Building Blocks of Intelligent Mobility

12

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Abstract

Usability and success of Smart Mobility go hand in hand with an over-arching framework that takes all relevant aspects into consideration and is able to facilitate the process of identifying and applying strategic, functional, and technical building blocks. The Building Blocks of Intelligent Mobility (BIM) give orientation to service consumers, decision makers as well as business and government contributors along the multi-diverse and multi-dimensional complex of Smart Mobility. Contained in a BIM catalogue, each of the BIM is now introduced and structured. Among further elements the following four, namely the ecosystem-driven approach, the assignment of use cases, the personae-driven path, and the Smart Mobility role model are key contributors to the Smart Mobility Procedure model.

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The extensive display of usage scenarios and examples in Chaps. 7 and 8 sheds light on distinct viewpoints on Smart Mobility and its functional as well as technical applicability. The ecosystem design parameters, the personae approach, and the *role model* of the *Internet of Services (IoS)* serve as the contextual glue.

Motivated by deep-dive investigations and projects, a proposition is now made for the construct of Smart Mobility applications and services in the form of the so-called *Building Blocks of Intelligent Mobility* (*BIM*). The format to contain the BIM is referred to as the *BIM catalogue*. The four layers *Smart Services, Smart Data, Smart Products*, and *Smart Spaces* give orientation and serve as a technical and functional frame.

Technical and functional accomplishments would not be sufficient or scalable without decision making capabilities, a sense for innovation, and the claim raised to ensure mobile future generations in a sustainable, fair, efficient, and growth oriented manner. Therefore, we added the layer *Program Management*. Based on our experience, a strategic and project oriented sequence of actions is a key and critical success factor for successfully deployed Smart Mobility. This set of criteria and the layer model therefore form the Smart Mobility *BIM* as outlined in Fig. 12.1. Each of the elements that are part of the *BIM catalogue* is now introduced. They serve as the foundation for any Smart Mobility undertakings. There might be additional elements or future, not-yet-captured elements. Those can be added to any organization's specific initiative.

The elements have been elaborated on in a systematic manner. If necessary, they are deployable in a custom fit and staged order and do not necessarily require a full suite deployment in the first phase. Each of them is now introduced and described, element by element:

- Smart Mobility Program Management according to Sect. 12.1
- Smart Services according to Sect. 12.2
- Smart Data according to Sect. 12.3
- Smart Products according to Sect. 12.4
- Smart Spaces according to Sect. 12.5.

12.1 Smart Mobility Program Management

The *Smart Mobility Program Management* (see Fig. 12.2) embraces the well-known project management relevant tasks. Next to them are addressed those tasks that ensure the strategic embeddedness of Smart Mobility initiatives within an organization and its ecosystem.

Smart Mobility is not a one-way street or a solo effort. Leadership from the top management signals its backing through sponsorship and support. Leadership is multi-faceted and could be the top management of a commercial enterprise, the departmental leader of a community, a city, a province or a ministry, an innovation office, or the designee of a company, for example.

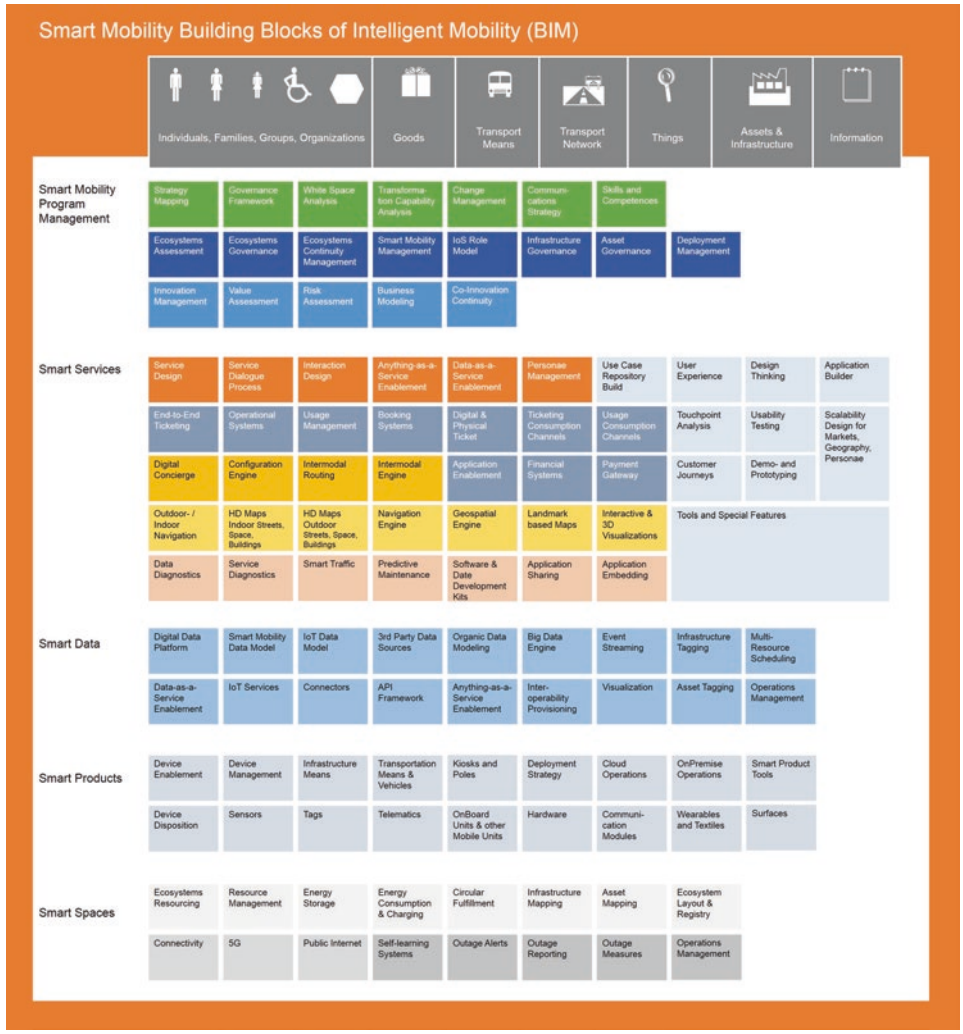

Fig. 12.1 Smart Mobility: Building Blocks of Intelligent Mobility (BIM) – the catalogue

Sponsoring refers not only to the sponsoring of budget or issuing funding programs. It embraces the provisioning of expertise and know-how, access to subject matter experts, contacts within the ecosystem, and facilitating business and governmental partner involvement. Any Smart Mobility engagement is characterized by access and use of data. Next to engaging collaboration partners from strategic, functional, and technical stakeholders it is highly recommended you engage the legal ombudsman and data security engineers from the very beginning.

Strategy Mapping One of the cornerstones of strategy thinking is strategic impact assessments and *white space analysis*. They result in identifying a new business segment and its influence and impact on an organization's structural, economic, functional, and

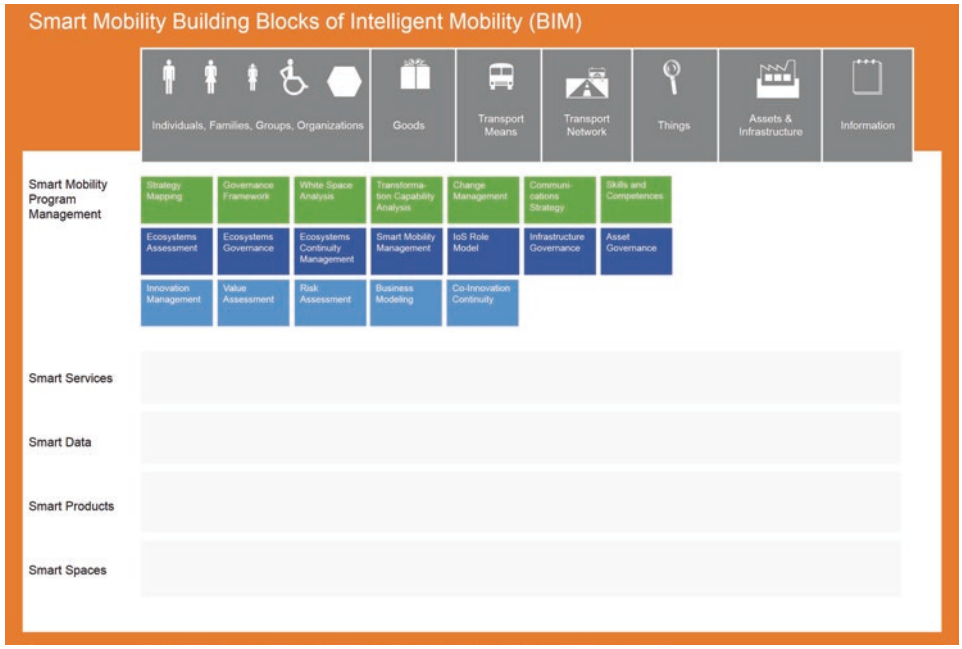

Fig. 12.2 Smart Mobility Program Management

societal set-up. Here we apply an approach that is grounded in the findings of Kaplan and Norton [150] and results in so-called *strategy maps*. The *strategy map* is defined as "a comprehensive description of an organization's strategy". It provides a checklist for a strategy's components and interrelationships.

Strategy Mapping underpins the alignment of Smart Mobility initiatives with other ongoing and/or planned initiatives to ensure the long-term strategic positioning of an entire organization or of one of its divisions. Transformational undertakings with technological characteristics, a high degree of interconnectedness with the population, and to be revealed benefits demonstrate their capability in assessing the need for strategic adaptation. The deployment of a piloting project or a field trial serves to reconsider the strategic targets and reveals the necessary steps for a long-term process of adaptation.

Change Management is another key element next to strategic thinking. Job profiles, competences, training, and self-improvement accompany the employees being employed by a government institution or a private company. Independently from the usage volume/test size of a field trial or a long-term targeted initiative, project initiators need to define a communications strategy and an information panel to embrace the project participants and the population. The population is thus an inherent part of the project.

The governance framework, another key element of the Smart Mobility program management pillar, takes into account the governance of guidelines and policies and a meaningful implementation alongside the project and beyond.

Ecosystem Assessment, Governance and Continuity Management The analytical foundation of ecosystems was depicted in great detail in Chap. 3. To ensure a meaningful and successful design of the Smart Mobility undertaking, the continuous traceability of the applied and/or targeted ecosystem is a key activity. One the one hand, it serves as a communication vehicle for the participating parties and stakeholders. One the other hand, ecosystem continuity management results in a more and more complete depiction of the relationships of the participants within the targeted ecosystem, in alignment with other ecosystems and even within an organization.

The ecosystem assessment refers to the study of the location, such as a city, an economic zone or, for example, an industrial area and its participating members, interactions, the local advantages, and location relevant services. It serves furthermore as a catalyst to derive potential and deployable use cases for the targeted and involved stakeholders and industries. In addition, the ecosystem assessment triggers business model relevant questioning.

Another key activity within the ecosystem assessment is the identification of roles, responsibility, and positioning options for stakeholders. Figure 12.3 outlines the corresponding personae management within the IoS role model.

Depending on context and the individual character of the observed location, further techniques and methods could be applied.

Infrastructure and assets in the context of Smart Mobility are technological elements as well as constructional elements. It is recommended that you target Smart Mobility

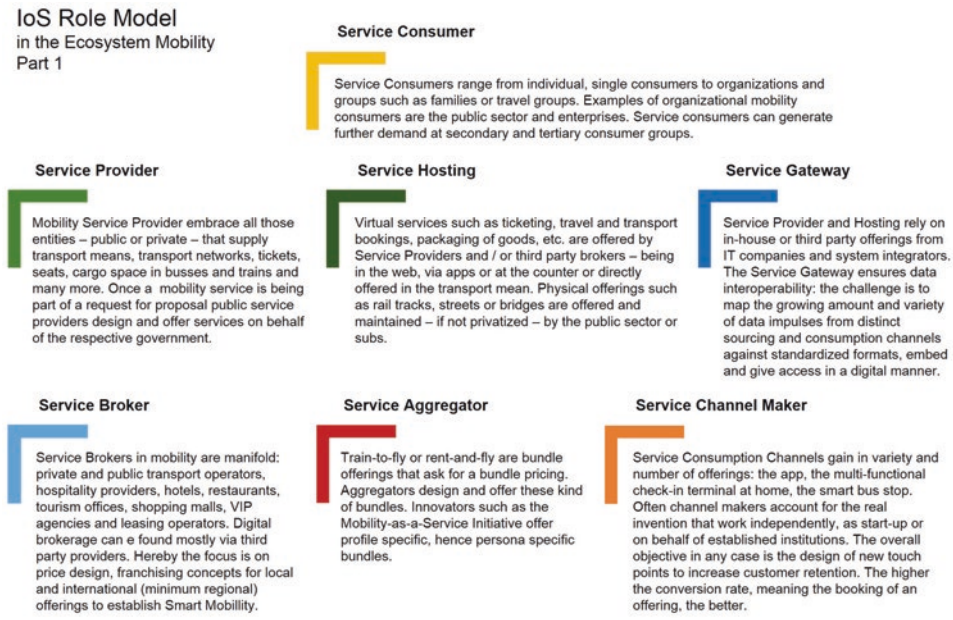

Fig. 12.3 Smart Mobility IoS role model

related assets and infrastructure holistically in so-called *cadasters*. Cadasters are a kind of registry that contain and describe all mobility relevant assets (e.g. streets, bridges, facilities, light poles). They should be defined independently from the current organizational alignment and ownership in city government and maintenance departments. Especially in communities, cities, and regions unnecessary discussions usually take place about who is responsible for what. A Smart Mobility undertaking, as any other ecosystem targeted undertaking, asks for transparency and the willingness to share and update information and data among the participants and addressees. In the future we expect that existing role models give way to a contextual assignment of roles and responsibilities instead of a hierarchical or an assignment characterized by separating public and private roles and responsibilities.

Innovation Management and Value Proposition No doubt, Smart Mobility is one of the most wanted innovative themes that offers a broad range of discovery and invention outcomes. Creativity and design of Smart Mobility offerings play an important role, given the reach of its assets and services towards distinct consumer groups. The same accounts for business modelling. The later aspect targets the evaluation of qualitative and quantitative criteria of Smart Mobility offerings and their pricing strategy. In the markets, movements such as *Business Model Innovation (BMI), digital business modeling,* and *business model generation* opened up the discussion among distinct organizations and encouraged the sharing of commercial considerations. Any of the movements aims to define the *unique selling proposition (USP)* of a product or service to outperform known and unknown competitors and derive a suitable and promising calculation schema.

Especially in Smart Mobility app offerings the calculation schema is driven by volume, meaning the size of the targeted user community. Pricing wise most of the observed Smart Mobility apps are free of charge to attract a reasonable number of users. Profitability and economic capacity build rely on chargeable add-on services that amplify the initial offering.

A common pattern in the field of innovation triggered initiatives is the acquisition of public funding. Another element concerns the set-up of coinnovation projects in collaboration with representatives from business and research institutions as well as mentors and business angels. Regardless of the applicability of public funding and research budget, and the overall project organization, it is recommended you set up a coinnovation continuity program. This concerns the ongoing exchange and sign off for the relevant steps to be taken for market entry, further field trials, and the expansion of service offerings.

One of the observed mistakes is the launch of coinnovation projects or hackathons that succeed in the first round, but miss the efforts to continue. We come back to this phenomenon by introducing a continuity-triggered involvement throughout the Smart Mobility Procedure Model (see Chap. 13).

12.2 Smart Services

Within *Smart Services* there are six key areas (see Fig. 12.4):

- Service design
- Launch and conduct of use cases and a use case repository build
- Ticketing concerning mobility related services and other kind of services
- Digital concierge and intermodal routing
- Outdoor and indoor navigation
- Mobility diagnostics.

Alongside the definition of the layer model, *Smart Services* contain service and solution triggered tools. Furthermore, the entire *solution lifecycle management* takes place within Smart Services.

The following depiction of Smart Services is dedicated to introducing key features, functions, and tools for successfully deploying Smart Mobility. It does not serve as an architectural model or technical schema.

Fig. 12.4 Smart Mobility services – an overview

Service Design *Service design* embraces all necessary tasks and activities to define elements and parameters of Smart Mobility offerings in an optimal and adequate manner. The identification and invention of applicable services is taking place in the context of interaction design. Any activity, task, or request can be offered as service these days (aka Anything-as-a-Service). This could be an individual who accompanies a patient to the hospital, the offer to review all necessary travel documents and filling in the necessary forms, or the offering of a private car owner to use his car for a maximum mileage per month in a pre-defined time window.

The variety and multifaceted nature of services is what we refer to as the *Anything-as-a-Service* phenomenon. A similar effect is encountered with the variety and multifaceted nature of data. Under the assumption that the user provides the unconditional acceptance to release usage insights as well as accepting the bundling of usage-related data with publicly available data, a data-as-a-service movement in the field of mobility is emerging.

To be successful good service design embraces the addressees and answers the question about who is taking over which role in which time and process segment. Therefore, personae management is part of this building block.

End-to-End-Ticketing *End-to-end ticketing* or *one ticketing* targets the connectedness of the entire travel chain in a digital format. The requirements for and functioning of *smart ticketing* that have been covered in Part II play a significant role in pursuing the digital connectedness of means of transport on-site, cross-regionally, and internationally, and the corresponding services with one ticket and one payment.

This area is often declared as one of the most challenging building blocks of Smart Mobility. Depending on the scope of Smart Mobility, proprietary IT solutions, standard applications, public and/or privately issued services are in use. Intermodal routing that embraces two or three means of transport does exist already. The current discussions target the connectedness and intelligent use of further means of transport and alternatives, as well as accompanying the traveler digitally. The digital companion we refer to as the Digital Concierge.

Digital Concierge Similar to the functioning of a sixth sense, the *Digital Concierge* operates through a number of algorithms and data status monitoring. The heart of the Digital Concierge is the autonomous, unsolicited interaction with the user. The user, depending on a traveler's profile, is the person itself and/or the proxy. All relevant tasks and activities, alerts and notifications, incidents and bookings, and travel alterations are bundled and operate in a pre-conditioned format.

Following the exemplified intermodal travel schema from Sect. 8.1.4, the Digital Concierge captures, in step 1, all preferences of the traveler and his travel conditions in a *mobility profile* (see Fig. 12.5).

The identification, calculation, and presentation of alternative routing options for the traveler are subject to step 2 (see Fig. 12.6).

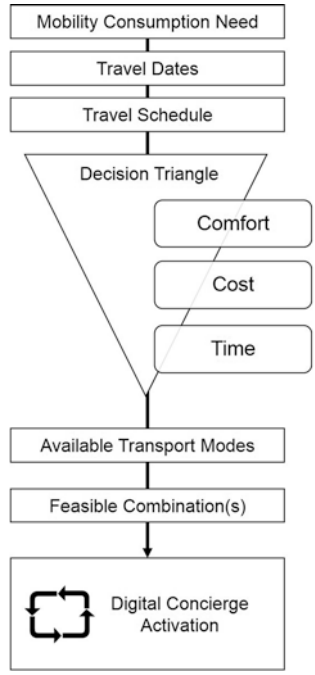

Fig. 12.5 Ecosystem Mobility – intermodal on the road – step 1 – alternative routes for one trip <door-to-door>

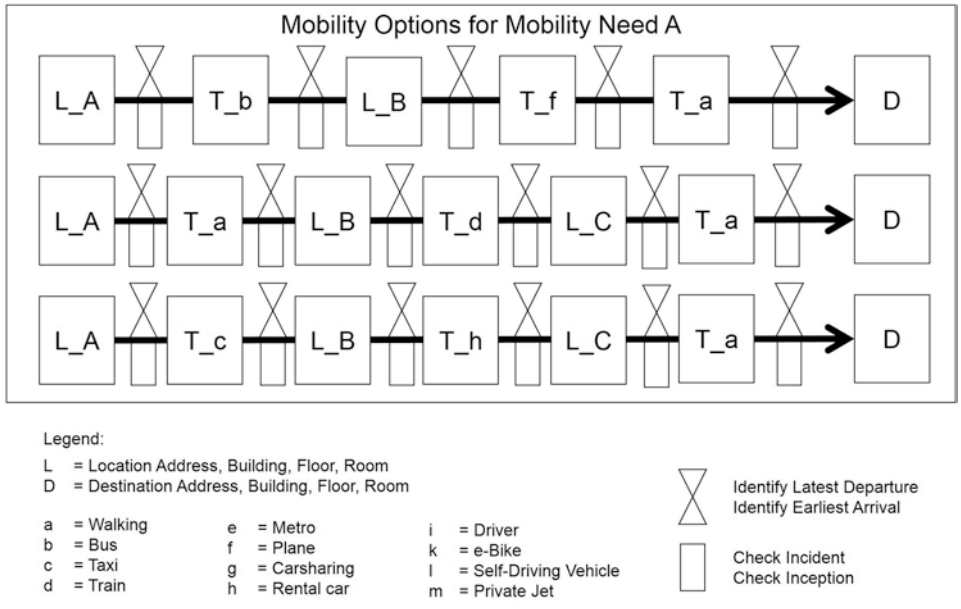

Fig. 12.6 Ecosystem Mobility – intermodal on the road – step 2 (extract) – alternative routes for mobility need A

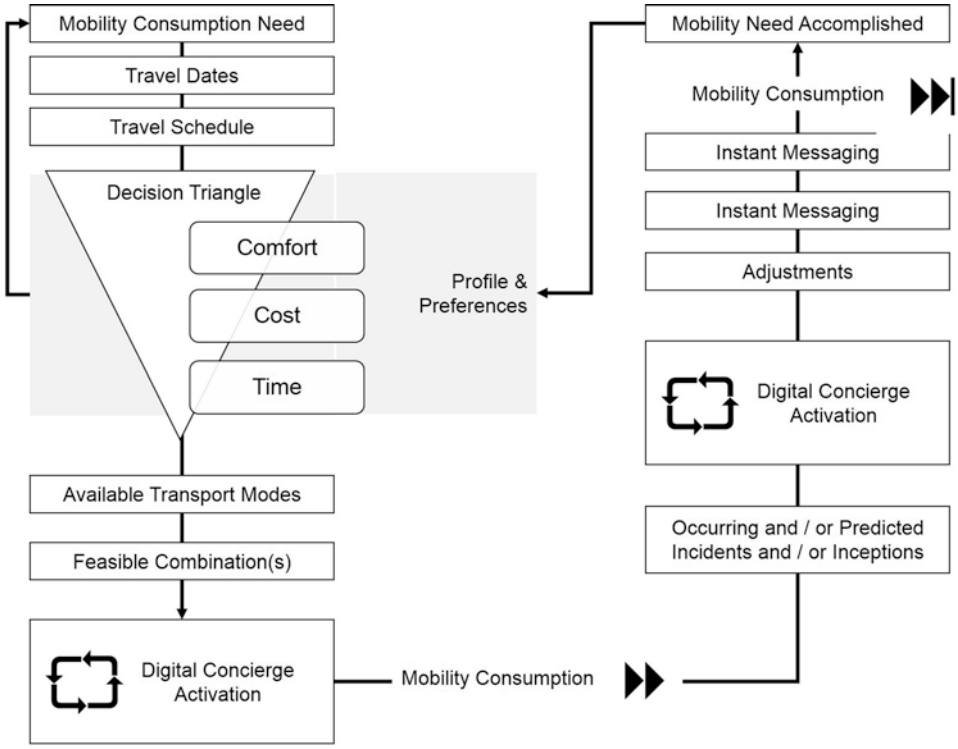

Fig. 12.7 Ecosystem Mobility – intermodal on the road – step 3 (extract) – alternative routes for one trip <door-to-door>

Within step 3 the Digital Concierge accompanies the traveler along the entire journey (see Fig. 12.7). The same accounts for the proxies in case they have been defined and configured for the traveler.

The Digital Concierge ensures a flawless and smooth travel experience, regardless of the type and impact of incidents or exceptions. Even more, the Digital Concierge supplies the traveler with social and business contacts in a purpose driven and theme oriented manner. The Digital Concierge links in where social networks often end for travelers: experienced and inexperienced travelers expect to receive theme and purpose driven guidance and suggestions, and moreover the chance to turn the trip where possible into a positively surprising experience before, during, and beyond travelling.

Outdoor and Indoor Navigation The digitization of buildings and the increasing capture of internal pathways and spaces are judged as groundbreaking as the digitization of streets and road networks and the resulting business segments of map providers and information service providers.

The map is the clue to better orient pedestrians and to bundle road related services for autonomous driving. The map is the digital base that gives optimal orientation, seeking geographical entries and exits, or proposing an elevator or escalator nearby, following the Digital Concierge's recommendation.

In addition, landmark mapping is a critical BIM, too. External landmarks whether they are signature buildings, sites, and orientation points such as well-known fashion stores, supermarkets, or top spots all accommodate a traveler's need to orient himself in an unknown territory externally as well as in internal spaces.

The entire field of outdoor and indoor navigation concerning Smart Services is interacting with the *Smart Spaces* area of the BIM. A detailed depiction of navigation trends and requirements can be found in Chap. 9.

Mobility Diagnostics Next to Big Data proceedings and the supply and processing of data sources of diverse formats is as essential, further BIM is the provisioning and use of software relevant development kits (*Software Development Kits, SDK*s) and data related development and processing kits (*Data Development Kits, DDK*s). Pre-configured entry gates will offer access to data source providers and data streamers to issue further application processing. Service providers could, for example, rely on tools for data quality checks, data assurance and security measures, as well as tools to remove error prone, outdated, and irrelevant entries.

Data influence the logic and scope of the perceived prediction to target mobility services. One application area is the matchmaking of the itinerary of a spare part with the specialist and the to-be-prepared targeted operating site with onsite personnel, pathways, and available time slots for the exchange.

So-called in-app offerings, where an application is being called in within a running operation, benefit from continuous data analytics processing. Referred to as *application embedding* the system knows which applications and services should be offered in parallel to the started ticketing purchase. Data thus link applications and serve as the glue binding distinct providers, to the benefit of the consumer.

Next to application embedding, a consumer is empowered to use his applications and services while switching devices. This kind of *application sharing* is relevant to a traveler when starting an operation at the desktop and seeking to continue when exiting the office and entering a taxi or train compartment that is being reserved for company employees, and offers access to the company's virtual private network.

Already to date, data are being offered as a critical resource to give credit to newly established business models and facilitate disruptive offerings. One example is the transit travelers' behavior making use of public transport. Another one is booking an annual subscription for family car-sharing. Data triggered services resonate through the build of data capacity and behavioral reasoning in the phase of free of charge offerings and the transformation into data-injected predictions in the market expansion phase. At the point of having enough capacity, a second transformation step happens: the chargeability of add-on

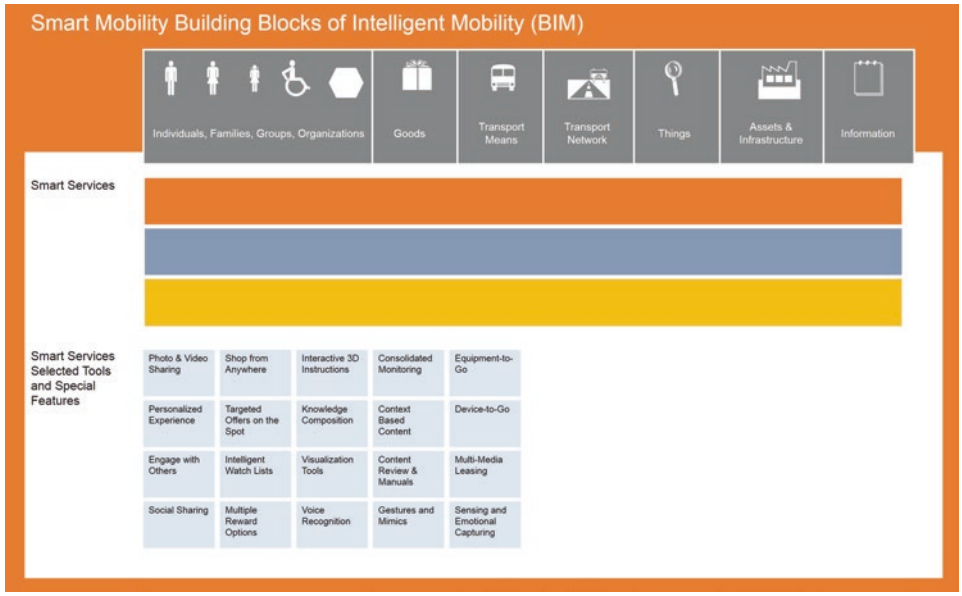

Fig. 12.8 Smart Mobility services – selected tools and features

features. To what extent will the business model reasoning change once the consumers as ultimate data providers ask to get reimbursed for the provisioning of behavioral statistics? This question remains pertinent to the pressing aspects of sustainable business modeling.

Selected Tools and Special Features In this category, as outlined in Fig. 12.8, a number of tools and functions are clustered. Those stand for a plethora of offerings for private consumers. More and more these offerings find entry in the business environment.

12.3 Smart Data

The *Smart Data layer* (see Fig. 12.9) comprises data provisioning, data assurance, and analytical offerings as well as data hub design and data hub operations. Next to these elements the Smart Data layer is the home of the *Smart Mobility data model*, organic data modeling, and the tagging of applied infrastructure and assets.

The *Smart Mobility data model* unifies all personae, things, means of transport, routes, and new forms of information and data carriers that will merge into Smart Mobility processing. The development of using new forms such as wearables or textiles, and the resulting new kind of data mediators, force the dynamics of the data model.

With respect to tagging, you need to decide how long a thing or an element needs to be registered and administered. Starting with a size of one hundred million tags for one

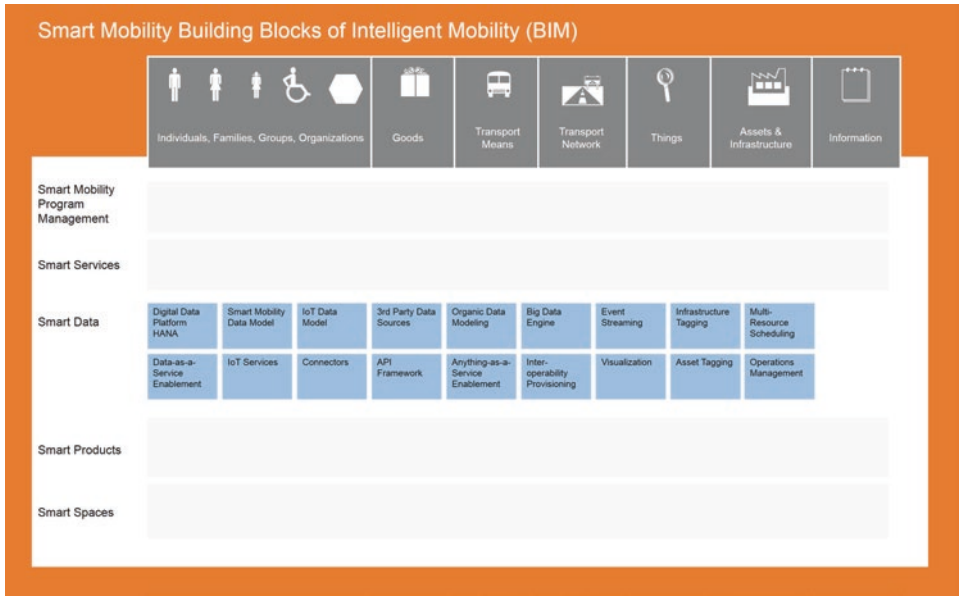

Fig. 12.9 Smart Mobility Data

ecosystem and the shelf life of one medium, through changing habits a discussion around de-archiving registered things has begun. It concerns questions like: Does de-archiving become part of the governance framework of businesses? Should all registered assets become replicable, retraceable, and evaluable over months and years – in relation to the company's internal and legal frameworks?

12.4 Smart Products

Within *Smart Products* (see Fig. 12.10) all physical products that contribute to an ecosystem functioning are digitally captured, categorized, and administered in the form of a *cadaster*, then evaluated and maintained. Examples of physical products are means of transport, traffic lights, light poles, bridges, and parking garages. In addition to the product related capturing of products, further characteristics such as frequency of use, construction condition, and contextual use should be added. The last one refers to the role the product plays in the context of mobility: being a facilitator, being a navigation element, or being for example a product-in-flux that changes its condition based on utilization and the means of transport. Similar to the described contextualization of products, the augmented asset capturing applies to the physical road management and transport related system such as streets, railways, water ways, and air space. The last one tends to be looked at from an airport functioning perspective. Another viewpoint is emerging through the use of air space in cities.

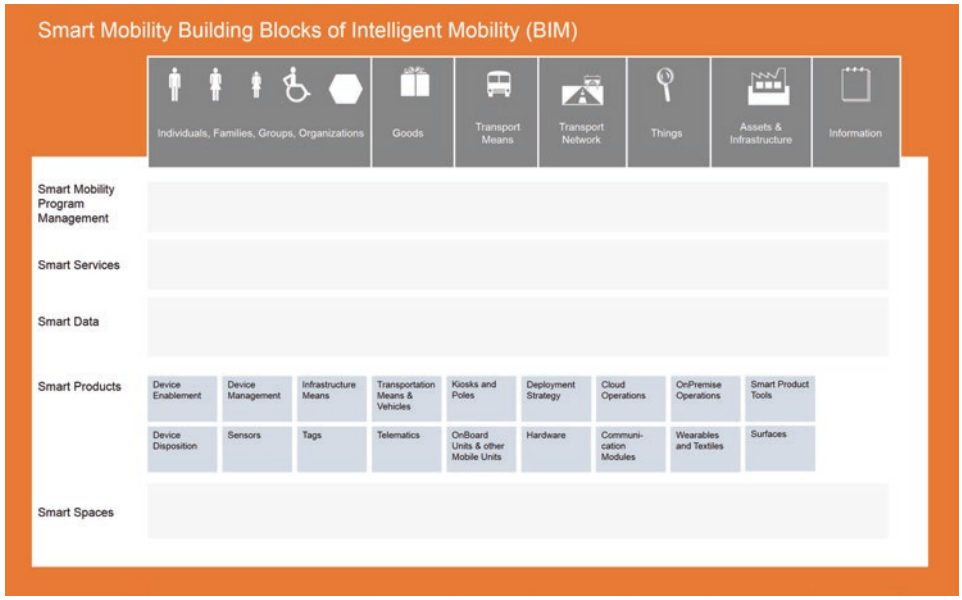

Fig. 12.10 Smart Mobility Products

Devices and communication media such as onboard units in vehicles and telematics are part of Smart Mobility products, too. Furthermore we add sensors, beacons, wearables, and textiles. In the near future, further connected things and chained elements will expand the registry of Smart Mobility. The latter aspect asks for an open and adaptive management of the cadaster.

Next to device management, device enablement and maintenance tasks such as exchanging data and information providers account for the removal of outdated and unnecessary elements.

12.5 Smart Spaces

The mapping of physical and digital spaces and its management is subject to *Smart Spaces* (see Fig. 12.11). Smart Spaces embrace all elements that were assigned to Smart Products, Smart Data and Smart Services as well as resources such as energy, water, and connectivity.

Here we introduce the concept of *ecosystem resourcing*. Ecosystem resourcing denotes the process of equipping the habitat with life essential, operation relevant, and functional resources. Thus the process of turning the habitat into a self-contained functioning system is factored in.

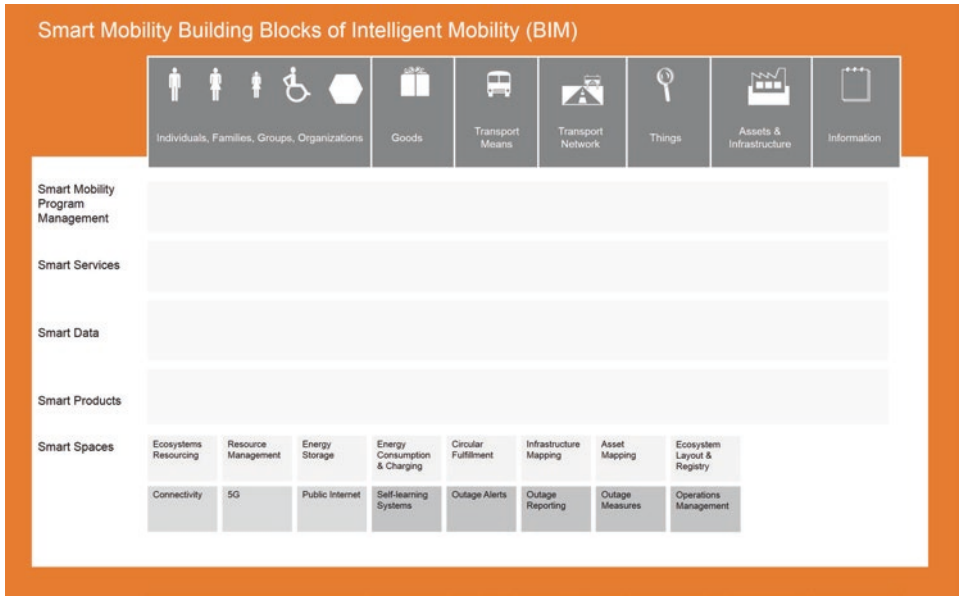

Fig. 12.11 Smart Mobility Spaces

In the case of missing resources or backlogs in the supply and distribution chains resulting from contingency measures or natural disasters, the risk increases for the individual. Smart Mobility offerings function only with premeasures and operation concepts that are in place to combat connectivity outage in the field of telecommunications, energy provisioning, or climate related interferences.