triggered travel planning and booking throughout the entire service cycle despite distinct service providers, selection, booking, billing, return transport, emergency care and temporary care, and household personal provisioning Adaptability of retrievable information and data to international, multi-language contexts Coupling of travel and event data such as flight bookings, hotel, pick-up services, hospital admission, duration of medical treatments, accompanied return Add-on services for healthcare insurance providers Increase of predictability of medical action planning in particular in tourist regions Differentiate physicians and hospitals by following a framework for accreditation that fosters transparency and competitive advantages
Owner	Healthcare insurance, hospitals and new service providers with focus on full service provisioning

Table 8.2 (continued)

Elements	Detailing the key elements
Personae	Billing agency, clearing house, doctor, nursing agency, patient, transport company, travel companies and agency
Market Offerings	Manual offerings are available to a large extent Digital offerings in the field of analytics Service bundles in cooperation with multiple service providers such as nurses, care agencies, nursing service, nutrition consulting, and general practitioners
Roadmap	Analysis of the healthcare business network Conduct of a interconnectedness analysis Design of mobility patterns of travelers to derive personalized and individual treatments of tourists in holiday resorts

Facilitating Travel-In-Company Digitally Mobility means freedom. Especially the elderly people, people with disabilities, and/or those that do not feel comfortable being on their own in an unfamiliar environment are searching for freedom. However they often give up due to high coordination efforts in traveling with others or simply because of missing companions that support them.

Family members and friends help to watch out for travel-in-company offerings. Examples of a companion could be equipment such as wheelchair or a walker, or a qualified person, or a person that knows the area. We all know once having encountered or observed a situation where help is needed how difficult and challenging it could be to just visit the physician or the municipal office around the corner. It does not take a lot of creativity to picture tedious and time consuming coordination efforts, lengthy and hard-to-overlook booking and invoicing tasks.

Smart Mobility in this context is really smart once effortless business processing and non-IT expert knowledge facilitate the travel-in-company. Furthermore we promote a *digital assistant* that manages the end-to-end mobility process from the first instance of getting to know about the travel need to getting the traveler back home. Beneficiaries of the digital assistant are both, the traveling person and his companions. We refer to this digital assistant as a *Digital Concierge*.

Nowadays, travel offers with respect to the above outlined needs are highly personalized and need to be manually found and configured. Often the offerings with respect to international travel needs are not localized to the traveler's needs or translated. And overall, offers do not exist!

In our vision the Digital Concierge assesses all relevant offerings and compiles from preferences and the traveler's profile a condition framework that can be looked up and hooked into the offerings of caring personnel, experts, and people that are familiar with the location, for example. That matchmaking process issues a booking request and ensures the

service delivery – in a nutshell. Up to the time that an autonomous vehicle is an option to serve itself as digital assistant, the Digital Concierge provides a certain amount of relief. Even further it discloses the dos and don'ts of a functioning matchmaking application that will be surely be embedded in the digital service functioning of autonomous vehicles.

Applying the significant design elements, the usage scenario with respect to mobility turns into the following, as outlined in Table 8.3.

Table 8.3 Usage scenario for travel-in-company

Elements	Detailing the key elements
Addressees	Accompanied travel in the own environment Accompanied travel in foreign territory such as vacation and for business trips
Motives	Be mobile
Value Drivers	Event triggered travel planning and booking throughout the entire service cycle despite distinct service providers, selection, booking, billing, return transport, emergency care and temporary care, and household personal provisioning, especially booking of intermodal mobility requirements and means of transport selection Adaptability of retrievable information and data to international, multi-language contexts Coupling of travel and event data such as flight bookings, hotel, pick-up services, and accompanied travel Add-on services for healthcare insurance providers and non-profit establishments
Owner	Experts in travel and healthcare industry Travelers Family members Friends Digital service and tool providers Special equipment and transportation providers
Personae	Accompanying person, family, friends, traveler, transport and travel company, transport provider, rental companies for mobility and medical auxiliaries
Market Offerings	German offering called Begleithilfe.de (English Accompanying Help) [110] Otherwise manual, non-digital offerings
Roadmap	Analysis of the network offerings for specially equipped means of transport and vehicles as well as auxiliary means Conduct of a interconnectedness analysis for the accompanying person Design of mobility patterns

8.1.2 The Personal Mobility Account

Mobility and innovation go hand in hand. Consumers of mobility enhanced devices that are conducting their business tasks raise their expectations of a functioning, yet innovative, offering. Whatever process, information, and data are being elaborated, subject to business processing, and presentable in a mobile manner, the mobile format asks for a much more sophisticated and safeguarding approach for business users than what consumers have been willing to forego for private purposes. Processing time, device independent app usage and processing, security layers according to task profiles and geography are a few examples that business users stated as key requirements in our studies.

Further benefits relate to the disclosure of mobility needs from users in their private lives. What appears to be a paradox is easily explained through the following example. Technicians, field workers, or caring personnel fulfill everyday high expectations as part of their duties – they are on the road, document and note down requirements and wishes, and they represent in a highly professional manner their employer on-site – regardless of whether the travel on-site is filled with obstacles, requires huge effort, or if the targeted location is a remote location and difficult to access. Further tasks from a private traveler perspective expect to be fulfilled in a similar timely and efficient manner: collecting the kids from sport lessons after work, bypassing the grocery store to get the food at home, the booking of a private doctor's appointment, or managing to purchase a gift while traveling.

Hence, users experience a *dual identity* of requirements and expectations for their very own mobility. A dual identity, as we call it, is capable of separating logically private and business mobility matters. It preserves the separation of budgets and accounts. As the dual identity overlooks and maintains bookings and payments in accordance with the employer's compliance framework, it follows other guidelines and allowances that have been maintained in the user's profile.

The *personal mobility account* thus administers the required functionality such as identification and authentication, payment, reporting, and the personal user-dependent configuration of rooms of trust (trust gates). *Trust gates* describe those digital entry doors that are kept open for handing over earmarked user's data or preferences based on his approval or that are kept closed because of a user's denial to hand over data or preferences. Alongside any digital data and business processing we encounter multiple trust gates within one process. In a three-tier process, the first gate would be kept open for information purpose and accordingly classified data. The second gate relates to preference related data that influences, for example, the proposed mobility means. A third gate is opened with a user's permission to transmit payment information.

The personal mobility account facilitates the use of trust gates in mobility related and intermodal applications. Once created, the user enriches a trust gate with his preferences and his requirements related to intermodality, billing, tolerances with regard to to-be-selected routes, geographies, and preferences. The administration is digital only and accompanies the traveler through a physical medium such as a mass storage device

(e.g. a USB stick or a micro SD card). Thus the device transmits the traveler's preferences and further operations-related data once it has been placed, for example, into an autonomous car, a third-party fleet car, or a car from the shared mobility offering of the district where the traveler lives. The car then adapts itself to the traveler's preferences. Important hints regarding meetings, appointments, and interests are communicated and taken care of while traveling. The billing takes place in accordance with predefined preferences: on a monthly basis, subscription based or based on the mileage or consumed time.

The characteristics of the personae that travel regardless of the distance, the daily way to work or the operation site, or the well-prepared vacation have been described in detailed in Sect. 5.4. But what about travel behavior? To make Smart Mobility work it requires insights. It is recommended to offer *persona-driven mobility accounts* that are able to make behavior triggered and behavior dependent mobility offerings re-usable. Re-usability could then be adapted by geography and medium. The account supports the users' acceptance of shared vehicles and autonomous vehicles once they successfully offered a personalized treatment.

When applying the key elements, the usage scenario with respect to mobility turns into the following, as outlined in Table 8.4.

Table 8.4 Usage scenario for personal mobility account

Elements	Detailing the key elements
Addressees	Transport such as autonomous vehicles, shared vehicles Transport with high ratio of change of personnel District, city, or region specific fleets
Motives	Transmitting preferences
Value Drivers	Transfer consumer related settings from one means of transport to another digital method
Owner	Mobility consumer
Personae	Mobility consumer Service channel maker such as hardware manufacturer and device manufacturer as well as connectivity provider Service broker such as rental car company of a city or region, insurance company and others Service gateway such as automotive industry, shared vehicle fleet operator, navigation and entertainment system operator
Market Offerings	None
Degree of Deployment	Not available to date
Roadmap	In planning stage

8.1.3 Deployable End-To-End Ride- and Interest Sharing

As Robin Chase, the founder of Zipcar, stated "shared network assets always deliver more value than closed proprietary ones" [111, p. 19]. Encountering more than 300 ride-hailing service providers in Germany or observing the market opening up in countries such as Malaysia and China, providers might ask "What comes next?" in ride-sharing. One example of service enrichment is driven by SAP [112]. The TwoGo ride- and interest sharing offering started with alike thinkers and sharing enthusiasts that wanted to change the habit of individual, one-by-one commutes to the working location, back home or to a meeting or event venue.

The rationale behind the offering started with an assessment of the previously consumed mobility efforts from a company's and commuter's perspectives:

- The average commuter in Germany rides 46 kilometers in 54 minutes.
- The commute in the USA generates 1.3 metric tons of greenhouse gases with an average of 1.1 persons per vehicle per commute and an investment in 215 square feet of parking space that gets occupied for 1760 hours over a commuter's working year.
- Companies in rural areas seek to lower parking costs and reduce travel expenses for consultants, sales and mobile personnel; moreover costs savings occur due to fleet size reduction.

In every subsidiary around the globe within SAP, small, medium-sized and large enterprises and their employees, all make use of TwoGo. Starting with commuting services, the offering now has the following features (see Table 8.5).

Table 8.5 Ride-sharing features of TwoGo

Instant use	Cloud-based solution
Ease of booking	Mobility booking is done as calendar entry, via text message, in devices such as smartphones or tablets, automated backend processing
Matchmaking functionality	Authentication service Matchmaking driven by person's preferences Mapping public and private available transport means Driver or co-driver maintains a preferred commuter list
Viral offering	Turning mobility into a communication package that bundles up with lottery, active requests, and other purpose driven mobility needs
Multi-purpose functioning	Meet-your-colleagues-while-commuting Pick-up service for employees Delivery services for goods Site2Site and round trips Analytical dashboard for organizations and institutional service providers such as government departments

Table 8.5 (continued)

Instant use	Cloud-based solution
Ecosystem wide and cross-regional, international use	Time zone functions Multi-lingual Local maps
Personae	Individual travelers and/or groups; goods, equipment, spare parts, services, collateral
Alignments and integration potential	Mobility-as-a-Service Alliance Public transport and ecosystem-wide bundles
Business model metrics	Enterprise license to cover annual fee per user (driver or co-driver) regardless the number of rides and distance Employees use app[a] free of charge Individual users use service free of charge

[a] https://itunes.apple.com/ch/app/twogo-by-sap/id673140392?mt=8.

Similar to BlaBlaCar, ride-sharers like the idea of exchanging information and knowledge. From a company's perspective commuters get to know each other and depending on a consumer's interest and willingness he has the opportunity to network and establish good contacts. In the offering from TwoGo, users can decide whether they are only a member of their internal company group or want to drive with the entire ride-sharing community. Moreover, planning and budgeting efforts to attend a conference or a sales meeting turn into a positive event.

By adding products, equipment, and goods ride-sharing turns into a multi-usage and even more optimized space management functionality. Beyond an organization's interest, entire construction sites could turn equipment and tool delivery into a whole new meaning for onsite shared assets and co-shared rides to lower traffic congestion, air and noise pollution, and reduce waiting times and delays.

Example of the Ford Smart Mobility Program for Passenger Transport As part of its company strategy, Ford launched a program to investigate Smart Mobility through the analysis and conduct of usage scenarios in the field of individual mobility. The undertaking of 25 experiments on a global scale concluded in the formation of a new business unit called Ford Smart Mobility [113]. These experiments, as outlined in Table 8.6, take place in cities as well as Ford sites. The corresponding cities are added in parentheses.

The Ford program is a great example of orchestrating the variety of usage scenarios for individual mobility needs. A number of the experiments are conducted alongside so called challenges. Challenges refer to competitions of schools, universities, and local appeals.

Table 8.6 Usage scenarios of the Ford Smart Mobility program

Accessory Challenge [Johannesburg]	Data Driven Insurance [London]	Future of Mobility [Argentina]	Proposed Australia Accessory Challenge [Australia]	Share-Car [Bangalore]
Big Data Drive [Dearborn]	Data Driven Healthcare [Gambia]	Infocycle [Dearborn, Palo Alto]	Mobility Integration [Chongqing[a]]	Summur Golden Hour [Delhi]
Car Swap [Dearborn]	Dynamic Social Shuttle [London, New York]	Los Angeles Parking Lot 2.0 [Los Angeles]	Monsoon App Downpour [Mumbai]	Summer mHealth [Tamil Nadu[b]]
City Driving onDemand [London]	Fleet Insights [Dearborn]	Painless Parking [London]	Remote Repositioning [Atlanta]	Traffic Tamer [London]
City Mobility [Lisbon]	Ford Car sharing [Germany]	Parking Spotter [Atlanta]	Rapid Recharge and Share [Dearborn]	Urban Commuter [Shanghai]

[a] City in South West China; [b] Province in India

In addition to the chosen locations Ford could benefit from the existing infrastructures that are provisioned and supplied through the production sites and sales offices: examples relate to shift related mobility requirements and service supply between locations and sites. Another benefit of targeting Ford's own infrastructure relates to the direct addressing and solicitation of Ford's own communities, meaning production and sales personnel, their families and friends, and the associated local habitats, as test users as part of the field trials.

8.1.4 Mobility Management for Facility and Asset Management

While researching digitization opportunities, especially the service front for real estate managers and the housing industry, the idea was born to investigate mobility driven collaboration opportunities for personae, for example real estate personnel, rental and housing agencies, and tenants.

Mobility Requirements in the Real Estate and Housing Segment The housing and real estate segment is characterized by highly connected and interlinked sub-industries and adjacent industries. The approach to mobility and service needs is driven by a multi-perspective analysis. The key reflection points for service and mobility needs have been defined as follows:

- Task oriented reflection of the process from property construction to operations once the idea is born and the construction site has been selected – characterized by 13 tasks:
  - Billing, constructing, designing, evaluating, implementing, installing, measuring, moving in and out, planning, procuring, renting, and selling.
- Activity oriented reflection along the business process from the moment of purchasing the property to utilizing it – characterized by the 13 key process clusters:
  - Target group driven promotion of the property
  - Finance, insurance, and credit counselling
  - Sustainability and energy efficient related mounting, development, reconstruction, and modernization measures
  - Technical emergency, monitoring, and security services
  - Cleaning services related to the property and its environment, being a garden, the access areas, or parking
  - Driving, pick-up, and transport services
  - Communications and leisure offerings
  - Housekeeping services
  - Counselling and mediation of social services and home care programs
  - Waste and recycling management
  - Infrastructure management
  - Social and commercial community management
  - Operations management, monitoring, and benchmarking
- Considering all aspects concerning sustainable property build and management:
  - Those aspects take place ideally in accordance with the 11th United Nations Sustainability Development Goal (aka SDG 11) titled "sustainable cities and human settlements" [114].

Applying the key elements of the usage scenario with respect to mobility leads into the following, as outlined in Table 8.7.

Table 8.7 Usage scenario for facility management

Elements	Detailing the key elements
Addressees	Housing industry overall and particularly facility management in certain sites
Motives	Create distinguishing features such as branding, image, attractiveness Foster settlement Upgrading residential areas and connected target areas such as commercial and recreation zones Deploy sustainability goals in the district, the city, and/or the region

Table 8.7 (continued)

Elements	Detailing the key elements
Value Drivers	Offer flexible housing and cohabitation throughout the district, encompassing life with own mobility pooling Promoting ecological home building Sustainable resource management by bundling efforts for repair, gardening, modernization, and new build projects by real estate agencies, construction companies, or house owners and tenant communities Implementing target group specific housing under the premise of mobile accessibility Add-on service offerings for residents through grocery and household related delivery bundles, transport services in case of medical needs or to the hospital Add-on service offerings for real estate and facility operators for own personnel and for loading and unloading points. The latter aspect targets the joint use of loading and unloading equipment and transport means
Owner	City planning office, construction company, facility manager, mobility service provider that is associated to or operates its own real estate segment as in the case of the Swiss railway company SBB, traffic planning office
Personae	Architect, building administrator, construction company, facility manager, furnishing company, insurance agent, parking operator, planning office, real estate agent, real estate owner, rental manager, retailer, tenant, traffic planner, whole sales, urban planner
Market Offerings	Manual offerings with minimal use of IT except website or Internet commercial Isolated offerings that for example are focusing on the promotion of real estate and housing or that offer information on targeted locations or sites
Degree of Deployment	Manually without ICT-enabled services that would encompass all 13 process clusters Pilot phase with respect to sustainable district planning [115, 116]
Roadmap	Conduct of a interconnectedness analysis Coupling task oriented with activity oriented service description

Asset Related Mobility Fulfillment In conjunction with the above described scenario for the real estate business another adjacent scenario is targeting assets and the degree of utilization. The service *mobility provisioning* relates to real estate, housing, education, and working environments where assets such as fleets and loading space are made available outside the office or opening hours, at weekends, or on holidays.

Applying the significant design elements of the usage scenario with respect to mobility leads into the following, as outlined in Table 8.8.

Table 8.8 Usage scenario concerning needs-based mobility provisioning

Elements	Detailing the key elements
Addressees	Purpose related living and working areas (district, university campus, community area)
Motives	Create and communicate distinguishing characteristics in branding, image build, and attractiveness Countermeasure cost pressures driven by increased usage of resources or their limiting availability Deploy sustainability goals Increase resource utilization of unused or dormant vehicles
Value Drivers	Innovation leadership Cost reduction Personae driven and requirement driven mobility provisioning Increase commuters' security as well the security and health conditions for residents
Owner	Privately organized interest group, public sector related association, automotive manufacturer
Personae	Co-driver External infrastructure supplier concerning infrastructure such as bridges, bridge operations, crossings, railway systems, road management system road surface, surface condition and maintenance, waterways, and many more Internal vehicle and asset related infrastructure supplier concerning assets such as equipment, navigation, personalization software and technology Service providers such as driver, fuel station provider, maintenance provider, manufacturing, repair, asset and component recycle and upcycle providers that act according to the circular economy principles, telematics service provider, test engineer, traffic network provider, urban planning officer and further community planning officers and servants, vehicle and vehicle component provider
Market Offerings	Digital offerings through automotive companies Digital offerings through service brokers such as navigation service and hospitality service providers Digital offerings through individual service providers in the field of navigation and telematics solutions Mobile offerings concerning destination and location-based services Landmark-based navigation services still yet to come
Degree of Deployment	Partial service bundles are offered digitally, the overall end-to-end business process is still characterized by process breaks and limited data forwarding Degree of test fields and trials in Europe is still low and often focused on automotive technology such as driving operations, reach of electric cars, and others Example for deployment: ZipCar USA [25] Projects in progress: inclusive district initiative in Garching, Germany

Table 8.8 (continued)

Elements	Detailing the key elements
Roadmap	Conduct of a interconnectedness analysis with respect to city, working, and/or living environment and reach Defining the requirements catalogue for localization and personae related vehicle provisioning and usage Coupling of individual digital services for mobility provisioning and offerings onsite

8.2 Intermodality

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8.2.1 Setting the Stage

The over-arching objective of *intermodal traffic management* aims for an optimum coverage of mobility needs with the least additional traffic modes. Multimodality in that respect aims to shift mobility of passengers and goods from road to other means of transport [8].

The example in Fig. 8.2 demonstrates that a business traveler's options, hence his preferences concerning comfort, available budget, and time made available to meet business partners and share lunch or dinner, do not coincide with the available time and the offered means of transport. In real life, business travelers do not spend less than one hour managing one business trip as outlined in Fig. 8.2. The presented case is an easy one. Efforts with respect to intercontinental travel could expand up to four hours of effort per person, and more. Those measures resulted from our own observations and those of power users that travel more than 40 % of their working time in a calendar year.

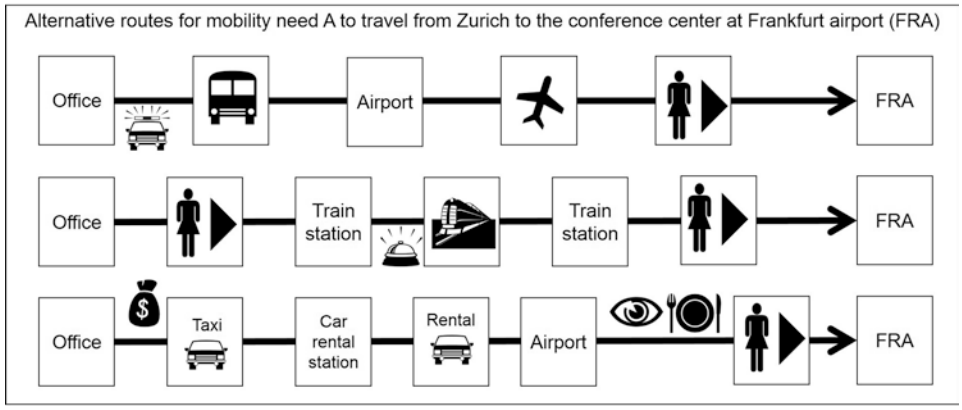

Fig. 8.2 Intermodal on the road – exemplified depiction of alternatives for one mobility need, 'A'

John's Travel Needs The following explanation aims to shed light on the current status, the main challenges, and possible future scenarios. When talking about intermodal mobility we mean an intelligent and interconnected mobility that enables a continuous journey from a starting point (A) to a destination (B) using more than one means of transport. John, working in Munich and engaged to Susan, who is living 20 kilometers outside Saarbrücken, could serve as an illustrative example.

As John is visiting her every weekend and does not have his own car, he tries to find reliable, continuous transport at reasonable cost. His solution is to take a bicycle that is located near his front door and cycles to the subway station Böhmerwaldplatz. From there he goes by underground to the central station Munich, where he gets the ICE-train to Saarbrücken. Having arrived there he walks to the parking lot beside the station and drives using a car-sharing provider to Susan in the countryside, because they have planned for a trip to France, in case the weather is nice. In this example John has booked his trip from his starting point to his destination with his mobile app with only one transaction though making use of various means of transport.

This sounds quite simple but is, in spite of digitization, not yet a reality. Its realization is dependent on a functioning complex, interconnected mobility system that needs to consist of at least the roles of traveler (customer), service mediator, service provider, and infrastructure operator. Additional roles in this kind of ecosystem could be payment provider, clearing, regulator, insurer, or other suppliers of add-on services. Each part of the chain has to render its special key tasks requiring certain business and technical capabilities.

The overarching usage scenarios for both private and business travelers' needs are detailed in Table 8.9.

Table 8.9 Usage scenario intermodality

Elements	Detailing the key elements
Addressees	Addressed are the movements within an ecosystem such as a campus, a village, a region or city, a company area, or an event location Addressed are the movements among ecosystems such as city to event location, village to a company area, or among cities, regions or villages
Motives	Realizing the mobility need based on travelers' needs concerning time, budget, and comfort: – Commuting to place of work or location of interest – Business related travel – Private travel for vacation, shopping, or visiting – Transit travelers with stopovers at a central station or a city prior to boarding a cruise ship – Shipping and delivery related travel for goods and services – Event or purpose driven mobility need – Field operations caused by security guarded events and/or caused by exceptions such as incidents, evacuation measures, and natural catastrophes

Table 8.9 (continued)

Elements	Detailing the key elements
Value Drivers	Targeted, purpose driven caring along the trip Cost efficient planning and deployment for the entire end-to-end mobility process Preciseness in arriving, transit, onward journeys, and returns despite incidents and unplanned occurrences Travel comfort and stressless arrival and return Safe arrival and return Spending time wisely for leisure, meetings, coincidental encountering
Owner	Service provider of public transport and publicly organized mobility Service provider of private means of mobility Service provider of mobility as such Transport management operator – private and public
Personae	Personae following the mobility consumer profiles
Market Offerings	Event triggered door-to-door offerings capturing intermodal needs on the spot are missing Selective digital offerings are available with respect to an upfront combination of two modes (rail and bus, rail and fly) that however do not reflect incidents and events Individual digital offerings concerning usage-based mobility, as the one from UbiGo Sweden [117] Transport mode related mobility booking systems such as the GATravelcard from Swiss Railway [86] or Qixxit from German Railway [97]
Roadmap	Analysis of the transport route network Conduct of a interconnectedness analysis Personae driven design of mobility patterns

8.2.2 A Matter of Interest

Translating our persona's trip, namely John's trip, into an intermodal concept means that he can communicate his intended journey to the service broker (transportation operator, mobility portal, travel agency, or such) on various channels. John then receives information about possible options to fulfill his travel requirements. To achieve this, the service mediator has to oversee all possible service providers that offer transport on this route, combine and match them with the customer's need, and display the identified options in a simple way for easy selection, maybe even considering some preferences of the customer such as inexpensive, fast, comfortable, or lowest carbon footprint. This step is already realized by companies such as Quixxit. But still buying a single ticket for the selected combined trip is only partly possible today if at all. The challenge for service brokers such

as Quixxit in selling this trip in one package is to decompose the selected journey into its single components, calculate the total price for the customer, process the transaction, and make bookings and payments to each single service provider of this travel chain.

Only then the bicycle-sharing company, the subway operator, the railway and the car-sharing operator are ready to promote ticketing relevant data to the mediator. And provide their transport services to John, being responsible for an easy and economical trip for their respective section. Thus, they need to be able to provide the required means of transport at the right time and location, managing their timetables reliably. In case of any delays or changes, John should not only be informed on time. The service mediator should even offer him ad hoc alternative options to minimize the delay as much as possible and without additional costs for John.

Next to vehicles the service provider also requires access to infrastructure such as railway lines, streets, traffic control, or similar. The operator takes care that the infrastructure reliably supports the smooth handling of traffic. Thus he has to maintain the infrastructure, adequately expand or remove it, and control traffic under his remit.

The Status Quo Concepts for intermodal mobility have been described quite explicitly and are well understood at the process level. Many approaches have been visible on the market for quite some time, implemented by renowned mobility companies. But still there is no resounding success. It seems to be hype, similar to new technologies such as UMTS (Universal Mobile Telecommunications Systems) that in the beginning of their market entries were not able to transform technological potential into attractive and useful services for the customer.

Currently, there are various providers that combine several offerings of potential travel routes and show customers how they may fulfill their travel needs. Providers can even optimize their trips according to customer preferences, such as the most eco-friendly, the most comfortable, or the cheapest. Thus, they are able to bundle and display timetable information and further offerings according to the customer's specification. Booking and paying for a trip with multiple sections and different means of transport in one transaction, receiving only one ticket, is not or only partly possible in today's applications.

This is not caused mainly by technological shortcomings but rather by a lack of clear positioning in the ecosystem or a lack of required business capabilities. Most of the established actors do not have a clear strategic picture of their role in these ecosystems, because they are uncertain about how participating in intermodal mobility will contribute to their enterprise targets once they join the game. To be successful, you need to have both a clear strategy and the necessary business capabilities for the targeted role.

Looking Behind the Curtain Let us look at the motivation of each participant of such an intermodal mobility chain. First the service broker is likely to be a new player in the ecosystem as the offering of timetable information and selling of tickets to the customer is usually under the control of and is one of the functions provided by the service provider. Thus, new players are mostly regarded as a threat as they are the ones that take over the customer interface at least in the selling and maybe even in the customer care phase. Their main success factors are the usability, the completeness, and the quality of information.

Usability is in the sense of how easy and intuitively the customer can find the travel chain that best fulfills his individual needs. Completeness, means ideally all available service providers with their sections and timetables as well as all additional services and functions that can be combined with the travel chain, including payment. This role is a purely data driven business model and players such as Google, Uber, or new start-ups enter the ecosystem. They of course are experienced in the way they address customers via digital channels, how they deal with customer data, design user friendly interfaces, and handle these huge data volumes and varieties. In addition they have clear perceptions of how to play the game and are of course neutral in the sense that they do not provide any of the transport themselves. Therefore, they are very much considered as disruptors by the traditional service providers, hijacking the direct customer relationship that is regarded as one of the most relevant success factors for the service providers. This is a potential conflict and can already be observed in a kind of battle for the customer as service provider. For example, Lufthansa, SBB, or Deutsche Bahn try to extend not only their sales capabilities and channels to tie their customers tightly to them, but also their means of transport such as Flinkster car-sharing or allying with local public transport carriers. Hence, service providers, especially the large ones, try to act also as service mediator even though they cover the mobility chain only partially. It is regarded as most important in this role to be the first contact in a multi-stage travel chain. As a consequence, the target groups with their requirements must be considered and served carefully in order to identify the addressable segments and find whether there is even a business case, and to cater to their needs better than the competitors.

Service provider and infrastructure operator could profit from such intermodal mobility concepts by increasing the capacity utilization and by equalizing the distribution of traffic volume during the day to finally reduce unit costs. Thus, there are benefit potentials for each role in this ecosystem, but while the established companies have the means and the most important capabilities to be part of the game, they very often lack a clear formulation of their strategic positioning and motivation. On the other hand, new players such as Google know exactly what their strategic position should be and what they want to achieve, but they lack important capabilities to provision all components with their respective operators and ensure correct settlement among the service providers. Provisioning entails the decomposition of a travel chain into its single sections in order to commission single sections from the respective service providers. In order to confirm the trip, you need not only technical capability, but much more importantly bilateral and multilateral commercial agreements.

8.2.3 Where Is Intermodal Mobility Heading?

As hardware and infrastructure in the mobility sector have low to very low rates of change as railways and streets are not rebuilt overnight, or vehicles, especially in rail transport, are not swift purchases, in the short term the main impact in this area will be achieved by software. Thus digitization and technology development are one of the most important

drivers for possible development scenarios. Real added value can be generated for customers such as proactively informing travelers in case of disturbances or changes during a journey and supplying possible alternative options for the best way of proceeding. This could be a feature the traveler wants to take advantage of and so would be ready to book one ticket for the whole journey, having been assured of a holistic care package during the trip. This of course is only facilitated by mobile devices.

But facilitating intermodal mobility is not primarily a technological issue but much more an issue of the strategic positioning and role definition within its value chain. Consequently, latest trials put a lot of effort in connecting various service providers to enable full door-to-door offerings for customers.

For instance, SBB and local public transport in Switzerland are cooperating to set up a new common platform where they plan to use common applications and data to sell one ticket across various means of public transport. All participants have agreed on a common pricing model and on using common functions in the selling process, and on providing compatible information so that door-to-door connections within Switzerland can be offered to the customer. Besides the technical harmonization and standardization that is involved in this transformation, there is also a lot of negotiation required between each of the service providers about the price model, the income distribution, so that this platform is able to process payments. A specific challenge is the distribution of income when the starting point and destination are unknown, as it is the case when selling an annual or monthly ticket (e.g. GA, BahnCard 100).

Even car manufacturers such as Daimler and moovel set up networks of service providers that cover single sections of the travel chain to enable booking and even payments for door-to-door journeys. In this case, several transport partners (service providers) are connected in one mobile app; these are mainly Daimler partners or providers whose shares are held by Daimler. Thus they are able to mediate and integrate travel sections on bike in Nürnberg, the Rhein-Ruhr-Area, and in more than 30 German cities; local public transport in Berlin, Hamburg, München, Stuttgart, Nürnberg, and the Rhein-Ruhr-Area; the car-sharing provider car2go and flinkster; as well as Deutsche Bahn and mytaxi. Thus, moovel is capable of offering door-to-door trips within Germany. In many cases it is still route information, but in some cases payment is already possible. Preferences in selecting the best fit solution for one's own needs is still not feasible. Hence, these are early trials to mediate intermodal mobility services that still have to be improved and that demonstrate that it is a major challenge to unify a traditionally scattered and very diverse network into one common connectivity platform where all timetable and price information is accessible and compatible with each other.

In general there is still a long way to go and the described solutions that are currently available are probably only first steps into the new world of mobility. From a technological perspective far more advanced solutions could be realized even today. For example, an IoT-enabled solution could be the "Be-In Be-Out" concept, where metering occurs when a traveler enters or starts to use the means of transport and when he leaves or stops using it. This approach facilitates a post-usage charging of the services and sections used. This of course changes billing completely and could be handled much like a telephone

bill. Based on the sections and means of transport used, as well as the times the customer traveled, the monthly charge can be calculated and discounts provided depending on the intensity of usage. In this scenario conductors are no longer necessary. Instead they could be hosts or provide other passenger services. In addition, a lot of value added services could be offered to increase the comfort of the passenger, such as ordering coffee or water in advance to be served in the train or put in the booked car, or similar.

This seems to be a wonderfully uncomplicated way to travel, but the question still remains: How do we reach these new stages of mobility and overcome all those stumbling blocks, only some of which were described above? From our perspective, the most important enablers will be increased availability of formerly proprietary data, new payment possibilities, de-regulation, and economic pressure on established mobility companies.

8.2.4 Connecting Everyone – Intermodality in Rural Areas, Small and Medium-size Communities

Is intermodality a concept that serves mobility demands in the countryside at all? How many means of transport are being made available in the future for those that prefer to live outside a larger urbanization? There is a shrinking offering of public transport buses, trains, and taxis even to date.

An Undertaking in a Metropolitan Region in Germany The discussion in the German metropolitan region of Erlangen, Fürth, and Nürnberg about the extension of the so-called city-region-train led to an extensive exchange of arguments [118].

The promoters of the project considered it a long-term investment over the next 10–20 years and argued with the following key performance measurements in mind:

- Economic value that is generated
- Comfort for passengers with distinct needs
- Sustainability gain through using the train instead of spending time in the car waiting
- Stimulator for subsequent investment and investors allocating businesses and employees in the region.

The website, although in German, demonstrates the variety of material and knowledge transfer that aimed to provide utmost transparency to the constituents and households. Info sessions have been held. Detailing about the structural impact, budgeting, cost-benefit studies, train route, and moreover alternative proposals and comparisons on a technical level, have been provided.

The three cities even founded a governmental body, a territorial division so to speak, to manage their interests jointly. Similar to a maturity model, a cause-and-effect model has been designed to depict hard and soft criteria to assess the impact of each of the alternatives. The model included a projection of employment, skills and competence building,

present and future attractiveness of the region, and a smoother and more relaxed mobility experience for employees to get to work.

It is not intended to decide for or against the efforts of the local government, but here we illustrate how participation on a community level could look like.

The Integrity of Public Transport The following is presented in the context of mobility engagements that are driven by the national ITS organization of the Czech Republic [119]. By aiming to "contribute to better and safer lives and to a cleaner environment" the initiative's leaders seek to keep a high level of modal split in the Czech Republic. Even more it is stated that the integrity of public transport needs to be kept. Public transport in the Czech Republic is in good condition throughout the country. A dense road and railway network with a density of 0.12 kilometers of lines per square meter is comparable with the density in Belgium or Germany. Significant progress has been made by issuing a National Timetable Information System which steers all public passenger transport timetables:

- Access to the scheduling data is open, free of charge, and can be re-used by dispatchers and journey planners
- A mobility card is in use by 3 million of the 10 million inhabitants
- The mobility card manages public transport booking and fare management.

The accompanying legal framework ensures a stable operation. The details, with reference to the Czech Act No. 194/2010, are:

- Ensuring transport services every day of the week, mainly to schools and school facilities, public authorities and work
- Defining the objectives of public transport and expressing the public interest
- Defining the responsibility on federal, regional, and municipal levels that are covered in multilateral agreements
- Preferring public transport
- Defining transport performance and quality criteria
- Managing operator selection and public transport contracting.

One of the leading projects that concerns intermodality is the design and issue of a sustainable urban mobility plan for the city of Pilsen. The plan outlines concrete measures and decision making criteria to facilitate about 90 mobility related projects. Further evolutions focus on the extension of walking and cycling services, reducing noise through better parking-related regulation and operation. Moreover, the establishment of a city-wide mobility coordination role is being planned. The better reach to constituents via the mobility card benefits the launch and processing of other and new citizen services.

8.3 Business and Social Needs in the Age of IoT, Industry 4.0, and the Circular Economy

Barbara Flügge

8.3.1 Autonomous Driving

Autonomous driving, often referred to as *driverless driving*, is a hot topic in mobility and innovation led discussions. Autonomous driving is defined as self-steered and targeted maneuvering of a vehicle without driver or co-driver interaction. The lifecycle stages of autonomous driving have been well described by Prof. Lemmer [120, p. 10]. A phased approach ranges from accompanied vehicle functions, partly automated, highly automated up to fully automated. In case of partly automated vehicles the car is steered automatically for a certain time period. In fully automated vehicles continuous steering is provided. The latter aspect is what is now referred to as autonomous driving.

Early tests such as the one on BOSS, a 2007 Chevrolet Tahoe that has been modified for autonomous driving, Google's 2011 or Audi's 2016 competition reveal passion and inventors' spirit, but also a down-to-earth interest in making the vision come true. Others encounter the barrier of the Vienna Convention on Road Traffic from 1968 in which Article 8 states that "every moving vehicle or combination of vehicles shall have a driver" [121]. Others encounter autonomous driving as a feasible offering made out of technological progress, assertiveness, creativity, and a good portion of realism.

Regardless of a positive or a critical viewpoint, the relevant questions and topics should be discussed in a constructive and critical manner. The following reflections follow a presentation by Prof. Lemmer [120] and are expanded by authors' insights:

- Legal frameworks
  - Driven by the Vienna Convention on Road Traffic from 1968 and national and/or legal frameworks that might vary by region, service provider, and political assertiveness, the following questions arise:
    - Is the Vienna Convention being renewed or will there be a totally new convention?
    - Will mobility consumers purchase in the future a service that manages the tolerance of autonomous vehicles in a certain country or region?
    - Will the adaptability of an autonomous vehicle become tradable directly in the car?
- Technical considerations
  - What is the status of an autonomous vehicle? What does it take to be completely reliable – as a car?
  - The automotive industry developed, over the past decades, features such as sensor technology, actuators referring to propulsion technology, and geo-positioning. Will there be a scenario, hence usage-based, interpreter or a sentinel?

  - What about the feedback of incidents and countermeasures?
  - How are the co-drivers being informed and supported?
- Behavior and ergonomic considerations
  - How is the interaction between co-driver and vehicle designed, managed, and technically resolved, for example in the case of technical outages?
  - What are the co-drivers' roles and responsibilities in the future?
  - Human Machine Interaction (HMI) related research is a key contributor to those considerations and more [122].
- Societal considerations
  - Considering that technology helps to improve traffic and road safety and diminish accidents that are caused by human mistakes.
  - What is happening in cases where new assistant and feedback systems become error prone on their own and cause or influence accidents?
- Acceptance variety
  - Users of autonomous vehicles trust the technology and the car as a means of mobility
  - How are market potentials realized in a sustainable manner and in which time frame to build on that trust and expectation?
- Migration
  - What does a migration path look like when integrating an autonomous vehicle in traffic management systems and defining the so called connected and demanded reaction capability and reliability in hybrid traffic situations? Hybrid traffic is referred to as a mix of autonomous vehicles and traditional driver-led vehicles.
  - Will there be separate lanes?
  - Will there be a call for districts that focus solely on autonomous vehicles?
  - What does the migration path look like for autonomous vehicles and their "human", hence "human compatible", behavior?
- Infrastructure
  - How is infrastructure being adapted – meaning street markers in a digital, physical, or autonomous sense?
  - Who covers the efforts in infrastructure measures?
- Insurance and liability
  - With respect to insurance and liability the key question concerns who is in charge in critical situations and when unforced errors occur: will the autonomous vehicle undertake driving lessons and pass a license test? Who is going to train the car? Will there be training-on-the-job?
- Vehicles are open systems and offer entry points
  - Who opens them and who controls access?
  - Who steers, monitors, and maintains in future?
  - Digital infrastructure maps fuel the vehicle with hints about incidents (weather, congestion, traffic jams, bottlenecks, accidents). Are drivers' and co-drivers' preferences being considered, too?
- The self-driving vehicle learns independently by experiencing critical situations, incidents, and co-drivers' reaction:

- Does it need a driving license?
- Who trains the vehicle?
- Who insures it?
- Is there a control instance such as a technical control board?
- Which lock-in effects occur with respect to service usage?
- Are there options to retrieve driving behavior and service usage ad hoc, real-time, and in a predictive manner?
- How will service providers and the developer community respond to potential lock-ins and what are the countermeasures?
- What happens if automotive and/or technology providers manage, steer, or prohibit third party services? Is there a gateway to allow private and shared services?

New Autonomy Looking into autonomy related innovations from the manufacturing and aviation industries, procedures and a governance framework serve at least as a starting point to learn about the discourse of autonomous maneuvered vehicles. In the *new autonomy* we are considering the autonomous vehicle as a persona – an approach that has been introduced earlier in this publication – and further considerations and uncertainties about *self-learning systems* arise.

Especially in the field of traffic safety the condition framework and the deployment capabilities of autonomous vehicles among geographies, hence ecosystem-to-ecosystem, need to be checked in a careful manner. Distinct regulations based on geo-political or any other decisions might be encountered: these might result in distinct values and parameters setting tolerances with respect to speed, reaction time and reaction windows, braking behavior, configuration flexibility to accommodate personae with distinct 'driver' habits and profiles, or simply to foster the use of autonomous cars and design distinct offerings.

Further differences might occur in the case of co-driving from one municipality to another: for example, distinct accreditation guidelines about the purchase and supply of *open-service-systems* in the car in the departing municipality and different ones in the targeted municipality. Regulators thus might make use of special agreements and tolerances to leverage political strength, and economic and societal circumstances, among other parameters. Will there be an agreement among distinct regulatory parties? Or will there be a service offering called "tolerance metering" that guides the vehicle when crossing one region or municipality and adapts the parameters?

Another related industry that has an impact on autonomous vehicles is the insurance industry. Tending more into usage-based and geography-dependent policies the industry is fighting for a *personae-driven design*: opening up a person's driving and giving access to behavioral data is already a model in use. How does the insurance industry respond to the above-described tolerance and parameterization efforts? Who is being insured in the car – the persons in the front seat or will there be a responsibility shared with the co-drivers in the back seat? Might there be one co-driver in the autonomous car that agrees to take on the prime insurance coverage – similar to the agreements we encounter when sharing a flat and the rental manager asks for one main tenant? What kind of liability offerings will

enter the market? In this context we need to ask if those that co-drive need to gain more insights about the others that share the car. How do we know about the ones that jump in and jump off? More intimacy is provided in an autonomous car compared to a ride-share in a bus, a subway, or train compartment. A number of these questions derive from the overall definition of roles and responsibilities.

The network itself, such as the ones that participate in ecosystems (e.g. a city, port, or an event location) generates further *networks-in-networks*: the autonomous vehicle itself connects with other vehicles, exchanges experiences about resource consumption and driving behavior, might share services, or issues new service needs. There is a long way to go to cope with disruptive elements such as risk factors on the street, unplanned errors, and a self-learning, *artificial intelligence* fostered attitude. Nevertheless, looking back at the entry of robotics in a production environment and its influence on organizational set-ups and workers' profiles, the impact of autonomous vehicles will be far more intense to all of us that are on the move.

How do municipalities prepare now for the *new autonomy*? Urbanizations that already work with asset registries continue data capturing and digitization. Asset registries are a key element to feed the car with appropriate data and preciseness about disruptions such as weather, street conditions, accidents, bottlenecks, and maintenance and construction sites. Deviations and intermodal offerings can be added, too. Those and further activities take part in the mobility management efforts of the ecosystem.

The project initiative *Neue autoMobilität* (*NaM*, in English *New autoMobility*) launched by acatech [94] focuses on the above stated topics. Experts from distinct associations, interest groups, private and public institutions, and enterprises exchange, assess, and work on a holistic view of autonomous driving and its impact on economic, political, and societal governance frameworks.

How far are we along the line? The city of Gothenburg, Sweden, launched an autonomous driving initiative with business stakeholders, such as Volvo Automotive, and a €55 million investment [123]. The future of autonomous driving is nearby and closer! It is Gothenburg's aim to deploy autonomous driving and parking in the city center by 2020.

8.3.2 Continuous Business Process Enablement

Achievements in the age of Industry 4.0 influence not only the high degree of connectivity of components, machines, and participating organizations such as suppliers, OEMs, manufacturers, and logistics service providers. Those achievements hopefully imply a more responsible dealing of natural resources, material, and packaging.

Tagging Consumption Needs to Influence Production and Distribution Taking a look at the business world, mobile and desktop boundaries are blurring. The demarcation between working-while-traveling and desktop related work in one location is disappearing. Business processing is conducted in a smooth manner and is even not noticed by the

user himself. The intelligent business process has the insight into which replacement or maintenance order the technician is handling, approving, or requesting. The insights for decision makers with respect to critical and risk-encountered incidents grow: being fault signals, emergency scenarios, evacuation, or ad hoc measures relating to street related, rail or air traffic diversions that are necessary because of an unexpected operation to de-activate a World War II aircraft bomb. Digital intersections should be of least effort for the technician. Made invisible, digital capabilities allow distinct devices and brands. A standardized usage protocol connects data wise only the relevant, and not just all of the relevant, characteristics.

One of the five *Cradle-to-Cradle*® requests concerns the re-utilization and treatment of components in manufacturing [124]. The sharing of components and products is another request we derive from that principle. It should stimulate a conscious decision by the consumer to use and not own a product. Hence the purchase of a new product transforms into the usage of a re-utilized product or component.

By material re-utilization an organization and its extended supply chain identify the material streams that can be re-utilized when the product is taken back. This asks for reverse supply chain management capabilities. Furthermore, transparency about the entire bill of material within the production and fulfillment lifecycle is required.

Another Cradle-to-Cradle principle is about the elimination of waste and to produce and use renewable energy. An outcome of this principle is denoted as the *circular economy* movement. Furthermore, responsible production is also subject to people management and guidance along the supply and demand fulfillment activities. Socially responsible companies demonstrate responsibility with regard to their staff, and endeavor to make sure that companies in their supply chain are not violating these principles. Thus, ecosystems that share a set of values facilitate the process of following this principle.

How does a *circular economy* driven supply chain look like? We, the demanding consumers, can look up shareable products and components. Instead of an isolated view of our demand, we gain insights into re-utilized components, for example those offered by fair trade and fair phone initiatives. Through IT, we are able to combine our matchmaking efforts on value, excitement, reach, and service competence with a health check on circular offerings. The fulfillment lifecycle is anchored in the Cradle-to-Cradle design principles. It does not stop with the delivery. Rather it evolves through the return, storage, and deployment of shared and re-utilized products, components, and processing materials. Waste is eliminated wherever possible. With respect to infrastructure usage, we recommend a *digital asset map,* for example, to outline shareable space and means of transport, offering assembly lines and technical equipment on the spot.

Equipped with digitally enforced technical means such as tools and means of transport we then turn to our companions. Trucks and machines continuously collect data points and transmit them into the backend system. Data capturing on the spot is mean and/or asset specific and guides our focus to operations' duration and temperature or vibrations. The goods and items that are being sourced, delivered, produced, assembled, unloaded and unpacked, and finally delivered allow us to consider weight, volume, quality, and humidity

– measurements, restrictions, and potential risks. *Cyber Physical Systems* (*CPS*) help in monitoring the correct, expected, and commercially agreed upon functioning of an item and issue maintenance activities in case of a predictively diagnosed risk. Ultimately, CPS orchestrate the collaboration between trucks, goods, and machines.

The use of *Augmented Reality* (*AR*) simplifies the logistics processing, too. Integrated in business process transactions and inter-organizational collaboration it supports the mobile and desktop personnel.

Back to *circular economy* technologies, as the ones above foster not only a managed lifecycle of products and components, but a continued lifecycle. Products and components return into the consumption, production, and usage processing.

Smart Mobility is capable of orchestrating the re-introduction of components and products into the manufacturing and demand process. Furthermore, it connects tools, production relevant material, and components with fleet management systems in a continuous manner along the production and consumption lifecycle of resources. Smart Mobility even serves to intelligently support experts on-site to monitor production, auditing, and inspection.

A Continuous Mobility Demand Cycle Operations at any hub like cities, constructions sites, and event venues should run smoothly. Timely arrival of packaging and means of transport are one of the prerequisites to facilitate the hand-over of goods from one supply chain partner to the next one. In between a number of information sources arise – not all of them are visible to those that decide upon the next steps.

Ideally information coming from different sources interacts in a pre-defined and purpose driven format. The approach allows port operators to monitor transport orders in real-time, in the office or using mobile devices like tablets or smartphones, and to undertake any activity to transport goods more efficiently and safely.

The dispatcher oversees all the relevant transport activities of the fleet in the port area. Around 20 geographical areas have been identified, the geo-fences. Geo-fences reflect critical landmarks and areas such as bridges and freeway intersections with high traffic density. Further examples are the parking spaces for trucks offered by gas or truck stations. Any occurrence within the geo-fence triggers the provision of information to the truck driver's cabin. In parallel it does the same for the dispatcher. Equipped with a geo-positioning logic, the truck sends out a signal whenever it enters and leaves a geo-fence. Data are collected based on the direction, the position, and the speed of the vehicle. Data such as the license plate are only visible to the fleet manager and freight forwarder the vehicle is registered to. In case of sustainability measures such as road usage reduction, however, license plate recognition and directly steered interaction with the truck's navigation cockpit could transform the steered vehicle into an autonomous driving vehicle.

In emergency cases within one specific geo-fence, a dispatcher sends out a pre-notification to any truck driver. The dispatcher is able to collectively address all drivers at once. In another case he submits a pick-up order directly to the driver who is closest to the loading area. The driver himself receives the notification and routing change instantly.

The pick-up notification contains all the relevant information. No physical interaction is required, for example to note down the order numbers or check out the onsite delivery guidance. Drivers seek to arrive on time, smoothly, and without stress at the respective destination. Ideally no traffic jams occur. If so, a simulation feature indicates ahead of time the countermeasures to be taken. Those could turn into a newly appointed storage area or pre-gate entry notification.

Through seamless mobility for cargo, local road managers, construction site supervisors, and dispatchers will be informed in a timely manner about the number of incoming, transiting, and leaving vehicles. Teaming up with the digital site facilitator, the analytical tool, the dispatcher decides on the ideal route for the drivers to take and which critical areas to focus on. Criticalities occur, for example, owing to blocked inbound streets or incidents that require immediate notifications and alerts for any nearby or soon-to-arrive participant.

In the frontrunner project of *Smart Logistics,* truck drivers, dispatchers, hub road management, and decision makers were provided with traffic and infrastructure information directly into their vehicle or any of the chosen workplaces. Any information is contextual: driven by the individual's location, final destination, and tasks to complete. Mobility offerings as outlined at the very beginning of this chapter get pretty nasty if they are not able to meet small time windows. The window of opportunity, for example in the case of a drive-through bridge, turns easily into a window of disaster if it is closed for 20 minutes.

Thus, the interconnectedness of the transport infrastructure (roads, water berths, railways, bridges and terminals) is safeguarded with digital mobility offerings. The following key findings resulted from our observations in a real-time deployment:

- Digital enablement of multi-modal data and dependencies results in smoother traffic situations within the overlooked area.
- When visitors and travelers make use of the digital mobility facilitator the pressure is taken off and they are able to focus on what they need to do.
- The interconnectedness of the transport infrastructure (roads, water berths, railways, bridges and terminals) is safeguarded with digital mobility offerings.

8.3.3 Business and Social Arguments

The real-life scenarios we introduced earlier in this publication took into consideration a three-tier point of view: (1) the processes are assessed from a persona point of view, then (2) the identified requirements follow the needs of the individual personae. Finally, (3) a third viewpoint evolves by looking at the stakeholders' roles that they perform in the observed persona-specific E2E mobility process.

Often, the structured descriptions of processes on the lower levels contain process variants that only deviate from the main process in minor detail. This effect can be observed when comparing the requirements from a business traveler's point of view with the event

attendee's point of view, for example. Any variant to an overall E2E mobility process is therefore driven by the observed persona. The *usage scenarios* from a persona point of view assure a 360° insight into door-to-door mobility processes.

To underpin our assumptions, we conducted a series of 10 *customer journey mappings*. Thus, the door-to-door experience from 10 individual travelers was observed, measured, and represented in a coherent, detailed format:

- Identifying the interviewee profile with respect to the observed role and travel characteristics
- Describing one day in the life concerning mobility
- Identifying one particular section and capturing the emotional experience, and ultimately
- Conducting a negative projection on the emotions with the highest rating.

Out of the 10 individuals we captured the travel profiles for each of the demanding consumer groups: direct, secondary, and tertiary mobility consumption groups. Our interaction with these mobility consumers resulted in valuable insights concerning the travel experience, such as KPIs and measures of seamless mobility:

- Identification of common denominators
- Missing elements in door-to-door mobility offerings
- Turning the adoption potential into a true usage of digital means.

Any of the above observed travelers is making use of digital means, whether this is an existing app for a particular location, a trip booking system for combined hotel and flight bookings, or a company-wide booking procedure that results in a digital notification about trip charges, a digital compliance calendar, and an electronic document that contains the booking code and seat reservations.

Despite the above outlined expectations of Smart Mobility, the digital coverage of seamless and intermodal mobility offerings was rated 'partly available' to 'poor' by the participants. Poor is given for two reasons according to the interviewees: (1) the lack of interoperability, transparency, and interconnectedness among digital mobility front office services, and (2) ticketing is up to the traveler to prepare upfront and he has to be prepared to browse onsite for offerings. The frustration caused for travelers ended in 2 of 10 cases aborting travel plans.

For all observed travelers, the participants of the customer journey mapping reasoned that the common denominator for good mobility offerings is a combination of:

- Reliability
- Punctuality
- Security and safety
- Orientation in gated areas, trains to optimize changes during transportation
- VIP services, and
- Useful spending of time.

Table 8.10 Business and social arguments driving digitization

Persona	Business arguments	Social arguments
Business Traveler	Number of travelers e.g. within an organization, e.g. traveling in Europe. Sizing of the Business Traveler Market. Growth of the Shared Economy and subsequently freelancing businesses and individual travelers without a back office is supposed to grow by 3000 %. Overcome the administrative burden for travelers and/or travelers' assistants and/or back offices despite changes, delays, and on-the-go obstacles.	Align with community members on the spot. Travel in a shared economy-friendly environment. Save time to connect, work, and relax by transforming one hour of back office and front office efforts to plan and deploy travel and adjacent business arrangements as cost efficiently, smoothly and effectively as possible.
Event Attendee	Top four event countries in Europe: – 2.7 million Germany, – 230,000 The Netherlands, – 210,000 Austria, and – 190,000 Italy in the year 2013[a] – 1 million attendees traveling to the 20 top fairs in Germany and Switzerland.[b] Consider, for example, the number of fans and sport enthusiasts plus accompanying family and friends in the US market that are traveling, e.g. for the Super Bowl or US Open	Turn focus onto sports event. Save time and money for travel arrangements. Avoid delays and unnecessary transport changes for attendee and accompanying family and/or friends. Align with community members on the spot. Travel in a shared economy-friendly environment. Save time to connect, work, and relax by transforming one hour of back office and front office efforts to plan and deploy travel and adjacent business arrangements as cost efficiently, smoothly, and effectively as possible.
Traffic Management and Operations Unit	Unit supervises and is responsible for all specific urban transport and transport-related planning activities in a state, community, city, region, or on country level. Maintenance and Repair are next to Remodeling and New Traffic Management the most critical and costly element in mobility provisioning.	Be responsible for the availability of transport services. Be responsible for security planning and risk mitigation due to traffic related impacts.

Table 8.10 (continued)

Persona	Business arguments	Social arguments
	Traffic congestion costs in Europe, for example, could range up to 1 % of GDP per year[c]. As mobility needs increase, the demand for and the challenges to smooth, yet cost efficient and effective traffic management provisioning, increases even further. Depending on the scope and the geographical reach, traffic management and operations cover highway/regional and community streets, public buses and trains, subways and trams, and public transport offerings for public schools. Smart Mobility impacts the layout of a city and/or region and any other observed zone (e.g. industrial or academic). Therefore traffic management units have an economic interest in land use planning and re-purposing of bus lanes, streets, and parking zones, for example.	Traffic management operations are one of the mostly highly regarded institutions (especially if run as a public/government unit) that has the mandate and the role to contribute directly and influence proactively climate protection and sustainability measures – e.g. through shared economy offerings, e-Mobility buses. and trucks that traverse in an urbanization. Be partly responsible and/or actively involved in delays and changes from one means of transport to another. Example: train is breaking down and the mobility service is being substituted by buses.
Digital Concierge	Represents the persona of the digital configuration advisor and mobility algorithm calculator. Appears as an avatar to the Smart Mobility service consumers and service providers.	Processes the mathematical algorithms to calculate the ideal alternative routings for one or a group of travelers despite upcoming, predictable and unpredictable incidents and exceptions. Notifies users. Sends alerts. Distills data sources from own and third party data source providers.

[a] Association of the German Trade Fair Industry, http://www.auma.de/en/press/seiten/press16-2014.aspx, accessed September 16, 2016.
[b] Source: Heidelberg Mobil international GmbH.
[c] European Commission Impact Assessment (2011) "Roadmap to a Single European Transport Area", https://sustainabledevelopment.un.org/content/dsd/csd/csd_pdfs/csd-19/learningcentre/presentations/May%204%20pm/3%20-%20Julius%20Langendorff%20-%20EU%20White%20Paper%20Single%20Zone.pdf.

A functioning digital business processing asks for the resolution of the following four requests:

(1) Data gathering from distinct and not always known data sources
(2) Missing interoperability of distinct systems and apps to respond to consumers' needs
(3) Missing ticketing solutions that cover intermodalism in an easy-to-consume manner, as well as
(4) A comprehensive, usability oriented representation of travel details and accompanying documents.

Digital services are partly made available in two variances: (1) by local, isolated offerings for the departure, the transit, or the final destination, travelers are not able to oversee the entire process and modifications. (2) Digital services are not multi-modal; mostly they are offered in an isolated manner focusing on the two main means of transport(e.g. air travel and travel by train).

Concluding our field test, we encountered a series of business arguments and a series of social arguments that foster the deployment of the market potential of Smart Mobility. A successful deployment requires both sides of the coin to be leveraged, as outlined in Table 8.10.