Data Marketplaces in Smart Cities

Trend Report 2013/2014

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Veronika Gamper · Stefan Nothelfer (Editors)

Data Marketplaces in Smart Cities

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Class 2013 Fall

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The Center for Digital Technology and Management (CDTM) is a joint institution of the Technische Universität München (TUM) and the Ludwig-Maximilians-Universität München (LMU). This report was created by CDTM students and is part of a project cooperation with T-Labs. The CDTM is part of the Elitenetzwerk Bayern.

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Preface of the Editors

"Everybody can learn from the past. Today it is important to learn from the future."

As the statement by Herman Kahn, one of the founding fathers of modern scenario planning, nicely states, it is tremendously important for strategy and policy makers to get a deep understanding of possible future developments in order to be prepared for them.

We will give a brief overview on the approach behind the creation of this trend report, which involved the creation of future scenarios and the development of innovative product and service ideas. This approach has been developed and refined over the last thirteen years in over twenty projects. The goal is to create trend studies and business ideas in the field of information and communication technologies (ICT). Thereby, we rely on a tight cooperation between industry partners and academia. Combining the creativity and external view of interdisciplinary participants from academia with the knowledge of larger corporations, the outcome are long-term foresights and innovative ideas on how to prepare for emerging challenges in a certain field and product and service ideas that may solve future needs. Recent industry partners were large corporations, for instance Siemens AG, Telekom Innovation Laboratories and BMW AG. Topics were diverse, ranging from Smart Grid Infrastructures and Ambient Assisted Living Technologies to Urban Mobility Concepts.

The Trend Seminar at CDTM is a university course with around 20-25 selected students of various disciplines, such as business administration, economics, computer science or electrical engineering that work on a relevant topic related to ICT. After the topic has been defined, it is broken down into smaller modules, that are then worked on by smaller, interdisciplinary teams.

The course stretches over seven intense weeks, fulltime, during which the participating students dive deeply into the new topic. Thereby, they apply the knowledge they bring along from their main studies and extend it by extensive research. They learn and apply new methodologies, conduct trend analyses, design future scenarios and develop business ideas for innovative products or services.

The Trend Seminar is structured into three phases: The Basic Phase, the Scenario Phase and the Ideation Phase.

In the Basic Phase, the class is split into five teams that look at different aspects of the overall topic. Following the STEP approach, the status quo and trends in the fields of technology, society, economy, politics, law, environment and business are analyzed. Knowledge is gathered by literature research, preceded by a series of input presentations by industry experts, held by our project partner or other organizations. At the end of the Basic Phase, teams present their key findings to each other in order for everyone to get a holistic view on the topic to build upon in the following phases.

The following Scenario Phase starts with a two-day workshop. Participants work in four teams, newly formed in order to have experts from every subtopic of the Basic phase in each new Scenario team. Within the workshop driving forces for the overall topic are identified and structured. Two key drivers are identified, which span a matrix of four different future scenarios of approx. fifteen years ahead. The scenarios as well as possible timelines to these diverse futures are sketched out within the workshop. After the workshop, each team elaborates a vivid view of the life in one of the four scenarios.

In the third phase, the Ideation Phase, participants are again regrouped into new teams. The goal of this phase is to develop innovative business concepts, which are then tested against the previously developed scenarios. The phase starts with a two-day workshop on ideation methods. Based on the work by Jacob Goldenberg, Roni Horowitz, Amnon Levav and David Mazursky, the applied ideation methods are a structured way to develop new products or services. At the end of the workshop each team is equipped with a broad set of ideas. Out of these, the most promising five ideas are selected and further developed into detailed business concepts. The business model canvas, developed by Alexander Osterwalder and Yves Pigneur, serves as base structure. At the end of the seminar, the business model concepts are presented to the project partner and guests.

We would like to take the opportunity to thank several people who made this CDTM Trend Report possible: We want to thank Ernst-Joachim Steffens and Joachim Schonowski at our project partner Telekom Innovation Laboratories, who helped to define the topic and scope of the project and, together with their colleagues, provided great insight into current trends and future developments in the field. In addition, we would like to thank all lecturers for providing valuable input and contributing the Trend Seminar's success. Their expertise and motivation always result in a great lecture atmosphere and excellent outcomes. Finally, we want to say special thanks to the CDTM students of the class of fall 2013. They put an enormous amount of energy and enthusiasm into this project, which made it a pleasure for us to supervise the course and coach the individual teams.

We hope you enjoy reading up on the results of this trend report and maybe get some inspirations on the future development of data marketplaces in Smart Cities.

Veronika Gamper and Stefan Nothelfer
Center for Digital Technology and Management

Preface

„Data is the oil of the 21st century" indicates an interesting comparison between a physically defined substance and the digital space. While both are either used in their raw or in any converted version there is a fundamental difference: oil is a scarce and data is an increasingly available resource. Due to the current oil dependency of modern economies, much of the innovation effort is dedicated to improve the exploration, exploitation and consumption efficiency. The amount of data being generated all around the globe, however, is steadily increasing, and likewise do the processing and storage capabilities on countless IT systems. Real time traffic data is used already, e.g. in the Smart Port Logistics pilot at Port of Hamburg and in future mobility concepts to reduce fuel consumption and costs. All flavors of Data like Big-, Open-, Secure- and Private- and especially the mixture of different Data flavors are coupled with an increasing importance and dependency in various user scenarios in the private, business, governmental and global area already. But besides increased efficiency at business or enhanced convenience on an individual level, there is also a direct or indirect economic value attached with Data.
While the oil and oil-consuming industries face their challenges mostly at the ends of the value chain, data-centric business needs to focus on thoroughly closing gaps at intermediary value chain – or rather value network –nodes:

- Which data flavors exist, who "owns" them and which usage scenarios are hidden? Which data or data mixture provides which value for which application in which context?
- Is there one or are there different value chains or frankly "Where is the money?" Which are appropriate commercial models for data-centric business?
- Which governance is needed, in terms of ownership, privacy, quality, liability . . . ?

Besides usage scenarios, new service ideas or economic value, another important question is, "Where and how can, for their mutual benefit, data providers and data consumers get together? Data marketplaces denote a generic concept to do so. Embracing sellers and buyers of data to get in touch and finally do business with each other, they need to accommodate the whole customer journey from a first visit driven by curiosity or already by a dedicated need, to closing of the transaction and finally providing user feedback and rating. Smart data marketplaces may add value-added functionalities such as data analytics - hiding complex data processing - or data quality management. State-of-the art information and communication technology such as connected things, smart devices, seamless connectivity infrastructure, cloud computing and big data processing platforms play an important role bringing this vision to life.

From an economic point of view, these Smart Data Marketplaces bear the potential for significantly increased or even futuristic service offerings and totally new business. The ongoing worldwide trend of urbanization leads to Cities or Megacities, which require new innovative service concepts. In order to transform to “Smart Sustainable Cities” data becomes the fuel or even their operating system.

Therefore Smart Sustainable Cities provide the perfect playground for doing the exercise of trend analysis, scenario planning and product ideation with respect to Data and Data marketplaces as anticipated in the “trend seminar” format, being part of our fruitful cooperation with CDTM.

- A Smart Sustainable City enables a convenient, efficient and sustainable life-style for the citizens.

- They depend on a variety of different data flavors in static or real-time formats to manage and further develop such a complex organism.

- Data can be utilized from a variety of sources, ranging from individuals over private households, business and administration & politics. They require a resilient and secure ICT backbone couple with a Smart Data Marketplace to control, manage and mash the heterogeneous landscape of a City in terms of mobility, economy, environment, economy, living and people. There is a constant need to improve. Urbanization is a stable trend, and limited physical resources urge to improve convenience and efficiency on (IT-) service level in order to maintain or augment quality of life in city regions.

For Deutsche Telekom Innovation Laboratories, responsible for corporate innovation within Deutsche Telekom Group, data marketplaces in smart sustainable cities are of highest interest, from a technical, service and economic perspective.

Therefore we proposed this innovative and important topic for this trend seminar. It was a real pleasure for us to work with such a highly motivated and engaged student team. We jointly went through a couple of preparatory sessions opening the path to the profound results documented in this report.

In addition we would like to thank the program coordinators Veronika Gamper, Stefan Nothelfer and Michael Schadhauser for the joint preparatory work, perfect organization, highly professional and also very pleasant atmosphere throughout the seminar.

Joachim Schonowski and Ernst-Joachim Steffens,
Telekom Innovation Laboratories

The entire trend report was written by CDTM students under the close guidance of research assistants in 2013. The papers compiled here do not claim to be scientifically accurate in every case; they are rather meant to give a structured and broad overview of trends relevant in the context of Data Marketplaces in Smart Cities.

For more information about the CDTM and its related projects,
please visit http://www.cdtm.de

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Abbreviations

API	Application Programming Interface
BidCoS	Bidirectional Communication Standard
BMP	Bitmap
CAN	Controller Area Network
CAP	Common Alerting Protocol
CSV	Comma-separated values
EIB	European Installation Bus
ETSI	European Telecommunications Standards Institute
GIF	Graphics Interchange Format
HMI	Human-Machine-Interface
I^2C	Inter-Integrated Circuit
IEC	International Electrotechnical Commission
IP	Internet Protocol
JESSICA	Joint European Support for Sustainable Investment in City Areas
JPEG	Joint Photographic Experts Group
JSON	JavaScript Object Notation
M2M	Machine-to-Machine
NIEM	National Information Exchange Model
NSA	National Surveillance Agency
OT	Operational Technology
PNG	Portable Network Graphics
PPP	Public Private Partnership
SMARC	Smart Mobility Architecture
USB	Universal Serial Bus
XBM	X BitMap
XML	Extensible Markup Language

Part I

Trends

1 Chapter 1

Technology Trends

Simon Fakir, Raoul Friedrich, Ljudmila Ivanova, Alexander Preißner

Executive Summary

In tomorrow's Smart Cities, intelligent devices will be omni-present and integrated in an all-embracing network. Cloud services will play a key role in connecting and controlling these devices. To further improve, cloud solutions will increasingly integrate other services and make use of open data. This will intensify the interaction between different cloud service vendors, resulting in the need to use unified interface standards which enable data exchange among platforms. The Internet of Things will represent a central information source for data marketplaces, while increasing Machine-to-Machine-communication will further automate the coordination of data flow. A last crucial aspect of Smart Cities will be the integration of enhanced analytic capabilities, including real-time and predictive analysis.

Intertwined in a web of all aforementioned technologies, data marketplaces will emerge as a central hub for data management. This interconnected network will deliver the necessary information logistics to bring the "smartness" into future cities.

1.1 Introduction

In 2013, each day about 5,000 terabytes of data are generated. This data bears valuable information about different parts of our everyday life. Left isolated, it delivers only fragmented insights that are hardly usable on their own. However, combining information from different sources on a centralized data marketplace would allow the extraction of additional layers of intelligence from the otherwise single-sided data. In the context of extreme urbanization and resource scarcity in today's cities, the promise of such data marketplaces gains ever growing importance.

In order to tap into these potentials, various technologies are needed to collect, store and process data efficiently. An essential source for collecting information represents the increasing number of internet-enabled devices in today's modern cities. Combining the information from different sources and utilizing it for various users is a further challenge. It necessitates the introduction of unified interface standards and requires a scalable and elastic infrastructure to store the vast amounts of gathered data sets. Since Smart Cities demand real-time insights, clear customer benefits can be offered by quickly analyzing the joint data in a centralized marketplace. An analysis of the current situation and important trends in the mentioned technology fields is therefore crucial for the establishment of data marketplaces.

In this chapter we address the challenges around collecting, combining, storing and analyzing data in marketplaces in two sections. The first section outlines the current situation and respective limits of the main technologies that underlie data marketplaces in Smart Cities. The second section addresses the identified trends within these fields and gives further insights about their development.

1.2 Status Quo

In order to better understand the challenges and opportunities that data marketplaces in Smart Cities face, the status quo of the underlying technology issues has to be carefully analyzed. The following section describes the foundations of ubiquitous data collection that is fostered by the current proliferation of internet-enabled devices. Next, the current state of relevant cloud computing and technical standards developments is reviewed. Finally, advancements and obstacles in the area of data processing are outlined.

1.2.1 Basis of the Internet of Things

The Internet of Things (IoT) is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment [30, p.34]. As of today, over 17 billion devices are connected to the IoT which has increased rapidly from 500 million in 2003

[15, p.3]. These connected devices are a great source of valuable data and allow many technologies for future Smart Cities to develop. However, to enable ubiquitous computing, all devices and systems need to be interconnected and integrated into an omnipresent network.

This section outlines the current status of objects in the IoT and its impact on Smart Cities and data marketplaces.

The most important key factor for the distribution of intelligent objects, which is expected to be 50 billion by 2020 [15, p.3], will be power consumption of the technologies [29, pp.3–7]. New trends in regard to this factor are wireless networking technologies, data management, embedded operating system platforms, power supply and storage technologies as well as processors [29, pp.3–7].

The biggest challenge for ubiquitous computing is the power consumption of data transfers. Therefore, technologies, such as longer-range sensors and mesh networks, are being developed.[29, pp.3–4] In addition, to avoid unnecessary data transmissions to a central server, the idea is to keep the data in sensors and only transmit it upon request [50][10][33].

Second, another factor remains the battery itself. Despite several years of battery life, it is sometimes difficult or simply inconvenient to replace batteries (e.g. subcutaneous medical sensors) [42]. Solutions for the battery charging issue will be higher-power dense batteries using silicon anodes [6], power harvesting from thermal sources or ambient electromagnetic radiation and wireless charging [46].

In addition to the energy improvements that will allow more efficient usage of different internet-enabled objects within a Smart City, there will be dramatic hardware changes which allow to increase the distribution and density even further. One example is the University of Michigan's Phoenix chip, which is a breakthrough in size and power consumption [45].

In the next years, the already low price for computing products, such as the Raspberry Pi [21], will continue to decrease and hence enable creating inexpensive, but sophisticated controllable and autonomous things. Along with the previously introduced technology trends, the number of things participating in the IoT will increase tremendously [15, p.3].

Impact on data marketplaces in Smart Cities

As a result a lot more data will be produced by the tremendously increasing number of sensors and other significant objects in the IoT which is the most important foundation for data marketplaces.

However, the trend of on-premise data storage for improved power consumption of sensors makes it more difficult for a data marketplace to gather information and will be a challenge for the future [29, p.4].

Machine–to–machine (M2M) communication services are used for automated data transmission and measurement between devices [30, p.69].

Today, the majority of communication is human–to–human or human–to–machine. Nevertheless, with the increasing distribution of addressable objects forming a IoT and by far outnumbering humans, it is clearly foreseeable that this communication will shift towards M2M. [49, p.376]

Although the idea of allowing many devices to act together rather than each device acting on its own is not new, it has started to thrive only thanks to the rise of ubiquitous computing associated with the decrease in device costs and sizes. [54, p.37]

Along with the expansion of M2M, significant technical challenges will occur. To prevent a major security breach in a broad network with billion of devices, new solutions like “security–on–chip” are being developed. In addition, it is crucial for the growth of the IoT and M2M systems that new devices are simple to install and integrate into the network. Thus, plug-and-playable M2M solutions are mandatory for a broad acceptance of IoT technologies. [54, p.37]

Impact on data marketplaces in Smart Cities

The huge amount of objects surrounding us in everyday life produces a high number of data, especially when they are interconnected via M2M communication. This is a great data source for a data marketplace. In addition, M2M communication enables various different applications, like car–to–X communication where cars may react on real time street information to prevent accidents [17, pp.21–22]. These applications produce a high demand of data because they rely on real time data sets collected, analyzed and then distributed by a data marketplace. Furthermore, a data marketplace could be a link in a broader M2M communication chain, e.g. several Smart Cities could exchange strategies on how to save energy best in a certain situation.

1.2.2 Fragmentation in cloud services

The already well established concept of cloud computing, i.e. delivering scalable and elastic IT-enabled capabilities as a service over the Internet, lays the foundation for a truly Smart City [30, p.80]. On the provider side, a plethora of specialized cloud services has emerged and gained substantial ground as enabling force for a variety of Smart City solutions [3, p.2].

Still mainly fragmented, the different types of the specialized cloud services do not yet provide an optimal setting for the data exchange or aggregation that is essential for data marketplaces. Further limiting the current impact of cloud technologies is the dominance of the on-premise model for data storage and computing power provisioning [7, p.10].

1.2.2.1 Dominance of on-premise data and computing power

In recent years cloud services have gained substantial popularity in a business context. The share of organizations using or planning to use cloud computing, for example, has risen from 30% in 2010 to 59% in 2012 [55, p.24]. Consumers already enjoy ubiquitous access to their outsourced or backed-up files as well as media content through established cloud solutions such as Dropbox, iCloud or Netflix. However, cloud storage services are optimized first and foremost for large read-only files, long-term storage and geographically shared files and less so for transactional and active corporate data that requires frequent modification or advanced protection [39, p.4]. Considering the dominance of the latter file types, it is understandable that the installed computing resources in traditional, non-cloud data centers still prevail [48, pp.5–6].

1.2.2.2 Specialized and encapsulated services

The cloud solutions landscape in the field of Smart Cities is still rather fragmented, with a variety of stablished specialized services that cover narrow sub-areas [25, p.13]. Advanced products for customer relationship management (e.g. Salesforce), fleet management, energy consumption, massive open online course portals or electronic health records management are already adopted in many parts of the world. The solutions for different Smart City areas are barely interconnected yet, leaving thereby further coordination and business intelligence synergies untapped.

1.2.3 Incompatible standards

Today's cities are not yet smart, since the previously mentioned technological systems are indeed widespread but lack access to information [12, pp.8–10]. Comprehensive communications and data exchange are indispensable to provide this information [30, pp.39–40]. The plurality of interfaces and low data format compatibility are two major issues causing difficulties in doing so. They are further driven by technology vendors' pushing proprietary solutions onto the market [27, p.1][30, pp.39–40].

1.2.3.1 Plurality of interfaces

Today's plurality of interfaces on hardware and protocol level inhibits the setup of a comprehensive data exchange network, which is a major component of Smart Cities [30, pp.39–40]. Often mutually incompatible interfaces or protocols tackle the same issue causing difficulties when systems need to be interconnected or replaced. For example, CAN, I^2C, RS485 and EIB are all fieldbusses which have deviating specifications, even though they are mainly used in the same industries [56, p.VII-8]. Additionally, on the physical layer, for example USB, Firewire, and Thunderbolt use mutually incompatible connectors [28, p.1][37, p.3].

Manufacturers developing proprietary solutions in their own interest slow down the Smart City development. For instance, the home automation product manufacturer eQ-3 developed the exclusively used BidCoS radio protocol [13]. Despite the availability of mature industry standards, a lot of isolated solutions exist which prevent the development of a comprehensive M2M network [30, pp.65–72].

1.2.3.2 Low data format compatibility

The variety and coexistence of open and proprietary file formats complicate data exchange and hence defer the development of Smart Cities. Even in the narrow field of word processing, for example, open file formats such as OpenDocument Text Document and proprietary file formats such as Microsoft Word Open XML Document and Apple's Pages Document exist in parallel without being compatible [18].

1.2.4 Complex data handling

The modern way to gather information is to analyze data, extract patterns and draw conclusions about the future. Increasing numbers of IT systems produce more complex data, challenging the technology to handle it in a sensible way [26, p.1]. The massive generation of data, analysis on isolated data and time-intensive extraction of valuable information are expected to foster the development of smart cities and are described in this section.

1.2.4.1 Massive generation of data

The origin of the frequently mentioned "age of data" is the massive generation of data. Researchers and practitioners recognize volume, variety and velocity as its key characteristics [41].

In 2012, each day "5 exabytes of data are created [..] and that number is doubling every 40 months" [34, p.4]. This means that 90% of all information humanity has ever stored was created within the last two years. This data comes from a variety of sources and therefore differs from classical analytical data [34, p.5]. Another characteristic of massively generated data is high velocity. It refers to the challenge of handling a constant stream of data. An example for a high velocity data stream is a jet engine, which generates more than 300 gigabyte of data per minute [11, p.3]. In order to extract useful information from this data, technologies able to handle their high volume, variety and velocity are needed.

1.2.4.2 Analysis on isolated data sets

The common approach in data mining is to find correlations within a given data set. Currently companies perform analysis on isolated data sets from their own data warehouse. For example business intelligence software providers, like SAP, also primarily focus on the optimized usage of customers' internal data [44, p.10]. Nevertheless, start-ups have pioneered feeding data warehouses with market prices of competitors in order to quickly react to price changes [2]. However, the analysis on a combined data set of external and internal data has not reached the main stream yet.

1.2.4.3 Time-intensive extraction of valuable information

There are some applications where data-intensive mining is very common. A well-known example is the weather forecast which is generated by this technique in order to simulate the world's environment on large-scale systems [35, p.108]. Today these calculations are executed in slow and human-triggered processes, because software stacks "are unable to provide reasonable response times in handling expanding data volumes" yet [23, p.42]. Thus, the reaction times are a major limitation for the data analysis applications in Smart Cities, especially if instant responses are essential or dynamic condition changes are likely.

1.3 Trends

Building upon the outlined status quo, central technological trends that influence the development of data marketplaces in Smart Cities can be identified. First, based on further advancement and distribution of the technology described in 1.2.1, the emergence of an Internet of Things can be observed and is further discussed in 1.3.1. Following, the trend towards omnipresent cloud computing that offers increasing storage and computing capabilities and overcomes the fragmentation of services is presented. This section then concludes with an analysis of the increasing interface standardization and growing capabilities for Big Data analytics which will further shape the future of Smart Cities and data marketplaces.

1.3.1 Internet of Things

One of the foundations of Smart Cities is the ability to collect data from as many objects and devices as possible. This section describes the technology trends to foster the distribution of devices forming the IoT, challenges and their impact on data marketplaces in Smart Cities.

1.3.1.1 Convergence to ubiquitous computing

The most important factor for the distribution of intelligent objects, which are expected to reach 50 billion by 2020 [15, p.3], will be power consumption of the underlying technologies [29, pp.3–7]. New trends in regard to this factor are wireless networking technologies, data management, embedded operating system platforms, power supply and storage technologies as well as processors [29, pp.3–7].

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1.3.1.2 Increasing machine-to-machine communication

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The huge amount of objects surrounding us in everyday life produces a high number of data, especially when they are interconnected via M2M communication. This is a great data source for a data marketplace. In addition, M2M communication enables various different applications, like car–to–X communication where cars may react on real time street information to prevent accidents [17, pp.21–22]. These applications produce a high demand of data because they rely on real time data sets collected, analyzed and then distributed by a data marketplace. Furthermore, a data marketplace could be a link in a broader M2M communication chain, e.g. several Smart Cities could exchange strategies on how to save energy best in a certain situation.

1.3.2 Omnipresent cloud computing

Cloud computing offers a critical model for how to store and process the core information for Smart Cities and is therefore said to have the potential to truly transform the business environment [30, p.9]. Growing cloud storage and computing capabilities will boost a variety of scalable technology offerings in different areas of Smart Cities. On the application level, specialized cloud services are increasingly consolidated in comprehensive systems and product encapsulation is being replaced with a network of interfacing solutions. These will be able to provide enriched, more insightful input for data marketplaces.

1.3.2.1 Increasing capabilities for cloud data storage and computing

The current model of on-premise data storage and computing power provisioning is increasingly shifting to the cloud. By 2016 nearly two-thirds of all data center workloads will be based in the cloud, replacing traditional, non-cloud data centers as the main point for data processing (see fig. 1.1) [48, pp.5–7]. Here a workload defines the amount of processing a server undertakes to run an application and support a number of users interacting with the application [48, p.5]. The rising capabilities for cloud-based data storage and processing will make more areas of today’s cities smarter. As exemplified by Munich’s SuperMUC high-performance computing center, cloud-based facilities will be shared among different institutions with computation-intensive research needs [9]. Furthermore, IBM has introduced a low-cost shared cloud computing environment for local and regional governments which will accelerate the development of smart governance

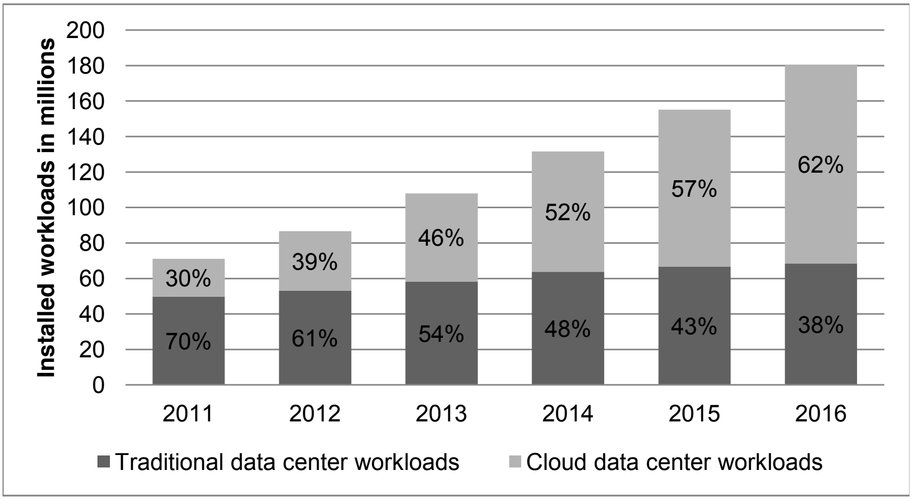

Figure 1.1: Distribution of data center workloads (2011-2016), own illustration adapted from [48, p.5]

[52]. Consumer technologies, too, will undergo a transition towards cloud-based storage and computing. “Thin client” personal computers will, at least partly, replace the established on-premise mode. Google’s Chromebook laptops, with their cloud-based operation system, file storage and data processing, are already pioneering this field. [51]

Impact on data marketplaces in Smart Cities
First, the increasing capabilities in cloud-based data storage and processing can be utilized by data marketplace providers for their own resource needs. Second, the transition from local to online storage of files means that new valuable sources of information will become more easily accessible, thereby expanding the breeding ground for data marketplaces.

1.3.2.2 Meshing and expanding cloud services to comprehensive solutions

Another trend in the area of cloud computing is the continuing expansion of single services to comprehensive solutions as well as the meshing of different cloud services.

First of all, more and more providers of specialized cloud solutions will cover wider areas of Smart Cities with product packages encompassing extensive parts of the transportation, utilities, education or healthcare system. In the field of water utilities, for example, stand-alone solutions for water consumption control or quality management, smart water meters and remote water sensors in dams and levees are already established. These products will evolve towards integrated water management systems that consolidate the previously fragmented data points and tools to manage and control a variety of issues. [30, pp.52–54]

Next to becoming more comprehensive in their application scope, tomorrow's cloud-based solutions for Smart Cities will also be more interconnected. First examples come from the area of integrated and open building automation and control systems, which integrate and optimize the management and control of heterogeneous building infrastructure equipment. By meshing different solutions, a variety of building functions can be controlled centrally (e.g. heating, access controls, on-site energy generation). [30, pp.65–66]

Impact on data marketplaces in Smart Cities

The trend towards more comprehensive cloud solutions will enable major providers to aggregate big amounts of data on site. Hence, these companies could easily establish themselves as key information suppliers for a data marketplace.

On the one hand, this would reduce the transaction costs for data marketplace operators, which would have to deal with fewer data brokers. Moreover, the meshing of different cloud services means that their providers already utilize complementary information inputs. Therefore, their data will feature an additional layer of intelligence even before it is submitted to a data marketplace.

On the other hand, companies with comprehensive cloud-based solutions and infrastructure that can act as a data aggregator will be favorably positioned for an entry into the data marketplace business on their own. This bears the potential to create complicated modes of coopetition between data marketplace operators and major suppliers of comprehensive Smart City solutions.

1.3.3 Interface standardization

As mentioned in 1.3.1 Smart Cities are based on the linking of all network-enabled devices. Interface and data exchange file format standards are key for the interoperability of devices, data representation, exchange, aggregation and flexibility. Thus, standards will play an important role in the development of Smart City models [12, p.2]. In this section the reduction and consolidation of intra-industry standards as well as the development of cross-industry standards are described in more detail.

1.3.3.1 Reduction and consolidation of intra-industry standards

Smart Cities will be based on the Internet of Things and M2M Communications [30, pp.69–72]. These technologies require common interfaces and industry-wide standards for data connections. To provide them, consolidation and standardization efforts will be promoted, partly in specially founded joint organizations. The European Telecommunications Standards Institute (ETSI), for example, is dedicated to worldwide telecommunications standardization. The

Smart Mobility ARChitecture (SMARC), which "is a versatile small form factor computer module" [19] for the automotive sector, exemplifies the upcoming hardware standardization trend [14].

Impact on data marketplaces in Smart Cities

Operational Technology (OT) denotes technology used for operational tasks, such as roboters in factories. So far, it has been realized stand-alone due to mission-critical demands. The integration of both, OT and IT, will benefit data marketplaces. The data, for example coming from an assembly line, will be increasingly accessible and contain a higher information load. [30, pp.31–34]

Open standards, data descriptions and protocols using IP, like the Open Data Protocol, will emerge [36]. That will expand the potential of data marketplaces, because any application can be easily enriched by information available on the marketplace [30, pp.65–66].

Standardization efforts will simplify the M2M Communications business. The effort needed to collect, combine and distribute data will decline on the marketplace operator side. Vice versa data accessibility and exchange will be facilitated, which promotes new emerging businesses. [30, pp.69–72]

1.3.3.2 Developing cross-industry standards

As described in 1.3.1, devices originating from various industries will connect to each other. For this purpose "establishing a standards-based data model is imperative" [27, p.2] and companies as well as service providers will agree on cross-industry interface and communication standards to ensure networking capability, like ETSI already does for telecommunications [14]. Relating to data marketplaces, agreed upon standard data file formats will emerge and callable services will be adopted progressively [12][4][30, pp.28–30].

Xively - formerly called Cosm - for instance is a platform providing all tools and services needed to create comprehensive products and solutions for the Internet of Things and thus an adequate example of where data marketplaces will develop to. Xively offers an open API and support for official programming libraries based on standards like JSON, XML and CSV. Connections are always encrypted and the user can define fine-grained access permissions. [4]

Impact on data marketplaces in Smart Cities

The establishment of common standards promotes developments like the Smart City Information Architecture and Functional Platform, offering fully-integrated data- and standards-based services for Smart Cities [12].

Cross-industry standards will enable organizations to transform their tightly coupled isolated solutions to modular systems. This will enable the easy setup of a data marketplace, because the physical data representation stored there is independent of the specific user application. [22, pp. 33–35]

Companies will increasingly collaborate through joint organizations meant for standardization, as interoperability will become a competitive advantage. This collaboration will facilitate the enforcement of worldwide used standards and thereby support the setup of a global data marketplace. [14]

1.3.4 Big Data analysis

The public attention has been drawn to the topic Big Data, especially since the Harvard Business Review described it as “the Management Revolution” [34, p.1]. The Gartner research institute has defined it as “high volume, velocity and variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making” [22, p.3]. These sections describe three technological trends with high impact on data marketplaces in Smart Cities.

1.3.4.1 Increasing integration of data sources

Data integration means that data residing at different sources could be linked to an “unified view of these data” [5, p.262]. This trend will develop towards a more integrated use of information over the boundaries of companies and countries. An indicator for this trend is the growing popularity of data marketplaces. For example, the Microsoft Azure Data Market, announced 2010, is now used in 50 countries [8]. Azure Data Market provides data feeds in a standardized protocol called “Open Data Protocol” (OData) [38, p.41–42], which allows companies to integrate this data directly in their applications and processes.

The integration of different data sources is further facilitated by open data providers. The platform open data Bayern provides a collection of public data for further applications [47]. This data could be combined with mobile phone to “help transportation planners and traffic reports” , as exemplified start-up AirSage” [40].

Impact on data marketplaces in Smart Cities
The integration of data facilitates the “ability to forecast and manage urban flows and push the collective intelligence of cities forward” [43, p.434]. In general, the increasing integration of data sources can create synergies realized through the combination of multiple data sources in all Smart City areas.

1.3.4.2 Implementing real-time analysis

Real-time analysis requires that the results are fast enough to respond to real-world events in an effective manner [24]. Also, today’s data consumers have to be able to ”reexecute various steps” [31, p.28] of analysis within short response times. Real-time analytics is described as the processing of “timely and meaningful analytical results” [31, p.27] with extremely fast response. With the falling prices of computational power the number of use-cases for this technology increases. This trend will be seen in an increasing utilization of real-time analysis in classical industries such as manufacturing and leads to a greater importance of data as a competitive advantage.

Impact on data marketplaces in Smart Cities
Real-time analysis is a technological enabler for applications based on data marketplaces and applied in Smart Cities. More precise, before cities become smart, they have to provide real-time data management, alerts and information processing [43, p.435].

1.3.4.3 Enhancing prediction capabilities

Within the next 24 months data-driven predictive analysis in terms of simulation and scenario development is said to become more important than reporting and historic trend analysis [32, p.27].

From a technical point of view prediction comes from classical statistics and is next to segmentation and frequent pattern extraction one of the major data-mining disciplines [1, p.2]. The task of predictive analytics is to develop "the best possible estimate of a system's future" [53, p.46]. With the growing data basis and improving algorithms, the predictions are getting more accurate [1, p.12]. Also cloud services like the Google Prediction API facilitate predictions for smarter software [16].

Impact on data marketplaces in Smart Cities
One characteristic of Smart Cities is to make decisions based on prediction rather than reaction [53, p.42]. Since these predictions require a broad data basis, they foster the demand for data marketplaces. One common use-case of predictive analytics is the future traffic management, which is a serious problem for growing cities. The predictive analytics techniques are expected to "provide a new ability to model and simulate very complex urban systems in real-time" [20, p.XXV]. It is expected that today's urban managers and planners react and make intensive use of real-time dashboards and predictive models [20, p.XXV]. In general, predictive analytics will be seen in several applications within Smart Cities from transportation to security-systems.

1.4 Conclusion

An in-depth research on the topic of data marketplaces within smart cities has revealed four major technology trends that will drive future developments. By increasing the number and interconnection of web-enabled devices, the Internet of Things will represent a main source of data. Cloud computing facilitates the management of all these devices by offering an elastic, scalable and cost-efficient infrastructure. Besides that, the currently fragmented and specialized cloud services will evolve to comprehensive solutions for wider areas of Smart Cities and mesh with other cloud solutions. For realizing the high level of interaction that Smart Cities demand, interface standards are critical. Upcoming reduction and consolidation of intra-industry and development of cross-industry standards will alleviate current incompatibility issues in this field. Thus, different data sources will be increasingly integrated, processed in real-time and predictive analytics algorithms will be easily applied. The aforementioned technology drivers will enable data marketplaces to become a central hub for data collection, enrichment, analysis and exchange within Smart Cities.

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2

Chapter 2

Trends in Society and Customer Needs

Benjamin Haller, Florian Kofler, Diana Babiac, Daniel Herzog

Executive Summary

A growing urban population and an increasingly aging society are two major challenges our society is facing today. To solve these problems, cities must become smarter. As inhabitants form the core of each city, their needs must be taken into account at all times and are critical for a city's evolution. They require convenient and efficient solutions in retail, health and leisure activities, a reliable and punctual transport system as well as secure and easy-to-use communication tools.

Therefor, the status quo in the three sections personal life, mobility and communication is analyzed before relevant trends for the next five years in society and customer needs are identified.

Today, personal life is characterized by a limited usage of technology in leisure time, personal health and homes. People mostly use means of transportation that are not connected to each other or the infrastructure. Communication is predominantly happening via voice or text.

In the coming years, an increasing connectivity and the ubiquity of technology in our personal lives are overreaching trends. Personal analytics, the merging of online and offline markets and the increasing usage of smart home solutions are trends that can be seen in personal lives. There will be a higher demand for innovative mobility solutions like multi-modality, communication between

different means of transportation and shared property. People will communicate more frequently and seamlessly with each other as well as with machines.

2.1 Introduction

With the dawn of Smart Cities, society and customer needs have a decisive influence on the role that data marketplaces will play in the future. Major drivers such as urbanization and increasing amounts of data, combined with technological breakthroughs, provide society with the opportunity to redesign and enhance the way people live.

Within the Smart City context, future developments mainly stem from current needs of the city inhabitants which act both as cells of society and as customers. In practice, the two roles can not be regarded in an isolated way, because of their intertwined nature. It is therefore very interesting to take a closer look at the personal life of city inhabitants as it comprises the essence of both roles. Furthermore, intra-city mobility is another important aspect to be observed in the transition towards Smart Cities. While the increasing urban population poses new challenges, improved connectivity and access to real-time information create new possibilities of redesigning urban mobility. Data Marketplaces, in the context of Smart Cities, have also the potential of facilitating social and human-computer interaction, leading to enhanced communication in general.

Through the lens of customer needs and society, the following chapter will provide an insight into three aspects of smart cities: personal life, mobility and communication. The chapter begins with the description of the status quo for each of those aspects. That lays the foundation for the second part of the chapter which contains an extensive discussion of the trends that will affect the population of smart cities in the next five years.

2.2 Status Quo

Urbanization has increased during the last years, presenting cities with several challenges in order to satisfy their inhabitants' needs. People are now closely living together, communicating with each other as well as with machines more frequently and faster than ever before. Traditional mobility concepts like car ownership and unconnected vehicles are still the prevalent mode of transportation. Dissatisfaction due to noise, congestion and an inefficient infrastructure system forces cities to come up with innovative solutions to fulfill the rising needs of inhabitants for convenient and inexpensive solutions. As society forms the core of a smart city, this part will analyze the status quo of today's society from the previously mentioned points of view.

The status quo section is divided into the three parts personal life, mobility and communication.

2.2.1 Personal life

This section describes the status quo of the society and customer needs with regards to the personal life of the inhabitants and is divided into the four areas leisure time, personal health, domestic surroundings and shopping behavior.

2.2.1.1 Offline leisure time activity

Leisure time of today's society consists of individual activities that can be clustered in two categories: activities with usage of technology, for example playing video games or browsing the internet, and activities without any usage of technologies, e.g. meeting friends or reading the newspapers. Although the internet plays a central role in large parts of our society, almost 50 percent of Germans do not use it more than once a week in their leisure time [128]. Thus, the internet has not reached the leisure time activities of big parts of our society yet. Gaming is the only field in which large parts of our society have changed from offline to online, where users play against their friends and compare their achievements in social networks [88].

2.2.1.2 Loose coupling between actors in the health care system

Customers usually want the best value for the lowest price. Health care systems follow different approaches to achieve that goal. While the German health care system focuses highly on treating ill people, prevention plays a much bigger role in the Scandinavian countries[102].

Patients in Germany usually begin their treatment with a general practitioner, but as soon as a serious illness is diagnosed, they are assigned to a specialist. Usually the patient organizes the transfer by himself, as a consequence there is only very limited information transfer between actors in the health system[118]. For instance pharmacists only receive a prescription stating dosage and name of a medication but no further information such as potential intolerances of patients. Therapists have no direct access to the only comprehensive databases, which are handled by the insurance companies and are mainly designed for administrating money transfers [70].

Prevention and follow-up care programs are very limited within the German health care system, e.g. in 1999 only 10 percent of the adult population over 35 took part in a general health check scanning for cardio vascular problems[104, p. 57]. It is important to note that pursuing the prevention approach is not necessarily linked with higher costs for the customer. Figure 2.1 shows that Germany has the highest relative health expenditures compared to Scandinavian countries [117].

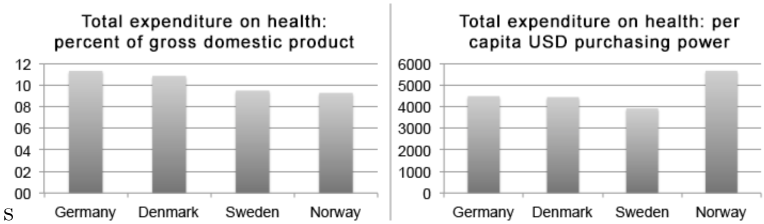

Figure 2.1: Health expenditures in Germany and Scandinavia

2.2.1.3 Limited usage of Smart Home solutions

Today the typical household contains only simple home automation assistants, for instance for of turning off the lights after a certain time, but it does not make use of smart technologies. Even though Smart Home solutions have been offered for many decades, they still play a negligible role in our everyday lives . A main reason for the low distribution of smart technologies are high implementation costs, e.g. customers are required to wire their home or buy expensive hardware to install a remote controlled system for doors[87]. Given the long life time cycle of houses adaption of Smart Home solutions is a tedious process [132].

2.2.1.4 Separated usage of offline and online markets

The shopping behavior of today's society is characterized by a clear separation of offline and online channels. Depending on product type, several articles are rather bought online, e.g. electronics and media, whereas other products are prevalently bought offline, for example groceries and furniture [66]. Although the online market has been growing over the last years, offline purchases still account for 75 percent of total retail spendings in Germany and 81 percent in the EU [68].

2.2.2 Traditional mobility concepts

This section describes how inhabitants move forward today and how they can use connected features to communicate with each other and with the infrastructure. The first section delivers an explanation why motorized individual transport and public transport are still the dominating means of transportation. Afterwards, the status quo of the available connections between the different means of transportation is presented.

2.2.2.1 Motorized individual transport and public transport as dominanting means of transportation

Today, people mainly use motorized individual transport and public transport to move in a city, e.g. to go to work [82, p.65]. A study conducted by Continental AG observing the mobility behavior in Germany, the US, France and China, demonstrates the importance of car ownership for the society. In each of these four countries, between 80% and 83% of the population states that owning a car is very important to them [76]. More precisely, 66% of the population in Germany would buy a car, 10% can imagine using car sharing instead [77]. In May 2013, car sharing is used by an all-time high of 270.000 customers in Germany [67, p.2]. Compared to more than 3m registrations of new vehicles per year, car sharing is still occupying a niche [105].

2.2.2.2 Limited connections between means of transportation

Customers already access real-time information for arrival times or delays of public means of transportation at rail stations or major bus stops, but as the used technology is still too expensive to provide real-time information at e.g. every single bus stop, a lot of means of transportation are still not totally connected with their infrastructure [63, p.1808]. Users of mobility services can partially close this gap by using their smartphones. Applications like Google Maps provide real-time information for different means of transportation for a few cities [95]. Furthermore, mobile applications are available to localize planes or trains of selected networks [127].

Consumers already show interest in connected vehicles. 46% of the U.S. vehicle owners mention that they would like to have access to internet applications inside their vehicles to get most current maps or information about available parking spots [129]. In 2012, 11.4% of all cars are connected to the internet [116]. The difficulty caused by the lack of connection between the vehicles and their infrastructure can be illustrated by the average time spent while looking for a parking spot. In German cities, car drivers spend ten minutes and have to drive 4.5 kilometer on average to find a parking spot [114].

2.2.3 Interaction and communication

In order to design Smart Cities that fully meet the needs of their inhabitants, it is of vital importance to analyze the patterns of communication and interaction within nowadays' society. The first part of the section presents the way people interconnect via technology, while the second part describes their touch points with technology.

2.2.3.1 Technology mediated human-to-human interaction

The channels of interpersonal communication have been greatly enriched the past decade, as in addition to face-to-face communication, other channels such as voice call, messaging and email have become part of daily life. While face-to-face is still the main communication channel, due to the complex media environment, technology-mediated communication is much more used than in the past, with the mobile phone being a primary communication device [133][100]. In addition to the traditional uses of a mobile phone, voice calls and messaging, a large number of people connect to the internet via smartphones with the purpose of human-to-human interaction. 45 percent of smartphone owners use instant messaging and 20 percent use a VoIP app to reach their peers [59]. Furthermore, up to 54 percent of the young people in Britain use the smartphone as a main device to access social media websites [80].

2.2.3.2 Purpose and scope of human-computer interaction

Human-computer interaction is involved in a large share of our daily lives. In 2012, in Germany, people used the Internet for a daily average of 83 minutes, with news and shopping websites being on top of the user browsing preferences [61, p.368][136]. The number of human-computer touchpoints has increased significantly with the use of internet-enabled mobile devices and with the increasing number of applications [115, pp.8-9].

Characteristics and content of user interaction with computers, especially in an online environment, are often archived. This collected data is often referred to as the digital shadow of a person[91, p.47]. On the government level, the digital shadow is being used to acquire information to combat terrorism, prevent crime, but also for future scientific use. On an individual level, this data is used to customize and optimize the interaction with computers. Examples of applications making use of the digital footprint are recommender systems and virtual assistants.

2.3 Trends

The following section uses the same structure as the status quo and describes trends in the three areas personal life, mobility and communication.

First, the increasing availability of personal data as well as the usage of Smart Solutions in home and retail are analyzed. The mobility section addresses the increasing connectivity and sustainability in different means of transportation and the underlying physical infrastructure. In the last section trends in the way that humans communicate with each other as well as with machines are identified.

2.3.1 Personal life

The increasing usage of technology in all parts of our life will influence the society over the next five years. Self-tracking devices in leisure activities and in the health sector, smart home solutions in our homes as well as permanent connectivity across the retail chain will be the major trends throughout the next years. All these trends result in an increasing availability of personal user and contextual data.

2.3.1.1 Increasing monitoring and socializing in leisure activities

Although a large percentage of leisure activities is still performed offline, a growing part of the society starts using internet technologies in activities they previously performed offline. For instance, the number of people playing online-games increased by 58 percent between 2007 and 2012, reaching 14 million users in Germany in 2012 [125][69]. This development is not only limited to gaming. One example is runtastic, a self-tracking app for running and other sports, which already has more than 25m mobile users[1] [134].

These first developments describe a trend called "personal analytics", a practice in which persons use self-tracking tools to constantly measure aspects of their personal life and compare their results to others [83, p.4]. Although the trend of self-tracking has been there for a long time, for instance stepping on scales to check your weight, the emergence of the iPhone in 2007 equipped large parts of the society with sophisticated and omnipresent devices for tracking our personal data [107]. Consumers want to use these self-assessment tools to make more fact-based decisions and find the real "truth" in areas they previously relied on their gut feeling [83, p.3]. One example for personal analytics is the unobtrusive and continuous usage of self-tracking software to measure one's physical activity [101, p.1]. Users easily get information about their personal fitness and can monitor their progress over time. In the future, besides applications in the health or lifestyle sector, possible use-cases might be mood monitoring or measuring social values [83, p.3].

Another aspect of personal analytics is socialization. Instead of keeping individual data private, people are willing to share and compare it online with like-minded people. This will serve people's need for acknowledgement as well as guidance from their peers.

Implications for data marketplaces and Smart Cities:
The unobtrusive and continuous collection of personal data will make the individual life more transparent as it is today. Furthermore, people will be willing to give away more contextual data like their location, personal fitness level and feelings [113]. The availability of such data comes along with certain risks and opportunities. The major risk is data security, which leads to an increased

[1] As of May 2013

customer need for trustful dealing with their information. Opportunities lie for example in the early detection and prevention of injuries resulting from overexercising.

2.3.1.2 Higher cohesion among actors in the health system

Several studies reveal that a growing number of patients and practitioners prefers the concept of "shared decision making for forming their relationship". Additionally there is a negative correlation with age indicating that this might be the future of patient-doctor relationships [84][81]. Even though the fundamentals of shared decision making were developed in the 1970s its broad adaption started only with the arrival of the 21st century [57]. Contrary to more classical approaches like the paternalistic model, in which the doctor decides solely about patients' treatment, patient and practitioner form a team to choose a therapy matching the patients' needs [72]. Otten claims that patients more and more tend to conduct online research about their illness and organize themselves in online forums [119], while Chaudhuri et al. show that this is even true for older patients[73]. These findings indicate a steadily growing need for transparency among patients accompanied by increasing insecurity on the practioners side [119].

Further technical development will also enhance connectivity between actors in the health system[118]. For instance a pharmacist might directly receive the prescription from the doctor. With the additional information customer needs can be satisfied more efficiently, e.g. one could improve the convenience by either having the medication ready for pickup when the customers arrive or directly delivering them to their address. On the other hand, service quality can be improved with the pharmacist being able to choose a medicine specific to the customer needs e.g. considering possible intolerances. Besides increased connectivity on the health care service providers' side there will be also increased information transfer between customer and practitioners. With the increasing distribution of smartphones and more and more customers following the trend of personal analytics,[2] valuable data pools emerge for doctors and researchers to design an optimal therapy for patients[109][92]. Moreover, the associated telepresence[3] opportunities can be used to improve the therapy of chronicle diseases and for setting up effective and cost efficient prevention and follow-up care programs. A possible scenario could be patients self-monitoring their blood pressure after a doctor's appointment. The measurement results are then directly transferred to the doctor and discussed with the patient in a video conference saving precious time and ressources [94].

[2] for more information see 2.3.1.1 personal analytics

[3] for more information see 2.3.1.1the section about telepresence

Impact on data marketplaces in Smart Cities
Offering Smart Health solutions requires customers to share very sensitive data. This obtained data can also be used for improving service quality in other domains. For example, shopping assistants can facilitate the shopping experience for people with lactose intolerance. Customers require the development of reliable and transparent privacy as well as data security concepts before they will adopt these new technologies.

2.3.1.3 Increasing adoption of Smart Home solutions

Smart Home solutions offer costumers the possibility to save ressources, increase their security and improve their quality of live. Like stated before, implementation costs are a main inhibitor of the Smart Home solution development, hence customers request affordable and convenient implementation [132]. A fruitful approach to reduce implementation costs is using existing infrastructure. The increasing availability of affordable smartphones and internet access enables product developers to offer Smart Home solutions at a more attractive pricepoint [75][99]. In fact, a survey conducted by TNS infratest in 2012 revealed that more than three quarters of the German adult population between 18 and 70 are ready to adopt Smart Home solutions [132].

Possible applications for Smart Home solutions can be found in almost all aspects of domestic life. There is an increasing number of products trying to make the customers life more convenient with functions for remote controlling activities, e.g. feeding pets, watering plants, managing fridge contents or opening doors. Another approach are assistant systems for memorizing, shopping or finding lost items . Home security can be improved with more elaborate fire detection, burglar detection, surveillance and door opening systems. Furthermore resources can be used more efficiently by deploying Smart Home solutions. For example the Tado system demonstrated at the IFA Berlin helps customers to save in average 27 percent energy by controlling their heating system based on their geolocation [97].[111]

Impact on data marketplaces in Smart Cities
According to Menn customers require a standardized interface for controlling Smart Home solutions. As of today there are already a few products addressing that need coming to the market [111]. Finally, one should note that the success of Smart Home solutions crucially depends on the added value provided to the customer compared to classical home automation systems [132]. Hence Smart Home solutions crucially depend on existing infrastructure, data marketplace providers should consider collaborating with architects and construction companies who shape the infrastructure of the future. Optimizing planning and construction processes with regard to Smart Home solution compatibility will significantly facilitate the distribution of Smart Home solutions. Another important aspect is that Smart Home solutions can be targeted by criminals, for

instance control mechanisms for opening and closing of windows can be of great use for burglars. As potential cases of abuse might deter people from adopting smart home solutions, data marketplaces have to develop solid protection against unauthorized access.

2.3.1.4 Merging of online and offline retail channels

The growing pace of today's society as well as the increasing connectivity will lead to changing customer expectations regarding their shopping activities. Customers request more convenience and want to make decisions based on as much information as possible [79]. BMW recently announced that it will distribute their new electric vehicle i3 solely via showrooms and a mobile sales force called "Product Genius", which will force the customer to purchase the car online [64] [108, p.40-45]. Furthermore, IKEA will launch their 2014 catalogue as augmented reality mobile app, giving users the possibility to virtually place the furniture into their home by using the camera of the phone [124].

These two examples are only the beginning of what customers will expect in the future. According to Boston Consulting Group, there are signs that the boundaries between online and offline retail channels will blur for consumers - and might disappear entirely [131]. Beneath choosing where, when and what to buy, they will also want to decide which channels they use and which role each of them plays [131]. A trend towards a more personalized and integrated shopping experience can be observed. Figure 2.3.1.4 shows how an omnichannel purchasing journey might look like in five years from now.

Another trend that will accomodate the increasing demand of customers for convenient and fast solutions is mobile payment, which is projected to grow from a worldwide transaction value of 61bn USD in 2012 to 617bn USD in 2016 [85].

Implications for data marketplaces and Smart Cities

The growing usage of mobile technologies throughout the whole shopping experience will lead to an increased willingness to share user data, e.g. bank account information and personal preferences, as well as contextual data, e.g. location. The availability of this data, especially confidential information like bank account information goes hand in hand with an increased need for data protection and information security. As customers are willing to use services like mobile payment in the future, it is necessary for businesses in smart cities to install the necessary infrastructure.

2.3.2 More innovative mobility concepts and connected infrastructure

For the first time in history, more than 50 percent of the world's population is living in cities and in addition, the absolute number of people living in cities is

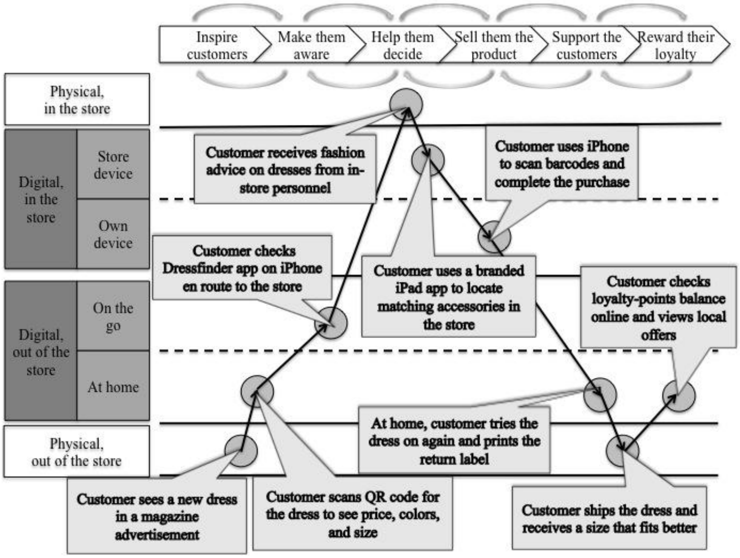

Figure 2.3.1.4: An example of a nonlinear omnichannel purchasing journey
Source: Adapted from [131]

still growing. [135, p.2]. The resulting challenges of this development force the inhabitants to change their traditional moblity behaviors in cities by using more innovative mobility concepts and focusing on interconnectivity. This section aims to identify the main trends in the field of mobility in cities. At first, the higher demand for innovative mobility concepts is explained. The second section presents the trend towards a constant connectivity within the Smart City.

2.3.2.1 Higher demand for innovative mobility concepts

Reliability and punctuality are the most important factors for people when choosing means of transportation [78, p.6]. The trend towards a growing urban population and the emanating problems like congestion lead to an increasing demand for new and innovative mobility concepts, which are able to replace the traditional ones. This is the reason why multi-modal mobility concepts are gaining relevance. They provide more efficiency and reduce travel times by combining motorized individual transport and public transport for the consumer's journey [62, p.11]. Furthermore car sharing, bike sharing or car pooling can be integrated into the multi-modal passenger transport. [122, p.11-12]

The promised advantages of a Smart City in the field of mobility are increasingly perceived by the society. Mainly young people are using more often means of public transportation in addition to their cars. For example, the share of car owners using public transport grew from 30% to 40% in Germany and in Great Britain [98, p.9]. A growth can also be observed in the users' demand for sharing offers. In Germany, the number of car sharing users increased by 22.7% from 2012 to 2013 [67, p.2].

Impact on data marketplaces in Smart Cities

The trend towards multi-modal mobility concepts leads to a higher demand for data concerning journey planning in a city. Consumers need access to precise information about all means of transportation to select the most efficient combinations for their journey. The demanded data can include availability of different modes, time-tables or ticketing [122, p.12]. Section 2.3.2.2 reinforces the meaning of the allocation of this information which is getting more important as well.

Furthermore, consumers using multi-modal transportation can generate new data about their mobility behavior which they could offer on data marketplaces. Sharing their movements patterns allows cities to observe the selected means of transportation in different journeys. The outcome of this promises valuable information about efficiency and best combinations for different destinations as well as probabilities of delays caused by different combinations of means of transportation. Public authorities and operators of means of transportation then could acquire the collected data from their customers on data marketplace. It can be used to develop sustainable mobility concepts which are necessary to adapt the infrastructures to the needs of growing cities and their inhabitants [122, p.7].

2.3.2.2 Increasing availability of real-time information in connected means of transportation

Innovative mobility concepts ask for real-time information about the players and the infrastructure in a city. This leads to a higher connectivity of the means of transportation and the infrastructure. Customers already use the partial connection between the players, the means of transportation and the infrastructure, as described in section 2.2.2.2. This connection is getting permanent and will offer real-time information to the customers everywhere. A permanent connection between the players in the city and the infrastructure promises to inform players immediately about traffic jams, unwanted and dangerous situations or available parking spots [120, p.85]. One example of an interconnected infrastructure is the Amsterdam Smart City project. Its aim is to connect the municipality of Amsterdam to the traffic system of the national government to manage traffic more efficiently and to reduce vehicle loss hours. Therefor, an integration of real-time traffic information into the vehicles' navigation systems is offered.[58]

The possibility of accessing real-time information in vehicles leads to a higher demand of connected vehicles. Consumers already desire internet in the vehicle to search for places of interest or to get most current online maps [65]. Access to this real-time information could therefor help to reach targets easier and to release occupied space on the infrastructure faster. The consumers' demand for this higher incorporation of internet in cars explains the predicted raise of the world's cars connected via internet from 11.4 percent in 2012 to more than 60 percent in 2017 [116].

Impact on data marketplaces in Smart Cities

Sensors in means of transportation and infrastructure as well as the communication between the different players in a city generate a large quantity of new and valuable data in real-time which can be traded among all players on data marketplaces.

On the one hand, cities can benefite from purchasing this data because it allows them to calculate current and future traffic flow as well as exact times of arrival. This gain in data allows improvement of the traffic flow by suggesting alternative routes to consumers [74, p.2]. Furthermore, cities can use the aquired data of real-time information to promote multi-modal transportation since it promises substantial time savings for usage of public transport in addition to using a car [74, p.3]. Smart Space solutions deliver data about the current availability of parking spots and can improve the transportation within the city by offering a smarter usage of the available but limited space in the city [89].

On the other hand, players in the mobility concepts benefit when they offer the collected data of their movement behavior on data marketplaces because its analysis finally leads to a minimal waiting time, reduces the risk of missing the means of transportation and lets them feel more secure when they do not need to spend unnecessary time at stations [63, p.1807].

2.3.3 Increasing communication and seamless interaction

Increasing ubiquitous interconnection and communication are trends that shape the society and living environments in the near future. They impact the life of individuals on a personal, interpersonal and mass level.

2.3.3.1 Increasing connectivity and technology-mediated social interaction

The number of devices as well as the number of applications capable of supporting human-to-human interaction is growing steadily [115, p.7]. Furthermore, together with the pace of everyday activities, the pace at which humans communicate is accelerating and is tending towards instant response communication [91]. People want to contact others and receive feedback instantly. This will be facilitated with the help of new devices and improved connectivity.

The use of technology-mediated social interaction will continue to increase both in magnitude and number of touchpoints. For example, in the past, people were mainly communicating via mobile phones and computers, but nowadays, they also use gaming consoles and music players as communication devices. As this trend develops, communication capability will be embedded ubiquitously in more and more devices: smart watches, smart clothing and home appliances [115]. Within every activity there will be a possibility to communicate with peers involved in the same type of activity, but also with outsiders [126]. As interpersonal and mass communication tend to converge towards a hybrid version, where often personal messages can also be viewed by other members of a community, more and more personal information is publicly available [71][96]. This is an indicator that people will be more and more willing to lower privacy barriers when engaged in social interaction. Communities will have a greater impact on interpersonal communication [71, p.45][91].

Apart from communicating mainly via text and voice, consumers will also use telepresence applications. Video calling in hand held devices, videoconferencing and collaborative augmented reality have constantly gained more popularity and will continue to do so in the next years [112][93]. Additionally, consumers will not only communicate but also physically interact through technology. For example, research demonstrating the potential of remote surgery is well under way [60]. Time constraints and specific skills scarcity, as well as the convenience of using these means of interaction, will lead to an increase in the use of telepresence in the next years.

Impact on data marketplaces in Smart Cities

With respect to data marketplaces, the increasing technology-mediated interaction will lead to an easier acquisition of data. This data is twofold: on the one hand, there is the actual content being communicated, and on the other hand the meta-data that accompanies it in the form of context data and user data. While contextual data, such as time, location, interaction participants, may bring numerous practical advantages, making use of the message content can prove rather challenging. As previously mentioned, privacy concerns in social interactions will decrease over time, but the still problematic is the fact that there is often a discrepancy between what people are doing and what they say they are doing [90, p.130].

From the perspective of smart cities, the most important implication is the need for a robust, high capacity network capable not only of transmitting huge amounts of information, but also filtering the data transmitted. On a social and governmental level, there will be a need for probing the data in order to detect and prevent crime. Furthermore, there will be a need to regulate and protect access to this information such that personal privacy is respected. Using communication data, smart cities will have the potential to anticipate and proactively adapt to inhabitants' needs in order to optimize resources such as space, infrastructure and public transportation [130].

2.3.3.2 More implicit decision making and automation in human-computer interaction

Sensing and acting are primary functions of living systems and the computers that surround us will become more and more similar to living systems. Human-computer interaction will increasingly resemble an interaction between living organisms, where both parts collect information about each other and then behave accordingly. The digital footprint of each user will be used to adapt and optimize computer behavior. This trend will lead not only to the end of user interface stability, but also to the automation of more and more functions [103, p.36][91].

In the next years, consumers will interact with an increasing number of devices and appliances that will be equipped with a growing number of sensors[123, pp.22-24][106]. As a result, they become operators of complex systems and they will face an increasing amount of information that needs to be processed and acted upon [121, p.286]. Despite the fact that the quantity of potentially relevant information will grow, the capacity of humans to make decisions and process that information will stay relatively the same. Therefore, there will be an increasing need for machines to partially take over the management of data. The data collected about the user, together with context information, will be used to seamlessly adapt the environment and minimize human-computer interaction. By partially making use of collected information, general purpose applications, named virtual assistants, will increasingly help users with the completion of everyday tasks. For example, this trend can already be observed in the smartphone applications Siri and Google Now. These are voice activated applications that manage simple tasks such as setting calendar appointments or searching for information online. Surveys report that people make use and are satisfied with this type of applications [110]. In the future, these applications will increasingly try to predict user needs and proactively act for the user's benefit [86].

Impact on data marketplaces in Smart Cities

Smart cities will become more and more like living organisms, where basic tasks are handled automatically by reflex functions. From the inhabitants' perspective, this will lead to a much greater realtime insight into events that take place around them and will lead to an improvement in the quality of life. For example, traffic, hazard, pollution information will be accessible to everybody and proactive adaptive measures will be taken automatically by surrounding systems. The existence of information related to human-computer interaction in the data marketplaces is merely an opportunity for further optimization and improvements of the computer systems that surround the citizens of a Smart City.

2.4 Conclusion

Smart Cities can satisfy customer needs for convenient and efficient solutions in retail, health, and leisure activities. Decision making can be more efficient and transparent. Services, e.g. in the health sector or retail experiences, are improved. Smart Mobility concepts create reliable and punctual transportation systems. The trend towards ubiquitous computing in growing cities leads to a smarter use of the available space. Furthermore, trends towards secure and easy-to-use communication tools can be oberved.

Inhabitants benefit from these developments when they are willing to collect and share data about themselves. Analyzing and distributing this data allows to connect the players and the infrastructure and to create the desired Smart City services. Thereby, every player of the city needs to access this data to get exactly the information she requires.

Smart Cities generate data in different areas and all player acquire different data according to their current needs. The data trade in Smart Cities driven by the presented trends is characterized by different data sources, receivers and data formats. Sufficient standardization of the generated data is another big issue that has to be solved to use the data in an efficient way without any loose of time or quality.

People in cities not only ask for Smart City services but also for a trustful use of their data. Hence, a lack of privacy is a threat for Smart Cities that has to be considered during this development. If privacy can not be guaranteed to the consumers, it will be difficult to convince them participating in Smart City models. Consequently, it is important to answer the question of how to collect and share data on the one hand while protecting it from theft on the other hand.

To conclude, Smart Cities offer great opportunities to meet customer needs in times of growing urban population. All important areas of an urban life, retail, health, leisure time, mobility and communication underlie trends which have a remarkable influence on data trading within the cities. At the same time, challenges like the customers' demand for privacy and standardization issues have be faced to guarantee the development of cities to Smart Cities.

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Chapter 3

3 Trends in Corporations and Business Eco Systems

Regina Endres, Philipp Herzberg, Thilo Koch, Sergei Krauze, Robert Weindl

Executive Summary

The economic system has undergone a lot of changes within the past few years. With the growing relevance and changing functionality of the world wide web social and professional networks, blogs and wikis have emerged, that facilitate interactive communication between users and enforce sharing of information. This development as well as the growing digitalization of the environment and economy are the reasons why the amount of generated data is skyrocketing. Data is becoming more and more valuable with data marketplaces turning data into a tradable good and corporations making use of data in a more professional way, changing how corporations will compete in the future. Advanced business intelligence, sharing data between companies via data marketplaces and data enabled business process optimization are key trends that companies face in the future. Also, the wide spread adoption of mobile devices and the increasing demand for flexibility at work changes the way people will be employed and recruited. Thus, future working environments will be more decentralized and the average number of years an employee will stay with the same employer will decrease significantly.

3.1 Introduction

The advent of digital technologies has dramatically transformed the business environment across all industries. It has increased the pace at which industries progress. Work processes are becoming more optimized and inherently more efficient. In a digitally assisted economy, access to information is easier and could in theory derive competitive advantages through better market analysis. Own data can help optimize business processes, thus decreasing costs and raising efficiency. For example, supply chain management heavily relies on the automatization of processes in order to deliver goods on time. Supply can easily be adapted to fluctuating demands via the fast integration of relevant digital data from all involved parties. Customer and competitors data may help make better strategic business decisions. For example, the effectiveness of a TV spot as a marketing campaign has already been done via data analysis [171]. Likewise, Twitter and Facebook feeds can predict the level of narcissism, Machiavellianism and psychopathy [170]. It is expected that 85% of all Fortune 500 organizations will be able to use Big Data as a competitive advantage until the end of 2015 [157], yet $232 billion will be spent on Big Data related IT work from 2013 through 2016 [158].

It can be safely assumed that globalized markets pose a risk for businesses. First, the entry into a new market has become easier due to quick and cheap access to new customers via the internet. This advantage is valuable for highly innovative, lost-cost start-ups that could potentially disrupt the market unexpectedly and fast. Second, businesses operating in a particular city will expect their city to provide the best possible environment for conducting business. Hence, it can be assumed that cities will compete for companies more than they already do. With regards to data, cities may provide an IT infrastructure that allows quick and direct access to relevant information such as customer, competitor and city data. Such data could be traded in data marketplaces, which address and deliver customized data package requests. Such Smart Cities may keep businesses by providing their data marketplaces.

This section of the report is structured as follows. After a description of the status quo in corporations and business eco systems, the report continues by showing trends within businesses regarding data marketplaces and Smart Cities. In the concluding remarks, the impact of the described trends are discussed.

3.2 Status Quo

The development of the internet led to increasing connectivity and globalization, facilitating change in industries at an enormous pace. In order to understand future trends it is necessary to assess the status quo of corporations and business eco systems and get a clear picture of today's situation. The following chapter is divided into two sections. The first takes a closer look on the current usage and trading of Big Data by corporations, while the second one covers the influence of technology on the labor market.

3.2.1 Data generation and management in companies

Over the past years the volume of data has grown exponentially making markets more transparent. Also, at multiple points of the value chain – from customer to company to supplier – data is generated. The next section focuses on how today's ubiquity of information has changed the markets and how business intelligence is used today to analyze the amounts of data. Furthermore, it concentrates on the current testing of strategic decisions based on experimentation. Finally, it takes a look at Big Data as a tradable good and at the current use of RFID in a commercial context.

3.2.1.1 Transparency of markets

The internet and the ubiquity of information has made the world more transparent and thus markets are "closer to the utopian state of perfect information by reducing information asymmetries between sellers and buyers" [146, p.637]. Today, customers can access nearly every information on a product. Such empowered customers are able to compare product alternatives easily via the internet and are thus able to make a more educated purchase decision. News blogs and social media platforms have become a major source for sharing information. With millions of posts and shared information on various websites and networks the degree of market transparency and with it the rules for how to compete in the digital world have changed. [146, pp.637-641]

3.2.1.2 Immature business intelligence

Companies have become more reluctant to rely on their gut feeling in strategic business planning and have started to gain as much insights on the current markets as possible by analyzing huge data sets, using the latest business intelligence (BI) technologies. Recent research suggests that, "companies that use data and business analytics to guide decision making are more productive and experience higher returns on equity than competitors that don't" [147, p.2].

However, business intelligence is still in its infancy: Companies mainly use internal corporate data and according to the customer reference survey of Gartner companies predominantly use BI tools that analyze the past. Predictive analytics that enable forecasts of changes in the market and consumer behavior are so far adopted by only 13% of the companies. [169]

3.2.1.3 Testing of strategic decisions based on experimentation

Companies have been using controlled experiments for a long time "to test hypotheses and analyze results to guide investment decisions and operational changes" [147, p.7], but the development of Big Data has pushed this to a new level. Companies can make use of the internet by getting in touch with consumers and getting instant feedback on products in the market in no time [146, p.635][148, p.8]. This offers them the opportunity to not only leverage on internal, but also on external data. While McDonalds tracks consumer traffic and ordering patterns via smart devices that gather the data, "Ford Motor, PepsiCo, and Southwest Airlines, [...], analyze consumer postings about them on social-media sites such as Facebook and Twitter to gauge the immediate impact of their marketing campaigns and to understand how consumer sentiment about their brands is changing" [149, p.8]. With the growing amount of data and the improvement of data analytics tools, experimentation has the potential to become a major method to facilitate strategic decision making.

3.2.1.4 Data as a tradable good

The amount of generated data has been growing exponentially over the past years. In 2012 the data volume amounted to 2.837 Exabyte worldwide and is supposed to triple within the next 3 years [194]. "The economics of digital information [...] are the economics not of scarcity but of abundance" [148, p.8]. The challenge for companies today is not to acquire information, but to find the right information within the vast amount of data. High quality information has become such an important factor for making better strategic decisions as a company so that information intermediaries (data marketplaces) have emerged that turn data into a tradable good. Microsoft's Windows Azure Marketplace is one example of such a platform that, among other services, offers and trades datasets [191, p.24].

Data marketplaces provide companies with access to external data. Thus, new opportunities have developed to monetize on corporate data. They also facilitate sharing of information across industries, reducing the current problem of "information hoarding" and "data silos" [147, p.4]. Research has shown that several retailers are already engaging in monetizing preprocessed data to business partners of interest [169].

3.2.1.5 Commercial use of radio-frequency identification (RFID)

Radio-frequency identification (RFID) is a technology that is not only able to identify and localize objects but also people and animals, who wear a certain sensor or embedded processor. The transmission of a position works via radio frequeny. Introduced during the second world war, RFID is today mostly used commercially to improve business processes by tracking objects in the logistic systems and in supply chains. Although widely used, the RFID technology still faces some challenges. While passive RFID tags are favorable as they are very low-priced and have a nearly unlimited lifespan, they are still practically useless for the purpose of exact localization. The RFID reader can only determine, if there is tag present in the reading rage or not. Active RFID tags, equipped with an on-board battery, solve this problem, but they're still very cost-intensive and the battery can be easily run down by repeated interrogations, disrupting the whole system. To counteract these issues, methods are worked on, to be able to localize passive tags in the future [144, p.17-18].

Furthermore, the ability of RFID to process information, to communicate and to connect multiple objects to an interlinked network of things still lags behind. [173, p.110]

3.2.2 Technology's influence on the labor market

Digitalization and improvement of technologies had and still have a massive impact on today's employment situation [142]. The first section concentrates on modern information and communication technology (ICT) solutions and the importance of work-life balance. The second part deals with companies competing for talent and the relevance of professional and social networks, while the third part takes a closer look at the current duration of employment.

3.2.2.1 Impact of modern ICT solutions

The internet and the wide spread distribution of smart devices facilitated a change in the way how people organize their work life. Today, people can easily work from home and use ICT solutions and networks to connect to work facilities. A study by BITKOM in the year of 2010 has shown that 67% of employees are always or at certain times available off the job for their employers via smartphone, cell phone or email [193]. Making work-related phone calls or writing emails in the subway or on the streets is not unusual anymore. Thus, private and work lives have started to overlap significantly. Social networks, like Facebook and Twitter, are examples, where the blurring of former boundaries become apparent. Facebook, which was initially designed to be a network exclusively for college and university students, has opened up for professional use, too. Lists of friends of social networks comprise colleagues from work as well as social friends, which brings more personality to the workplace, but "also carries work into the home" [190, p.102]. As a reaction to a continuously growing integration of work-life and private life the term "work-life-balance" has been coined [142, p.85].

3.2.2.2 Duration of employment

A few decades ago, it was common practice for an employee to work in the same company their whole life. Compared to today, the significance of long-term employment has already been decreasing, especially in western industrial nations. Globalization and increased mobility led to more opportunities to change the employer and jobs. [142, p.85]

3.2.2.3 The relevance of professional and social networks for recruiting

Up to today, more than a billion people worldwide actively use a Facebook account [195]. In Germany about every fourth person is connected to the biggest social network [192] and in a recent survey even more than 82% of the German Facebook users claimed to visit the network on a daily basis [197]. Xing, the German equivalent to LinkedIn, is the biggest German professional network with already more than 13 million users [198], who maintain a CV-like profile aiming at the attention of top-employers.

In fact, networking has never been as easy and important as it is today. Many young people change jobs and cities more frequently and with social and professional networks they are able to take their contacts with them. Employers profit from these internet-based networks when it comes to attracting new talent. Recruiters are actively contacting skilled people via platforms like LinkedIn, Xing or Facebook, instead of passively waiting for applications after publishing job announcement [190, pp.98-103]

Nevertheless, job search platforms on the internet and corporate websites are still the most used channels to find a new job. In a study of in 2012 more than 60% of job applicants claimed that they would use internet job portals and about 37% search on corporate websites for job announcements. Only 28.1% stated, that they would use professional platforms like Xing for their job search. [196]

3.3 Trends

The following trends section will discuss (1) the transformation of the business environment regarding increasing competition and blurring of industry borders, (2) data and its potential for holding competitive advantages, (3) how data can be used to optimize business processes such as in the retailer's supply chain and (4) how employees will seek mobile workstyles and have lower retention times with their employers.

3.3.1 Transformation of the business environment

Businesses will face increasing competition from the globalization of markets as well as the disruptive power of innovative start-ups. The dependence on data for optimizing business processes and making better strategic business decisions will increase. Companies will seek more joint ventures and merge with competitors in order to ensure competitive advantages through better product offers and cost reduction respectively. Smart Cities will have to provide an information infrastructure for businesses to access vital data on platforms such as data marketplaces.

3.3.1.1 Rising competition

The ongoing globalization of markets will increasingly allow companies from the same industry to directly compete with each other, independent of their geolocation. Neglectable telecommunication as well as reduced shipping costs due to larger container ships [183] have allowed companies to more easily tap into markets across the world. Businesses will have to monitor competitors on a global scale.

Through online business comparison services regarding pricing, quality and service, customers will make more informed purchases. Such empowered customers will request more transparency from businesses regarding their offers in order to compare them to competitors. It is expected that the demand for more transparancy regarding companies' products will drive empowered customers away from more closed businesses [166].

A third source of competition are start-ups. It has become possible for an individual to offer a service via the internet that is accessible around the globe. Hence, the relative market entry costs can be extremely low relative to the number of potential customers. For example, the 17 year old Nick D'Aloisio single-handedly built a news feed app, which became quite popular and was eventually sold off to Yahoo for £18m in March 2013 [186]. It is these low entry costs that encourage investors to fund start-ups. As a consequence of low entry costs, the financial loss of investors are implications for of failed enterprises Furthermore, failed enterprises have very little financial implications, thus fueling experimentation and ultimately innovation. Many businesses are able to reach a world wide audience of potential customers via the internet. These aspects elevate start-ups to the level of serious competitors.

Impact on data marketplaces in Smart Cities

Businesses will face more fierce competition from around the world, experience rising start-ups with innovative ideas and empowered customers that will demand more product transparancy from companies. As access to Big Data and its analysis become crucial for all players within a market the interest in purchasing and analyzing Big Data will increase. The trade of data and analytics services will drive data marketplaces.

3.3.1.2 Blurring industry borders

Todays markets are highly dynamic and consequently disappear, emerge and change at an unprecedented rate. Companies may choose to enter a market as a direct competitor as Apple and it's introduction of the iPhone in 2007 disrupted the smart phone market. In the third quarter of 2013, Apple generated 51% of its revenue from iPhone sales [165]. Companies may also collaborate in order to achieve a competitive advantage. For example, Samsung and Google collaborate in the smart phone business in order to achieve the highest market share possible. While Samsung has the expertise regarding the production of high standard smart phone hardware at an affordable price, Google provides the software that many customers are already familiar with. Such collaborations of businesses that specialize on different aspects can improve the product and achieve greater value for customers. Furthermore, an example for how merging companies could reduce costs by increasing their efficiency is given by the German telecommunications companies O2 and E-Plus. These two companies have recently agreed to merge in order to compete against T-Mobile and Vodafone. They seek to reduce costs by cutting down the number of towers needed to cover a given area, thus becoming more competitive [206]. It is expected that only the most efficient companies within low profit margin industries will survive. Such industries will heavily rely on data for optimizing their work flow. If data marketplaces with its data package offers and analytics services result in competitive advantages it can be assumed that any smart city of the future will have to offer data marketplaces to the companies within the city. The lack of such data marketplaces would put companies at a competitive disadvantage.

Impact on data markeplaces and Smart Cities

Collaboration among companies can ultimately improve the product or service. Cost reduction can be achieved through collaboration by increasing the companies' efficiency. Such measures will improve the competitiveness of companies, which is becoming more important as market competition becomes more fierce. Smart Cities will have to offer data marketplaces in order to avoid companies of migrating away.

3.3.2 Data as a competitive advantage

As mentioned in the status quo, it can be stated that data is playing an increasingly important role in modern enterprises. This chapter covers three emerging trends, explaining how the processing and analytics of Big Data will affect enterprises in the future.

The first trend states the growing demand for external data by companies. It describes growing need of additional data sources by the enterprise.

Two second one covers data analytics inside enterprises. It presents the development of predictive BI tools, which will provide better management decision support in the future enterprises.

The remaining trend predicts the emergence of corporate data marketplaces, where corporations will sell their internal information assets to other business players.

3.3.2.1 Growing demand for external data

In order to sustain market competition, modern enterprises are forced to process larger quantities of data. According to IBM [207], companies across all industries are looking for a way to manage untapped information in order to make better decisions about their business. Gartner also mentions this trend: it's stating that companies wish to personalize consumer experiences and differentiate between individual customer demands by seeking for new data [137].

In a pursuit of new opportunities and insights, companies are actively looking for new types and sources of information (both internal and external) [137]. This data sources include sensors, smart devices, social media, smartphones and Internet [207]. Companies also process location, sentiment, gesture and other data, enabled by the Internet of Things [138]. Large part of this data arrives in massive quantities and in its earliest and most primitive form [207].

Beyond different data sources, researchers emphasize the growing importance of non-transactional data sources (e.g. social media data, enterprise content, multimedia, behavioral data) [140]. Combined together, different data sources play critical roles in companies' innovation processes and enable competitive advantages. [138]

Impact on data marketplaces in Smart Cities

In a city of the future, we can expect the utilization of all relevant external sources of data for a company. This trend is driven by the desire for business insights that can be obtained from Big Data and the inherent competitive advantages that arise from it.

To be able to succeed, organizations should prepare themselves to be able to connect and aggregate emerging information sources from heterogeneous platforms. The ability to process and structure such non-uniform data will become an essential part of data integration toolkits [137]. This leads first of all to the growth of value of data, so stimulates development of data marketplaces. Also, it leads to development of tools, which will be able to provide data aggregation and processing.

3.3.2.2 Uprise of advanced analytical tools

The role of Big Data within enterprises is increasing. The increasing data volumes gathered from external sources as well as the need for better BI tools drive the development of new BI - advanced analytics. IBM states need of advanced analytical tools by mentioning that the main challenge for corporations is to have a tool that leverages large volumes of data to derive timely insights about their customers and address relevant business needs [207].

Gartner defines advanced analytics as “the analysis of structured data and content (such as text, images, video and audio), using sophisticated quantitative methods (for example, statistics, descriptive and predictive data mining, simulation and optimization) to produce insights that traditional approaches to BI — such as query and reporting — are unlikely to discover” [139]. New analytics will provide better forecasts, causal understanding, pattern identification as well as resource and process optimization. The core advantages of such advanced analytics are predictions and recommendations, which radically distinguish them from previous tools, which could solely measure the past [139].

Nowadays, corporations haven’t yet developed comprehensive data architectures for data acquisition and processing. This leads to the situation where decisions are based on insufficient data. Microsoft’s discloses high interest to advanced analytics solutions from corporate clients: 62% said that developing near-real-time predictive analytics is extremely important [141].

In the future, analytical toolkits will be used to support business decisions by assisting in the scenario planning process. As technological development progresses, it will provide the necessary analytical algorithms to structure Big Data for supporting decision making processes by the year 2015 [137]. Advanced analytics will change modern enterprises, requiring new skills to benefit from Big Data : “through 2016, 90% of business decisions will be based on a fraction of the available relevant data” [139].

Nevertheless, not all business players will be able to benefit from such advanced tools, but the ones who manage to implement such tools will see significant positive effect. According to Gartner, “through 2015, predictive and prescriptive analytics will be incorporated into less than 25% of business analytics projects, but will deliver at least 50% of the business value” [139].

Impact on data marketplaces in Smart Cities

It is expected that the volume of internal and external company data will increase. These large amounts lead to the challenge of developing comprehensive data architectures, which could support appropriate decision making processes. Future enterprises are expected to make more decisions based on the availability of data.

Complexity of development of own advanced analytical tools may lead a large set of market players to use external tools or services for this task. This services will be providing advanced analytics for this companies operating on companies’ data. It opens market for solutions, providing advanced analytical functions. Also, it requires relevant architecture from clients of such services, which will have to be able to share part of their information with such service provider and get processed results back.

3.3.2.3 Corporate information flow to data marketplaces

One upcoming business trend is the further development of corporate data marketplaces. The growing value of information as well as the low costs of data processing infrastructures will stimulate business players to monetize their data assets. Example of such business model can be found in healthcare sector, where clinics could aggregate patient clinical records and claims datasets and provide it as a separate service [172]. This will lead to the emergence of corporate data markets. Researchers predict that by 2016, 30% of businesses will allready directly or indirectly monetize their data by selling them or bartering with other market players [139]. This will stimulate further expansion of B2B data market business models .

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In a future city we can expect enterprises to publish more internal data, allowing other market players to access it via data marketplaces. Since not all market players will be able to introduce information-based products, “"information resellers" will arise to help organizations develop and execute information asset monetization strategies” [139]. According to Gartner, growing value of information will stimulate enterprises to control their publishing strategy, assuring that all shared information is providing relevant income.

3.3.3 Business process optimization in the retailer’s supply chain process

Achieving superior process performance and an advantage towards competitors are omnipresent goals for companies. Instead of tweaking individual business functions the Big Data revolution allows companies to optimize their entire business process [174, pp.60-66]. According to Niedermann and Schwarz [182, pp.88-89] the data related Business Process Optimization (BPO) usually consists of three phases:

- Data integration - Collection and implementation of all possibly relevant data.
- Data analysis - Analysis of the process model and process data.
- Detection and implementation of improvements - Detection of deficiencies within the process by means of the analysis results.

The ability to address unique objects and represent them in an Internet-like structure - also known as the Internet of Things (IoT) [145, p.1] - will have a huge influence on future business process optimization activites [143, pp.383-386]. “The pervasive presence [...] of a variety of things or objects like Radio-Frequency IDentification (RFID) tags, sensors, actuators and mobile phones” [143, p.386] will allow the permanent analysis of factors like weather, traffic and location

[177, p.389]. The following section provides an overview of trends which will improve the business process in the retailer's supply chain. The topics comprise the optimization of real-time delivery and vendor management, the improvement of order picking and the integration of automated product sourcing.

3.3.3.1 Regular use of real-time tracking and supplier management

Due to the generation of real-time information by the Internet of Things a comprehensive knowledge about the shipment's environmental conditions will be available and so the current location, status and exact time of delivery can be predicted [177, p.389]. Also, the tracking of high-priced items will be more efficient which results in a faster priority classification. In addition, the associated Big Data analytics solutions will enable a new kind of management the so called real-time management. It will optimize the delivery performance by analyzing on-time service, customer feedback and complaints [178].

Impact on data marketplaces in Smart Cities
Real-time data will have a huge impact on the optimization process on companies in Smart Cities. Data marketplaces that provide analyzed logistic data will be seen more frequently. The companies and customers will gain more insights in the status of deliveries. This facilitates better planning strategies for future activities which will inevitably result in a higher satisfication for vendor and customer.

3.3.3.2 Improved order picking

The order picking operation describes a warehouse process in which customer requests for a specific item are handled based on given quantity and time criteria. This process is highly controlled and aims at maximizing efficiency [187]. "Order picking has long been identified as the most labour-intensive and costly activity for almost every warehouse; the cost of order picking is estimated to be as much as 55% of the total warehouse operating expense" [153, p.2]. Poor performance of the order picking process leads to unsatisfied customers. Furthermore, the warehouses and its complete supply chain will be subject to higher operational costs. A higher efficiency of the picking process can be achieved by optimization [153, p.2]. In order to do so the continuous collection of different digital sources like orders, product inventory, warehouse layout and historical picking time in form of Big Data will allow for the prediction, analysis and improvement of the current picking process [178].

Impact on data marketplaces in Smart Cities
Due to the high importance of order picking in some companies further improvements are inevitable [153, p.2]. Therefore data marketplaces in Smart Cities have to provide services which assist companies with the evaluation and optimization of their order picking process. Before implementing an improved

picking process in warehouses and stores the collection of anonymous historical data of various companies and the service providing real-time data (3.3.3.1) can be used to establish an evaluation and simulation environment.

3.3.3.3 More efficient product acquisition

The process by which companies ensure that product supply dynamically meets fluctuating customer demands is also called product acquisition. Sharing real-time data like product demand and product sales enable companies to avoid out-of-stock situations which end in most instances in a decrease in revenue and dissatisfied customers [202, pp.1023-1024]. Big Data will support companies to get more insights of their product life-cycles and customer behavior by collecting and analyzing of intra- and inter-company data like the purchase history, product lead times and other influence factors. This analysis will result in an optimized and automated product acquisition [178].

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Product acquisition will become increasingly automatized, thus improving the efficiency of the company and reducing the overall costs. Providing customer data in a marketplace will help companies to predict demand fluctuations in Smart Cities to which product acquisition can be adapted to. Thereby out-of-stock situations can be prevented which results in higher revenue and more satisfied customers.

3.3.4 Employee dynamics

Employees are as dynamic as the business environment can be. The following subsection firstly considers a shift towards place and time independent working styles and how it affects Smart Cities. This is continued by the employee dynamics concering the multitude of jobs and employers people will experience throughout their work life. It then leads to different implications on what employees will do to position themselves on the labor market and that companies will find talent via social networks.

3.3.4.1 Mobile work styles revolutionize the traditional office

Home office and mobile office solutions are on the rise. By 2024 the latest, 75% of office workers in Germany are expected to use such solutions [168, p.97], while almost every company will offer mobile work styles [152, p.3]. This development leads to the trend that by 2020 a company will provide just seven desks for every ten office workers minimizing their real estate spendings [152, p.2]. People will rather work from semi-permanent locations than in traditional offices (see figure 3.1).

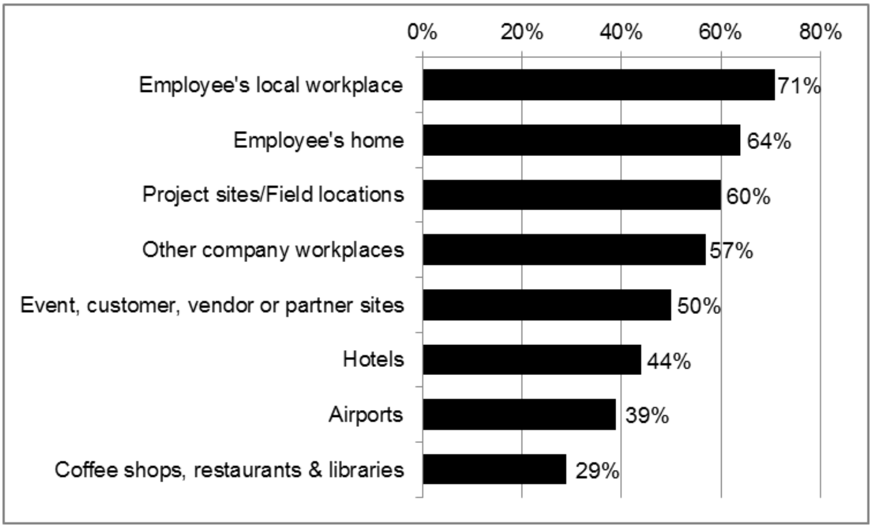

Figure 3.1: Where will people work? An estimation of corporations.
Source: Adapted from [152, p.7]

Through the so-called "workshifting" people will not only work in more convenient locations, but also to more convenient times, thus dissolving the "9-to-5 work style" as well as working five days per week at the local office [152, p.7]. To incorporate space independent work styles, the employee needs smart environments, which enable a plug and play style of use of devices. These could be output devices such as screens embedded in train seats, buses or other publicly available spots as well as input devices that - apart from keyboards and mice - enable various input forms such as touch, voice or gesture control [168, p.98]. While more sophisticated environments will be provided inside the company environment, public locations like coffee shops, hotels or airports will be used as well. People then have a choice of venues "for the price of a cappuccino" [204, p.151]. The wireless revolution will reach the next level via the construction of wireless domes or canopies, which provide whole areas with wireless access. This has already been established in San Francisco, Cardiff or London's Soho. The emergence of "guerilla" networks that are individually financed will be facilitated by state-sponsored urban digital networks [204, p.151].

While mobile work styles enable employees to organize their work more efficiently and access resources more easily it will come to drawbacks with lowering the threshold for communication [150, p.596]. The threshold normally functions as a separator of different areas of life, thus avoiding spill overs from work into one's private life. With having a home or mobile office in place, the borders of private and work life will increasingly blur away [151]. A trend that will nourish the blur is the Bring-Your-Own-Device (BYOD) policy in firms. Here the employee either uses their private laptop or mobile device for work purposes or is provided with a consumer-type device from the employer that he uses for company and personal purposes. In the next years, almost three quarters of all organizations are expected to accommodate and encourage BYOD [185] [199]. Despite potential drawbacks, employees will demand mobile work styles because they expect to be more flexible, productive and reduce commuting times as well as achieve a better work-life balance. [152, pp.4–6]. This will require the ability for self-organization and to take sufficient time for their private life.

The increasing mobile device usage will not only disrupt the traditional work style, but also enable new functionalities. Apart from mobile office functions, there are mobile specific dimensions that will increasingly be enabled and shift the data supply in an employees' daily life. Among them are notifications (automatically or manually generated alerts to change, take an action or inform), location tracking (ability to identify and locate a moving target, i.e. employee), navigation (travel guidance, optimal routes, enroute location information) and real time mobile job dispatching (flexible job assignments based on matching of requirements) [205, p.126] The mobile functionalities are able to replace traditional offices and even extend it towards real-time data, e.g. resource allocation, employee tracking or commuting alternatives. For companies it will be essential to critically monitor and conduct research of flexible work styles in order to guarantee the most effective usage, be compliant and fulfill security policies [179][152][199].

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Smart office workers optimize their working schedule, while carrying their office within their briefcase and are able to plug in at every smart environment. People will populate public places for working purposes and these places will adapt in order to attract workers. Home or mobile offices will reduce commuting times for the employee. The new features of mobile devices enable to react to Smart City dynamics using real-time location and navigation data. Companies will be able to track and improve processes of their field workers. Marketplaces fulfilling current needs of the future employee, e.g. geo data, will arise as well as data derived from the mobile usage. The dual purpose of devices for work and private areas will accelerate the utilization of smart devices and therefore nourish Smart City developments.

3.3.4.2 Decreasing employee retention time within a company

The hitherto CV based on long-term employments has already lost relevance in western countries [168, p.85] and bonds between company and employee have weakened [155]. While a German employee spent an average of 10.8 years in one company in 2008 [160], a survey of German students revealed that they expect to work only 4.3 years in their first company [159]. In accordance with this a survey of the "Future Workplace" states that 91% of people born between 1977 and 1997 expect to stay at a job for less than three years [203]. The so-called "Millennial Generation" [176] could then pass through 15-20 jobs during their work lives. Companies and job applicants will prepare for this fluctuation. On the one hand, the future employees will not stop learning and educating after having left school or university and adjust their skills throughout their careers [163]. People will be able to use open and distance learning offerings (ODL) [181, p.3], i.e. offered by universities like Stanford [201]. Online ODL will increase in quality and interactivity allowing face-to-face experiences [167, p.26][175, p.1] and manifest its place in society. The European Union supports the development of lifelong learning and enforcing a strategic program in education and training until 2020 [200].

Moreover, targeted human resource programs based on the needs of the company will be necessary to manage talent effectively. Succession management solutions can aim to retain future leaders [156]. Furthermore, companies have to meet the future employees' conception of the workplace. In a labor market, where "there is a growing mismatch between the skills employers need and the talent available" [155, p.24] employees will have "a greater say in how work is assigned, assessed and rewarded" [155, p.26]. Setting the company's image and values as well as relating the jobs to corporate social responsibility and environmental impact will become more important for the future employee [164][176, p.8]. Companies that fail to react to the change and fail to adjust the value proposition for the employee will have problems in attracting, developing and retaining talent.

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The higher turnover rates [184, p.8] and shorter durations of employment within a company will enable workers to become more flexible and potentially lead to higher work-related movements within or between cities. Consequently, people will optimize their work-related life in the city while having a major work place change and being challenged with new circumstances more often. Citizens will have to gather the information about their surroundings they find relevant.

With regards to the citizen's education, people will engage in lifelong learning possibilities, which will be an integral part of the future Smart City [163] Employees might make this even a criteria for the employer selection. Also, employers will have to assess their employees opinions and concerns via feedback data in order to retain talent..

3.3.4.3 Social networks become a recruiting standard

Employees will rely on representing themselves and actively searching for job opportunities in case they are willing to change their employer more often. Applicants will not only approach companies, but also display their achievements and career paths on publicly available sources and optimize their results on Google, Facebook, Twitter or business networking sites like LinkedIn or Xing [180], thus building a personal brand [162][154]. Maintaining their professional contacts, while transferring from one job to another will become essential in finding novel opportunities [189, p.98]. On the other hand, companies will use social technology and social recruiting to transform and improve talent management to find potential employees [161]. Apart from the acquisition of talent externally, reallocating and identifying growth opportunities for employees via internal social networks will become more common. Firms will create networks across business units and across functions among the company's worldwide staff that even include former employees [188, 149, p.4]. The number of companies using both internal and external social networking technologies will increase. According to a survey 75% of firms still perceive that they are behind the curve of attracting talent through social sources [188].

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Future employees strive to find new employment possibilities throughout social networks and their wider professional network. Companies make use of internal and external data marketplaces to find the best matching employees, identify their needs as well as attract and retain them.

3.4 Conclusion

Today's businesses are facing increasing competition. While the overall number of competitors is rising due to increasingly globalized markets, innovative start-up companies disrupt traditional market structures with new products and services. Furthermore, empowered customers seek out businesses that allow for more product transparency.

A general trend towards gathering and analyzing Big Data for achieving competitive advantages can be observed. Although only a fraction of companies are successful at leveraging from Big Data, the majority of IT spending is going towards the development of better analytic tools. Big Data will be utilized to predict market developments and support strategic decisions. It is expected that data supported management will rise to a necessity in order to allow a company to effectively compete. Big Data will further be used to optimize business processes, as for instance in the retailer's supply chain. Real-time delivery and vendor management as well as improved order picking and automated product sourcing will reduce costs via more efficiently designed processes.

Since today's Big Data analytics lack behind its potential, this will be the opportunity to make a difference in the upcoming five years. For many companies it will be a challenge to mine and analyze data on their own due to the high costs of system integration and the lack of skilled data analysts. Thus, companies are expected to increasingly demand external data analytics from respective providers, thus outsourcing this competency. As data is increasingly seen as a resource it will be traded as such on data marketplaces, where demand and supply meet.

Employees will seek mobile work styles, facilitated by the infrastructure provided in Smart Cities. Free wireless internet access throughout the city and plug-in stations for devices will form an essential part of the IT infrastructure. Finally, employees will have short retention times to their companies and build a set of skills that is presented in form of personal branding. Companies will form new recruiting strategies to attract qualified employees. The above presented trends may raise critical issues such as information security and privacy. It is expected that data theft will gain prominence as new analytic tools will increase the value of Big Data.

In summary, Big Data holds the promise of gaining competitive advantages within a market. However, the necessary analytics tools have hardly reached the market to this point. The rise of specialized companies will allow Big Data owners to outsource the analytics to these companies. As data is increasingly seen as a resource, data gatherers, data owners and data analysists will meet on data marketplaces.

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4

Chapter 4

Political and Legal Trends

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Executive Summary

Policy makers together with existing laws and regulations play a crucial role for the establishment of data marketplaces and Smart Cities. Due to the scarcity of resources and risk involved in Smart Cities projects, there is an evident shift towards more affordable financing of new projects through Public Private Partnership models. The increasing internationalization of Smart City projects leads to more efficient information sharing, which together with greater involvement of citizens has the potential to improve the overall performance of current and new Smart Cities. Currently, data policies are heterogenous across countries. Since digital information does not stop at national boarders, there is a need for global regulations with regard to data privacy. Personal data privacy without compromising the quality of services will be strengthened in case of political and legal trends. Concerning environment and infrastructure the EU will work with the international green building councils to create a transparent and transferable green architecture rating system. Regulations will develop that encourage efficient high occupancy vehicles and electric vehicles to reduce impact and increase traffic capacity. These political and legal trends will shift society closer to Smart Cities powered by data marketplaces in the next five years.

4.1 Introduction

Over the past years, Smart Cities have brought along a large number of innovations. With digital technologies changing and improving constantly, it is difficult for a static political framework to cover all relevant aspects to a full extent. The development of Smart Cities will require a legal and political structure flexible enough to adapt to innovations and improvements, including on the one side a system of governance, organizing smart cities in their infrastructure and environmental issues, as well as regulations for handling data with regards to privacy on the other side. As legal structures will be a relevant factor in the development of smart cities, the following chapter provides an overview of the juridical structures prevailing currently, as well as the direction that future regulations develop towards.

4.2 Status Quo

In order to identify the legal and political trends influencing data marketplaces in Smart Cities, the current state of policies and regualtions needs to be examined. The following chapter provides an insight into the role of the public sector in the Smart City ecosystem and discusses the existing laws and regulations related to data, environment and infrastructure issues.

4.2.1 Governance

Governments and city authorities play a crucial role in the development of Smart Cities. They have to provide leadership necessary to bring different motivations of stakeholders into harmony and decide on the financing of new projects.

4.2.1.1 Stakeholders

Smart Cities involve a number of different stakeholders. While the primary objective of the private sector is to maximize profits, the public sector strives to deliver high quality services, and citizens appreciate the greater choice of services and opportunities to save money [222, p.11]. All of the mentioned three groups are primarily interested in short-term results, which conflicts with the interests of knowledge institutions that try to make longer-term contributions [280, p.433].

Although the inclusion of citizens in Smart City projects is viewed as vital, they are often left out from the discussions and assume rather passive roles [222, p.12][214]. Despite the fact that the public sector should provide the leadership to engage stakeholders, the majority of Smart City projects are more based on a vendor/technology push than pulled by government/demand

[261][209, p.20]. This is to a large extent a consequence of the activities of various initiatives launched by large private companies. For instance, IBM's Smarter Cities Challenge provides expertise to leaders of selected 100 cities [260]. GE Ecomagination promotes sustainable goals and provides financing for Smart City projects GE participates in [249, p.32]. Another example is the Crystal, a sustainable cities initiative launched by Siemens in London in September 2012 that hosts the world's largest exhibition focused on urban sustainability [281].

4.2.1.2 Financing Smart Cities in the European Union

Financing is often regarded as one of the biggest barriers in the realization of new Smart City projects [238, p.27]. Given the limited financial resources of European cities, their transformation into Smart Cities is not realistic without financial help from the European Union and national governments [238, p.10].

The Smart Cities and Communities is an initiative launched by the European Commission. Projects must combine the transport, energy and ICT sectors in order to receive funding [241]. The initial budget of 81m EUR was increased to 365m EUR for 2013. Another initiative the Joint European Support for Sustainable Investment in City Areas (JESSICA). Member countries can allocate some of their EU Structural Fund allocations in urban development funds which invest them in selected urban projects [240]. Under certain conditions, JESSICA can be used to finance Smart City projects and can provide a way to transfer the risk from cities [249, p.10][269, p.3].

Some member countries have launched their own supporting schemes for projects related to Smart Cities. Particularly in Germany, the German Federal Ministry of Economics and Technology and the German Federal Environment Ministry launched the E-Energy: ICT-based Energy System of the Future initiative. Whithin this program, six regions receive financial support to implement e-energy solutions. The total budget including public and private sources reaches 140m EUR. [217]

4.2.2 Data policies

Data provides a basis for decision making, and with the unveiling data affairs including Julian Assange in 2010 and Edward Snowden in 2013, privacy vs. security is a highly controversial topic, not related to a single country [221, p.48]. From a global perspective on current data policies, there is little point for regulations condoned to a single country, as "national borders aren't even speed bumps on the information superhighway" [271, p.70]. In this chapter, the legal structures of two countries leading in data politics as well as trans-border regulations will be discussed to show contrasting perspectives on data policies.

4.2.2.1 Germany

In Germany, data privacy is regulated by the federal Bundesdatenschutzrecht (BDSG) and state policies of the states (Länder) as well as general privacy protection regulations (like privacy of correspondence or medical confidentialy). The BDSG is based on the European Union Data Privacy Directory [228, p.5]. It is aimed to protect the individual's personal right granted in the Basic Constitutional Law (Grundgesetz) [228, p.2]. For Internet and communication services (telemedia) in particular, the Telemediengesetz (TMG) states that customers' data is strictly confidential and has to be highly guarded. It obliges the provider of services to design and select systems using as little personal data as possible when collecting, processing or using data.[231] The Telekommunikationsgesetz (TKG) [230] includes regulations such as type and duration of personal inventory data that is to be preserved, but the respective clause contradicts the German constitution and has thus been voided, so the situation is currently unclear [227].

4.2.2.2 The European Union

Generally, privacy is guaranteed in Article 8 of the European Convention on Human Rights. The European Union Data Privacy Directory (DPD) is a legal framework for core privacy principles relating to the processing of personal data that seeks to ensure the free flow of personal data within the EU and addresses transferring personal data to third party countries. This includs data quality[1], consent[2], transparency[3], access and rectification[4], confidentiality[5], and security[6]. [278, p.75] The DPD is "probably the most influential privacy law in the world today" [278, p.74], but it has been criticized for relying too much on informed choice, and having failed to keep pace with globalization and technological advancement [221, p.48]. Thus the European Commission has released a proposal to reform and replace the DPD.

Concerning transfers of personal data to third party countries, especially those lacking adequate protection, the EU General Data Protection Regulation (GDPR) provides an exception where a transfer "cannot be qualified as frequent and massive" [221, p.48]. Even though this term hasn't been specified, it seems to be very relevant in case of big data. Currently, one of the main problems with data protection laws in both the DPD and the GDPR is that key words as "notice", "choice", and "consent" don't work the way they do for common law and these practices need to be adapted to the realm of digital communications.[221, p.48]

[1] Article 6
[2] (Articles 2(h) and 7(a)
[3] Articles 10 and 11
[4] Article 12
[5] Article 11
[6] Article 17

The Data Retention Directive (DRD) is the first EU law to address data privacy in law enforcement. This is especially relevant after the terrorist attacks in New York, Madrid and London [210, p.234]. It relates to the retention of telecommunications data all over the European Union. Member states are required to store citizens' traffic data (related to phone calls and emails) from 6 to 24 months and by court permission, security agencies are able to access details like IP address, time, date, and duration of communications[210, p.238]. Additionally, the Electronic Commerce Directive (ECD) has been adopted in order to set up an internal market framework for electronic commerce, providing legal certainty for both businesses and consumers through requirements for e.g. electronics contracts and limitations of liability, with a strong focus on transparency. The ECD also addresses basic intermediary services, such as access to the Internet, the transmission and hosting of information [245] and will be challenged by data marketplaces. Issues concerning intellectual property and related rights are being addressed in the Directive for Copyright in the Information society which adopted from the framework of the World Intellectual Property Organization (WIPO) [246].

Special interest institutions provide frameworks for specific data regulations on the EU level. In 2009, the Body of European Regulators of Electronic Communications (BEREC) was established and "committed to independent, consistent, high-quality regulation of electronic communications markets for the benefit of Europe and its citizens" [212]. The Digital Agenda of the EU that includes the regulatory framework for competition and growth in the field of e-communications is managed by DG Connect, the European Commission Directorate General for Communications Networks, Content & Technology [248].

4.2.2.3 The USA

Basic rules regulating privacy in the USA are constituted in the Bill of Rights. However, rather than protecting the privacy of it's citizens, the American Government has a stronger focus on preventing national threat (i.e. terrorism). While the Privacy Act of 1974 protects personally identifiable information and prohibits disclosure of these data without the written consent of the individual [288], due to the terrorist attacks on 9/11, the Patriot Act of 2001 permits extended surveillance and data retention (even for marketing purposes [259]) without court order. This affects cloud services on US-American infrastructure services, used by foreign stakeholders [213]. Similar restraints can be observed with the Foreign Intelligence Surveillance Act of 1978 [253] and the Protect America Act of 2007 [277], which provided the lawful conditions for the surveillance software PRISM. Moreover, the Electronic Communications Privacy Act (ECPA) of 1986 [234] and the Telecommunications Act of 1996 [252] have become obsolete with the fast pace of digital technologies, allowing the US government to track mobile communications. The Digital Millenium Copyright Act (DMCA) [287] regulating US-American copyright laws has served as a basis for the EU Electronic Commerce Directive and the EU Copyright Directive. Last but not least, the guidelines from the FTC Fair Information Practices, representing widely accepted concepts concerning fair information practices, form the basis for all modern privacy laws. As for the status quo, they are heavily challenged by Big Data issues.[278, p.74]

4.2.2.4 Global regulations

There are not many global regulations for data so far. The World Economic Forum has launched a project entitled “Rethinking Personal Data”, bringing together a wide spectrum of stakeholders [290]. The World Intellectual Property Organization (WIPO), a specialized agency of the United Nations, is dedicated to “the use of intellectual property (patents, copyright, trademarks, designs, etc.) as a means of stimulating innovation and creativity”. Including 186 member states and administering 25 international treaties, it has a pioneering role in harmonizing data laws.[292]

4.2.3 Environment and infrastructure

Environment, infrastructures and transportation systems are key factors that provide a city with its habitable atmosphere. The following section portrays the existing condition on how transportation and city architectures are sustained today.

4.2.3.1 Private transportation

In 2013, cars are a widespread form of transportation. While providing independency, they also introduce many issues. In Germany there are 640 cars per 1000 citizens including those without a driver’s license [265]. In response to pollution and traffic issues, Germany began to certify to what degree cars are environmentally friendly, letting cities decide where “low emission zones” are located. This allows only grant certified environmentally friendly cars enter this area, reducing pollutants and nitrogen oxide emissions [285]. This limits the traffic in “low emission zones” [216]. Another major topic in private transportation is car sharing. For example the government of Munich helped to introduce car sharing through special parking permits, which allow the driver to park in every public parking lot in Munich. This should encourage people to use car sharing and make it more convenient [289]. Lastly, many European countries finance their highways through tolls or temporary permit systems, vignettes. This additional income helps fund maintenance and building new infrastructure, but at the expense of the user [215].

4.2.3.2 Public transportation

Public transportation is a relevant issue for governments. The more convenient and efficient the system is, the more eco-friendly it becomes because more people will use it [286]. There are often incentives for certain groups to use public transportation, such as the "Semesterticket" in Munich, which was driven from students and the politicians of Munich [266].

Another issue is financing new infrastructure and its maintenance. In Germany, the federal government owns many parts of the public transportation infrastructure, thus it has to finance nearly all public transportation projects. The official government financial plan regarding this area is called "Bundesverkehrswegeplan". This plan describes how to finance streets, waterways and the infrastructure for railways [283]. For railways, the construction of new infrastructure is regulated by the "Gesetz über den Ausbau der Schienenwege des Bundes". This law describes the planing and execution of building new rails and investments in these projects [219]. The city government normally runs the public transportation within a city (subway, tram, bus) in Germany, except the suburban trains [279].

4.2.3.3 City architecture

Another relevant issue for Smart Cities is city architecture. In order to be a truly Smart City, it has to be built up from scratch or an existing city has to be reconstructed, for which funds are needed. Their financing and reconstruction of a city are regulated by the "Baugesetzbuch" in Germany. Especially the part on private initiatives is very important, thus the government can hire a company to reach the goal of a political decision, like installing and running cameras for open data [220].

Another topic for a Smart City is the combination of the transportation systems. If switching between a private car and public transportation is easy enough, it will encourage people to go to the public transportation station by car and switch to the public transportation system there. An example of this concept is the idea of the "P+R" Park & Ride GmbH, owned by the government of Munich. It provides cheap parking lots for a day near train stations so that less cars drive to the city [275].

The multi modal transportation of freights is also one topic which is nowadays on research, for example the European Commission's action plan for freight transport logistics [242].

4.3 Trends

Given the status quo, trends in government regulations and political policies will be identified. These trends are chosen based on their five-year impact on

Smart Cities and data marketplaces. There is still a gap between technological implementation and regulation, however the government is becoming more proactive and addressing some of these concern in advance. The first section will describe the governance, saw stakeholders will increase productivity and financial options through more Public Private Partnerships (PPP). Next, data policies will address new approaches to Big Data, data marketplaces, and international enforcement of information violations. Lastly, the environmental and infrastructure regulations and politics will be discussed through electric and high occupancy vehicles and more reliable sustainable development.

4.3.1 Governance

In order to develop more efficient Smart City solutions, governments and city authorities are increasing international knowledge sharing and entering equity partnerships with the private sector [238, p.24]. By involving end-users into the deciscion-making process, innovative solutions and greater satisfaction of citizens can be achieved [280, p.438].

4.3.1.1 The shift toward Public Private Partnership projects

Given the risk aversion of public investors, most Smart City projects will require a partnership between the public sector and the private sector [269, p.2]. Although city authorities may be reluctant to let the private sector control some parts of the city infrastructure, there are many examples of well performing Public Private Partnership (PPP) projects. The prerequisites for success are mainly carefully planned design and good execution [270, p.20].

The importance of PPP models will increase within the next years, as shown by the increasing support of such constellations in city projects [264]. An example of a Smart City project planning to use a PPP model is the Delhi-Mumbai Industrial Corridor project. It is expected to require an investment of 90b USD in total, of which 75% is envisaged to be invested through PPP projects. [232]

There is evidence of political support of PPP Smart City projects in various countries. An example is the Private Finance Initiative promoting the idea of PPP projects launched in the United Kingdom in December 2012 [257]. In Canada, the Smart City Framework designed by The Greater Halifax Partnership is also promoting partnerships between local authorities and private companies [255]. Initiatives supporting PPP models for building new Smart Cities can be also found in Italy and the USA [254][274].

Impact on data marketplaces in Smart Cities

As a result of the increasing application of PPP models, both the public sector and the private sector need to move away from a traditional customer-supplier relationship [222, p.29]. Both sectors have to understand the needs of the counterpart in order to successfully collaborate on developing common Smart City solutions. Consequently, the vendor/technology push will diminish and the technological solutions will become more suitable for the real needs of cities and their citizens.

4.3.1.2 Increasing international cooperation

Added value can be created by sharing experience in areas relevant to Smart Cities [238, p.22]. For this reason, the number of international Smart City initiatives is constantly rising and Smart Cities are often looking for new partnerships across countries.

The aim of the European Initiative on Smart Cities is to spread across Europe best practices of sustainable energy concepts. It supports cities and regions that are wishing to contribute to the reduction of greenhouse gas emissions through sustainable use and production of energy [239]. The Smart Cities and Communities Initiative provides financial support to selected demonstration projects that bring together academics, governments and industries [249, p.26].

International cooperation is evident also between individual countries and cities. For example, the Italian-German cooperation on Smart Cities aims to share technology in the energy, transportation and ICT sectors [273]. An example of a cooperation between cities is the partnership between Palo Alto and Heidelberg whose purpose is to exchange ideas and values in areas of environmental sustainability and innovation-driven economic development [282].

Impact on data marketplaces in Smart Cities

International cooperation between smart cities leads to greater knowledge and best practice sharing. This will necessarily lead to a faster progress in planning and implementing new solutions and make the current ones more effective. By coordinating the efforts within a larger institution such as the EU, a high synergy can be achieved [222, p.30].

4.3.1.3 Greater citizen participation

Citizens are the reason for the existence of cities, therefore, their inclusion in Smart City projects is crucial [222, p.12]. The involvement of citizens is gaining importance especially because many cities are trying to scale-up pilot projects to large-scale and the concept of open and user-driven innovation ecosystems is needed [280, p.433]. An example of such an ecosystem is the concept of a living lab in which all stakeholders including citizens collaborate on innovation processes in a real-world setting [222, p.13].

The European Network of Living Labs is an example that the living labs concept is becoming increasingly popular. It connects over 300 living labs that are all commited to foster co-creation of the Smart City by citizens [235].

Among others, it participates in projects that empower citizens and improve e-Government service applications [236].

Impact on data marketplaces in Smart Cities
Greater involvement of citizens in Smart City projects will lead to the creation of so called Public, Private and People Partnerships [280, p.433]. By enabling citizens to take part in the decision-making process and by facilitating easier communication between citizens and other stakeholders, for example through the use of e-Government Services, a long-term continuity of Smart City projects will be ensured.

4.3.2 Data policies

Once perceived as scarce, data is now vastly abundant and is growing at an alarming rate [224]. With the emerging Smart Cities driven by data analysis, it would be reasonable to imagine an amount of data that is several times the magnitude of data in the world today. As the dependency on data increases, it is certain that the future will experience major changes in political policies and national and international regulations. The following trends discuss the legal and political framework in data issues and their influence on individuals, organizations and data marketplaces in smart cities. Due to differences in ploitical and legal framework of data policies across countries, these trends are primarily described in regards to the countries in European Union.

4.3.2.1 Strengthening individuals' privacy rights

As the Smart City's reliance on data increases, the collection, analysis and usage of data increases as well. Data marketplaces, commercial organizations and governments seek more data to extract more information for significant economic and social benefits [278]. The benefits are observable in various sectors such as healthcare, mobile, power, traffic, secure payments to name a few [284]. Many of these are data-sensitive and, if exploited, may violate the privacy rights of individuals. This means individuals need to trade-off between their privacy and utility [268]. While the present European Union (EU) Data Protection Directive 95/46 (DPD) incorporates personal data legislation, it fails to meet the challenges of "rapid technological developments and globalization" [243] – a trend that is amplified with the rise of smart cities. In cities where data is a vital resource, it is essential that individuals make informed decisions about their privacy to prevent organizations from over exploitation. To address such issues, the political authorities around the world are continuously working on reforming data protection acts to strengthen individuals' privacy rights.

With extensive trade of data within individuals and organizations all over the world, it is very important that the individuals understand the scope of their data. This requires transparency between the stakeholders and genuine consent from individuals. The legislation to encounter such issues are very essential and is an increasing trend. European Commission (EC) is proposing reforms to their former DPD, requiring stricter transparency obligations including easy accessibility and easy understandability[244]. The consent will have to be explicit and not just unambiguous "ensuring the awareness of the data subject that, and to what, he or she gives consent" [244].

Smart Cities operation depends heavily on big data collection and analysis. Parts of this data are only relevant for certain amount of time and purpose, and are obsolete thereafter. New data regulations that are trending towards stronger individual control shall integrate these specific duration limited data and derived information. Along with the reforms to DPD, the EC is also proposing to include a new legislation for "right to be forgotten and to erasure" [244]. In the future, individuals will be able to take back the data that they had once consented to hand out. Moreover, the proposal states that the authorities should take actions to ensure that the notice of erasure is informed to all other third parties[244]. The legislation that is now limited to personal data shall extend to data in the trending data marketplaces. Granting additional control to personal data, individuals will also be able to restrict the processing of data in certain cases[244].

According to DPD, the "principles of protection must apply to any information concerning an identified or identifiable person"[237] and an anonymized data falls outside the scope of the directive. A recent technological development in [226] has further challenged EU DPD, such that they were able to uniquely identify the individuals with 95% accuracy given their set of spatio-temporal points – information of an individual's location at several points in time. When innovations as such take place that are outside the scope of present legislations, the data subjects privacy is at stake. Therefore, it can be well predicted that legislations and policies in data regulations will follow technological developments and will help strengthen privacy rights.

Individuals need to feed in sufficient personal data to obtain a particular service and EU DPD fails to address such issue [276]. However, establishing policies favoring individuals are no more limiting to political authorities as to organizations. Realizing the limited choices of individuals, Deutsche Börse Cloud Exchange allows clients to choose and contract within a unified market and also select the jurisdiction that will apply to the data [229].

Impact on data marketplaces in smart cities

Strengthening privacy rights and granting more control to personal data ensures the awareness of individuals in a Smart City. Individuals can make informed decisions on what data they would want to hand out. The regulations will assist data marketplaces in obtaining rather useful data and efficiently analyzing them for a defined purpose. Data marketplaces will have to comply with the regulations in a way such that they can offer services without violating privacy rights of the citizens.

4.3.2.2 Improving standards for data security

Data that is collected from various sources need to be stored, processed and transferred securely. At a time, when all sectors – finance, healthcare, transportation, public security – are driven by data, the importance of securing raw and processed data is critical. Lack of sufficient standards for data security may lead to severe consequences and even more so in a Smart City where data is considered an essential resource. Unlike present-days where device communications take place mostly with human interaction, it is expected that the future will experience communication between minicomputers, sensors and other machines – commonly referred as the internet of things [256]. It is likely that most of such data is sensitive and hence vulnerable to security attacks. The European Commission General Data Regulation proposal is insisting on stringent security requirements but currently concentrates mostly on personal data [244]. However, as non-personal data tend to become prevalent, the regulations will witness further changes trending towards improvement of security standards for all kinds of data.

Impact on data marketplaces in smart cities
Improved data security standards ensure that the data marketplaces maintain a high level of security system. Given the trend, data marketplaces can observe twofold advantage: on one hand the citizens of the city begin to trust the marketplaces more, which might increase the amount of shared data eventually increasing the utility and on the other hand the organizations can rely more on already available data that help them produce genuine results.

4.3.2.3 Harmonizing data regulations across sectors and regions

Facebook, an online social networking platform, asks its user to consent to their data being "transferred to and processed in the United States" [251]. It is, therefore, evident that certain data is not limited to a particular region or country. Once the data is transferred, the data protection regulations are outside the state's jurisdiction. And the era of globalization, it is impossible to bound data within a country or a city, hence harmonization of data regulations is required. The authorities, understanding the significance, are making attempts to establish harmonized regulations across different regions. The European Commission is proposing "a harmonized and coherent framework allowing for a smooth transfer of personal data across borders within the EU" [244]. However, the cultural differences between countries – for instance United States and countries in EU – raise a question if harmonization of regulations can be extended over the continents.

Impact on data marketplaces in smart cities
Smart Cities are growing around the world and, therefore, data marketplaces work internationally and also in several sectors. Harmonization of data regu-

lations across sectors and regions will enable data marketplaces to streamline policies and procedures. While it is apparent that data marketplaces will enjoy convenience, they will as well save some of their financial resources.

4.3.2.4 Fostering healthy data market competition

Data markets need to be regulated for healthy competition. Google is so far the largest network with extra ordinary data-gathering and data-collecting capability but has often raised questions of being too powerful [258]. A network that is substantial piece of the internet poses the threat of leveraging its power to stifle competition and creating a monopoly in the data market [258]. In order not to allow the rule of a single company, political authorities will establish policies favoring fair competition in the market.

Impact on data marketplaces in smart cities
Policies favoring healthy competition in data marketplaces advance the quality of services and utilities for citizens of Smart Cities without exploiting the data protection regulations for company benefits.

4.3.2.5 Defining accountability and enforcing data infringement

In cases where processing of an inaccurate piece of data leads to negative consequences, it is essential to define the right to liability and compensation if applicable. When the data market grows, trends provisioning legislation addressing liability shall emerge. If approved, Article 77 of European Commissions General Data Regulation proposal will provide grounds for the right to liability.

With emerging smart cities, services depend more on data and hence the value of data will expand with time. While it is expected that all organizations comply with the regulations, at times data infringements are inevitable. Since the data is increasingly valuable, the authorities will enforce stringent actions against infringements. In 2013, Sony breached the Data Protection Act in [225] and was fined 396,100 $ [208]. European Commission is also proposing that member states "lay down rules on penalties to infringements of the provisions"[244] of the Regulation.

Impact on data marketplaces in smart cities
The given trend will require data marketplaces in Smart Cities to process data with more caution and pay special attention to regulation in order to avoid being liable for data infringement. cautiously process data and to pay special attention to the regulations.

4.3.3 Environment and infrastructure

Environment, infrastructures and transportation systems are key factors that provide a city with its habitable atmosphere. The following section portrays the existing condition on how transportation and city architectures are sustained today.

4.3.3.1 More benefits for high occupancy vehicles

The demand for roadways with higher commuter capacity will increase. Two immediate solutions that can be implemented are High Occupancy Vehicle (HOV) and High Occupancy Toll (HOT) lanes. Implementation has occured from bus lanes to minimum passenger regulated lanes, electric vehicles, and hybrid vehicles. These lanes have been found to be highly effective when dealing with highly-congested areas because road capacity can be noticably increased. HOV lanes limit commuters soley based on the number of occupants, but High Occupancy Toll (HOT) lanes limit commuters based on a combination of number of occupants and a toll. HOT lanes can dynamically adjust costs to ensure the lane is fully utilized in non-peak times, while providing revenue to fund the project. Thus, the toll discourages drivers with low occupancy vehicles through charging those commuters a premium. Regulations began in congested areas in the United States in the 1970s [267, p.3]. Since, there have been variations implemented from Canada to Austrailia, England, Sweden, Spain and Germany. Germany will be looking towards HOV and HOT lane alternatives to increase roadway capacity, and lessen environmental impact, driven by the 2020 environmental initiative, a strong ride-share (Mitfahrgelegenheit) followership, and the developing transportation projects emerging in and around the EU.

Impact on data marketplaces in Smart Cities

As cities are built and become rennovated, the easiest way to impact transportation is legislation that encourages HOVs (and HOTs in specific places). These special transportation lanes have already entered the European market and will continue to be more widespread. This is a specific market for data, that public services and developers will be particularly interested in.

4.3.3.2 Increasing number of electrical vehicles

In order to limit air pollution some governments have decided to decrease the amount of gasoline cars on the streets. For instance in Shanghai the government decided to ban all (new) gasoline scooters and only allows LPG scooters or e-bikes. As a result Shanghai is one of the cities with the highest amount of e-bikes [262, pp.13-14]. This example can become reality for normal cars as well, if the pollution increases. The trend is to register more electrical vehicles instead of gasoline vehicles. For example BMW is going to develop electrical cars and test them for serial production [272].

The German government decided that one million electric cars should be registered until 2020 and six millions until 2030. Therefore the government will give drivers of electric vehicles benefits in car taxes for the next ten years, parking lots for electric cars and let them use bus lanes [218].

Another major topic related to electrical vehicles is the availability of fast charging stations, because there are some technical issues. The distance of a electrical car like the BMW i3 is nowadays between 150 and 200km. Also the charging time without fast charging stations can take up to 8h [211]. The European Union for example wants to have new fast charging station in Europe until the end of 2020. For instance, there are 2,000 stations in Germany there should be 150,000 stations until 2020 [247]. The European Union pushes this trend together with the European Commission investing about 0.5b EUR and the European Investment Bank providing 4b EUR loans to car manufacturers [250, p.6].

Impact on data marketplaces in Smart Cities

In Smart Cities electrical vehicles can be easily used for car sharing, as it is often limited to a small area within the city. A data marketplace provider can combine the information of all the car sharing companies and persons to improve the daily life of the citizens. The information of available parking lots and charging stations can easily transmitted from the data marketplace to the drivers.

4.3.3.3 Creating a uniform and transparent method for rating green architecture

Buildings account for roughly 40% of energy consumption and "30% of energy used in buildings could be reduced with net economic benefit by 2030" [233]. Green architecture rating systems can solve this problem through making the environmental impact much more transpartent. Today, there are numerous countries with Green Building Councils, and many of these have their own rating system. The current trend is uniting these Green Building Councils. That way countries can be more accountable. A new system needs to be constructed that will utilize the internet of things to promote education and conservation, while drawing from international experiences. The United States Green Building Council (USGBC) was an early mover with its Leadership in Environmental and Energy Design (LEED) certification that rates builidngs environmental friendliness. While currently the EU currently has an eco-label mandated by the Regulation (EEC) 880/92 in 1992, and more recently updated by Regulation (EC) No 66/2010. This rating is not sufficient. The success of LEED has led the USGBC to tailoring the certification to adopt to European markets [263]. Thus, in 2002, the USGBC partnered with seven other green building organizations to form the World Green Building Council (WGBC). This influence has spread to the European Union [291]. Now the EU is looking to have certifications similar to the LEED System. This would unify the European market. For the consumer, such a certification would be transparent and easy to comprehend. For businesseses, a certification would encourage energy and pollution reduction. This year, the WGBC set international relationships with the International Finance Corporation (IFC). “The partnership will focus on rapidly urbanizing countries with surging population growth that need to build sustainably to avoid emissions growth, bolster energy security, and minimize resource depletion” [223]. The emergence of a international collaborative green rating system is the next major step in significantly reducing energy usage and pollution, and is of the upmost importance during the transformation to Smart Cities.

Impact on data marketplaces Smart Cities
A uniform rating system will allow for much more consistent and more rapid development of Smart Cities. Specifically within the EU, new goals and regulations will be possible because there will be a standard basis to measure how “green” existing and new buildings will be. The use of ’the internet of things’ will be essentialy to sucessfully develop such a system. Lastly, political incentives aimed to improved these ratings will contribute towards the shift in E-Governance.

4.4 Conclusion

Trends in legal regulation and political discussion play a critical role in the development of Data Marketplaces and Smart Cities. An increasing internationalization of Smart City projects together with best practice sharing among existing Smart Cities have the potential to enhance and accelerate the development of new Smart Cities and the conversion of traditional cities into Smart Cities. The lack of financial resources which cities face will be overcome through involving commercial partners in Private Public Partnerships (PPP) models. Apart from commercial partners, also the citizens are becoming increasingly more involved in Smart City projects, because their cooperation is essential when continuity of new Smart Cities should be secured. An inherent part of Smart Cities are data gathered in Data Marketplaces. The way of treating data has been changing in the last couple of years and especially in the European Union the topic of enhancing data privacy and data security is turning into a pivotal point of political discussions. The focus on this topic is coupled with a debate leading to a gradual harmonization of data policies across sectors and regions. With the increasing importance of data, the question of data infringement is emerging. As any city, Smart Cities comprise infrastructure and are highly dependent on the natural environment. Therefore, the number of electrical vehicles is expected to increase and further benefits for high occupancy vehicles are likely to be introduced. Since the importance of reducing the environmental footprint of city architecture is rising, a uniform and transparent rating system for green architecture will be established.

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Chapter 5

5 Emerging Business Models

Dragan Mileski, Sascha Ritz, Philip Stroisch, Yoana Tsoneva

Executive Summary

In order to take one of the upcoming opportunities in the span of Big Data marketplaces, it is crucial to understand the whole value chain as well as the different business models within it. Especially in the area of Smart Cities companies will have to face enormous challenges to be able to stay competitive. The value chain already started to merge vertically - companies are trying to cover more steps of the value chain by taking over smaller parties. The pricing models are shifting from payment-per-data to payment-per-information as well as recommendation-as-a-service increases. At the same time, the amount of data is growing. Every two years the amount of data doubles compared to the data collected ever since. This data comes from various sources and needs to be processed in real time. Another trend is the vertical integration of related value chains in both directions, forward and backward. The acquisition of companies positioned at single steps of the value chain helps firms to gain more control about the process collecting and analysing data. In addition underlying data infrastructure grows as mobile sensor networks and data processing software are introduced.

5.1 Introduction

The global growth of data volume is estimated at 40 % per year which leads to a multiplication of global data by a factor of 44 between the year 2009 and 2022 [306]. Taking into account the trend of global urbanization, the question for existing and emerging business models in the intersection of Big Data and smart cities arises. Nearly 80 % of the global GDP is generated by 50 % of the global population living in cities. Out of these urban areas only 600 urban centers represent around 60 % of the global annual GDP [321].

Cities comprise a variety of economically relevant sectors from energy to mobility and logistics to health. Data generated outside and within cities can be leveraged to increase the efficiency of existing businesses by using advanced analysis and prediction software and infrastructure. In order to facilitate the development of these data tools, marketplaces where data is collected, filtered and refined are a crucial component on the way to the wide usage of Big Data in smart cities.

This chapter focuses on existing and emerging business models related to data marketplaces in smart cities by describing the core characteristics of different models and their specific parts of the value chain within a data marketplace. Starting at setting up and running data networks, e.g. sensor networks in M2M communication or cellular phone networks, followed by collecting raw data, the value chain of data marketplaces continues with the analysis of data. Raw data can be refined by the apllication of filters extracting only relevant information in order to derive recommendations and prescriptions which have more value than raw data. Analysing data is classified into three groups starting at descriptive, followed by predictive and prescriptive analysis [365]. These analysed data are then sold to the demand side of a data marketplace.

Chapter 5.2 gives an overview of already existing business models in data marketplaces with regard to Big Data usage as well as to services that support data marketplaces. Chapter 5.3 continues with emerging business models with a focus on trends in the area of aggregation of diverse data sources, vertical integration and underlying infrastructure in data marketplaces.

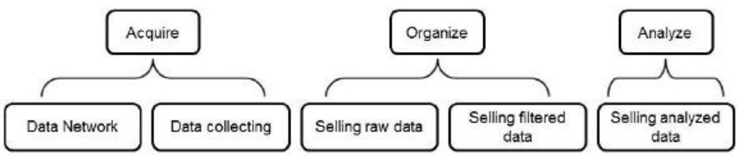

Figure 5.1: Data marketplace value chain

5.2 Status quo

The following chapter will give a brief overview of business models used by established companies in data marketplaces. The current business models in Big Data usage shaped trough partial vertical integration are: Data brokerage, Big Data consulting services and verticaly integrated data services. To provide the needed data, an established infrastructure is necessary. This leads to various business models in providing infrastructure as well as software for analyzing data. The business models can be separated into two categories: business models in Big Data usage and business models in supporting services. Taking into account these current business models, a whole new portfolio of business models opens up around Big Data marketplaces[298].

5.2.1 Business models in Big Data usage

Looking at the value chain of data marketplaces, already existing business models can be found on single or slightly integrated steps of the value chain, each model specialized on the handling of data generated in sensor networks. Besides the brokerage of collected, raw data, some market players are specialized on the analysis of data in order to turn data into valuable insights for their clients. Other players already offer integrated data services along the value chain and service bundles to their customers.

5.2.1.1 Brokerage of data

Data Brokers are companies that collect various sorts of data and then sell this information for a variety of uses. Data Brokers collect consumer information such as online transactions, purchase behavior, consumer interest information, sales details, data from people's social networks, and demographic statistics from millions of different databases that have been collected by themselves or by other organizations that can be categorized as 'Data Brokers.' They sell data such as names, contact information, additional demographics like age, race, occupation and level of education [296]. The data can also be very specific ranging from driving behavior taken from traffic reports, to how many times a person has been abroad. There are also Big Data Brokers that sell information about products like Amazon, customer preferences like Facebook, about places like Google Maps, about manufacturers, about employee names, about events and so on. For example everything that is typed into Google, Facebook or mobile phones, every e-mail, chat conversation or cloud document is available for usage of the Data Brokers.

Some of the data they are trading with is free and publicly shared for everyone. This data is called Open Data and it si provided mainly by organisations financed from the government or from the goverment itself. The main idea behind the Open Data is to attract entrepreneurs and community minded leaders to build innovative things with the help of that data. The US Government for example, decided to make the government-held data publicly accessible in a machine-readable format to let this data serve as a fuel for innovation and economic growth [351]. The rest of the data from the data package is bought from other companies and its pirpose is to enrich the Open Data. The merging process is very important because it is all about adding structure to the complex combination of various data sources. After the job is done the data is ready to be sold to the highest bidder.

5.2.1.2 Big Data consulting services

"Strategic Big Data" is a technology trend that Gartner announced in its "Top 10 Strategic Technology trends for 2013" report[313]. In this report Gartner claims that Big Data causes rapid changes in infrastructure with projections for \$232 billion in IT spending by 2016 [313]. Most of the IT leaders and information managers are aware of the Big Data potential and are planning to change their company's IT infrastructures and warehouses. However, not every company knows how to address this issue due to lack of insights and experience in the Big Data field. As an answer on the demand, the supply is business segment providing Big Data consulting services!

"Pythian" for example, is a company that offers various range of services on different levels like system architecture, data architecture, capacity planning, performance solutions etc. Their service portfolio includes: architect powerful data systems that support business-critical processes with increased efficiency and reliability, design or re-architect existing data bases, remove performance bottlenecks and improve scalability of entire company systems [355].

"EMC2" is a similar company that claims offering consulting services across the whole spectrum of Big Data capabilities such as: data warehouses, data governance, business intelligence solutions, data quality, etc. that help their clients to bridge the gap from the current IT architecture to the next generation Big Data architectures [360]. The large scale enterprises like HP, Oracle, IBM, Microsoft etc. are also providing consultancy services. However, most of them are powerful enough to provide products and services from all levels of the Big Data value chain. Therefore they are classified in the next section - "Vertically integrated data services". The Big Data consultancies are addressing the B2B market segments. Their costs are mainly related to human resources, because building the right engineering teams of Big Data experts is crucial for their business.

5.2.1.3 Vertically integrated data services

Smart dealers acquire, organize and analyze data, i.e. they have vertically integrated the steps of the value chain in order to realize synergies between these steps and to add more value to their product portfolio. Companies

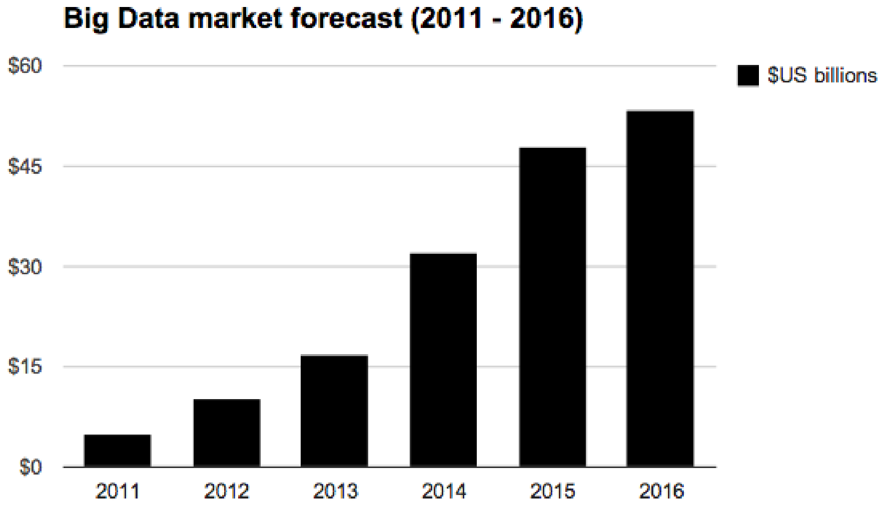

Figure 5.2: Big Data market size[367]

usually start by collecting data of existing data sources which are run by other parties. Large corporations can be classified into these business models, such as IBM, Microsoft and Oracle. They are primarily acting in a B2B environment offering their customers one interface to their services. Their focus lies on descriptive and predictive analysis of data they get from customers in order to provide a foundation for business decisions. Targeted customers have their own infrastructure for the collection of data, hence they have a certain size. Customers can be located in public services of cities, e.g. utilities with water networks that want to improve leak detection, forecast water demand and manage the supply more efficiently. Pricing is mainly calculated on a project basis for setting up the infrastructure and often linked to the project duration.

5.2.2 Business models in supporting services

Acqusition, organization and analysis of data - an infrastructure for Big Data has unique requirements. In the acqusition phase it have to be able to handle very high transaction volumes in a mainly decentralized environment. The gathered data must then be organized. Therefore the infrastructre must be able to process and manage the high volume of Big Data at the original storage location - to save money and time by not moving around large amounts of data.

For analyzing Big Data, companies need a software that is able to manage a large variety of data types stored in diverse systems [307]. The business models in this section provide a wide range of services, starting from pure hardware sensors up to the software needed to get useful information out of the gathered raw data.

5.2.2.1 Infrastructure

To be able to handle high volumes of data, the infrastructure needs to support a delivery of low, predictive latency in capturing and executing data [307]. Business models operating in this sectors have to face specific technical requirements. Usually infrastructure providers focus is on manufacturing sensory for instrumenting natural spaces, especially in the area of Smart Cities [301]. These data collection can take place in a variety of applications like infrastructure or habitat monitoring for providing the customer extra value by optimizing their logistic processes or by localizing vehicles in real time [339].

Examplary companies for established infrastructure providers are Agilion, Moog Crossbow or Enocean. While Moog Crossbow specializes in connecting the physical to the digital world by providing the necessary hardware, Agilion and others have established solid businesses by vertical integrating in other parts of the value chain on top [345]. Agilion, Enocean and others are targeting mainly the industry sector by providing wireless communication and location in real time. By selling the needed hardware like sensors but also by setting up the intelligent infrastructure with short time installation services, they extended their value chain vertically and gain extra value in revenue. The main focus still lies on providing smart wireless commication sensors to gather real time data [293][310].

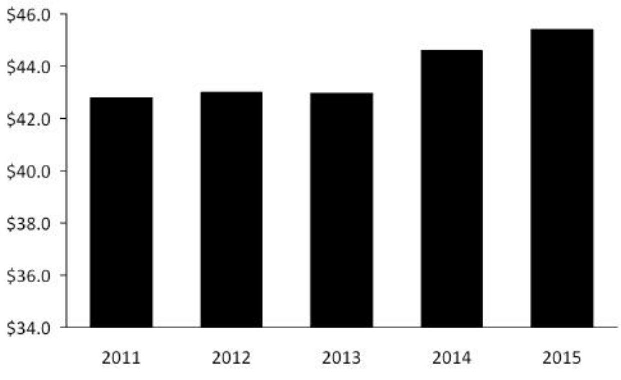

Figure 5.3: Worldwide Capital Expenditures by Carriers on Wireless Infrastructure (Billions of US Dollars) [322].

5.2.2.2 Analytics software

Knowing the fact that around 90% of the world data was generated in the last two years [347] and the increase contiues, companies that had vision and insights into the Big Data field established BI software product lines, that brought high revenue streams to their budgets [304]. For a large enterprise, the data volume may be at the petabyte scale, while for a small or middle size enterprise, data volumes may grow into tens or hundreds of terabytes [304]. Such data streams are very challenging for managing and analysis.. That makes easy-to-use business analytics tools more important than ever because the ability for businesses to visualize data, spot trends and define their strategy and innovation goals is becoming crucial.

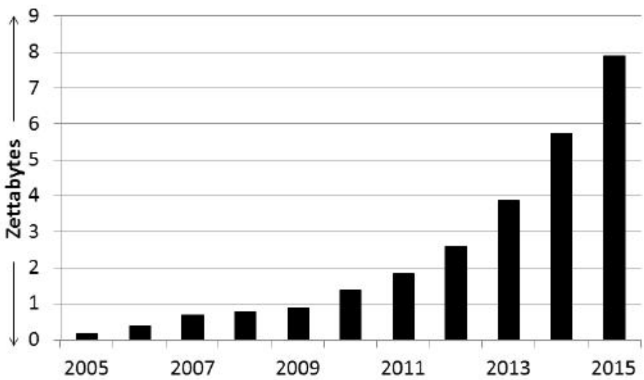

Figure 5.4: Global data volume

Reports from 2010 show that the Big Data software analytics industry on its own was worth more than \$100 billion with a growth rate of almost 10% per year. This is about twice as fast as than the whole software business in general[304]. That is the reason why companies like IBM, Oracle, SAP, Microsoft etc. have spent more than \$15 billion on R&D and acquisitions which help them to develop a comprehensive, integrated, and easy to use Big Data platforms to address the full spectrum of Big Data BI challenges [304]. IBM for example, established analytics software product line that includes establishing relationships between disparate data sources, low-latency real time data processing, deriving data from Big Data repositories, including Hadoop, relational databases, data warehouses and some other external sources like cloud infrastructure [319]. Oracle, on the other hand, developed “Oracle Advanced Analytics” which provides all core analytic capabilities and languages on a powerful in-database architecture that ensures low latency in real time data analytics, reliability, and security [349]. Microsoft with their “Microsoft Big Data” platform [343] and SAP with Sap

Hana in-memory-computing platform [358] ensure the existence of high level competition as as stimulus for further research and better innovations in this market. Analytics software companies are addressing the B2B environment.

5.3 Trends

Two years ago Big Data analytics was barely used but it was providing its few users satisfying results uncovering them its unlimited potential [357]. Nowadays its full exploitation is one of the most important challenges businesses are facing. Big Data is an enabler of change and contains great potential for the progression of Smart Cities. By unfolding the potential of Big Data, societies wealth could increase as well as businesses could benefit by finding new ways for monetization [346]. The following chapters will provide a detailed overview of some of the business models which will arise within a timeframe of three to five years and which will be used for the monetization of Big Data in Smart Cities.

5.3.1 Aggregating data from various sources

A key factor in the development of promising future business models is going to be the possibility of aggregating large amounts of data from various sources. Until now, the data collected from one source about one specific area was used to improve services and products in this specific area [362]. Now companies see a lot of unexplored potential in aggregating data from different sources, which could provide an important insight and will enable better predictions, higher sustainability or various product improvements [318].

A second significant factor, which enables the emerging of new business models in the era of Big Data is the time. Time is gaining rapidly importance for Big Data usage. New technologies are facilitating real time analyses of data and their importance is rapidly increasing. They will help companies to make data driven decisions in real time. This trend has the potential to drive a radical transformation in research, innovation and marketing [300]. Furthermore, real time Big Data analysis will play central role in Smart Cities development [297]. Information and communication technologies should make urban infrastructure and services more aware, interactive and efficient[316].

5.3.1.1 Increasing value of real time data analysis

The increasing number of startups developing different methods for real time data analysis is pointing out the importance of the time factor in the further Big Data usage [366]. While some of these companies develop products for end consumers, others are focusing on real time solutions for businesses. Diverse examples across several industries could be found for both.

Velocity is going to be one of the key attributes of Big Data. In the future, the speed of data analysis seams even more important than its volume. Real time or nearly real time information allows companies to be more agile than their competitors [340]or even creates new products like in the case of M2M communication [341].

Impact of real time Big Data analytics on the mobility sector

Taking a look at startups like AutoNOMOS Labs, which produce autonomous driving cars for urban use or even at bigger companies like Mercedes Benz with its concept of the “Car to X Communication” it is easy to see how crucial real time data analysis trough sensors is. Especially important is its combination with data from other sources in order to react to changes in the environment [294][342][332]. Other companies provide real time traffic information in order to avoid traffic jam or to find faster a parking place [331]. Streetline for example targets the parking market, which is a $25 billion industry in the United States [361]. This company’s main revenue stream is the subscription while other innovative start-ups in this same market offer their services for free to the clients. Others companies like ParkYa, for example, finance themselves only through in-app advertisement. They provide advertisers the possibility to deliver the right information at the right time and at the right place and they do this by displaying ads when the clients are approaching specific location [352].

In summary, the possibility to analyze real time data fast and precise generates new business possibilities for companies. Hence, in the future the importance of real time data is going to continue increasing.

Real time Big Data analytics for more efficiency

Real time data is being applied also in the energy and utility market. Startups like Volta, Ecofactor and Space Time Insight analyze data from sensors and weather forecasts in order to provide their customers the possibility to save energy and to make its use more efficient [309][364][320]. Real time Big Data analytics are explored also for retail and e-commerce. Online groceries like Fresh Direct go much further by adjusting prices daily or even on more frequent basis. They also personalize offers and promotions, which leads to increasing customer loyalty and satisfaction [308][300].

In these economic sectors, the increasing velocity of data analysis has already created an environment for the application of new business models and for the commercialization of new products.

Influence of real time Big Data analytics on businesses

Even if mentioned companies are targeting three different industries, they have something in common in their business models. They all collect data from their environment and analyze it in real time with one clear essential - to increase data monetization trough a timely, more precise, granular and frequent fact-base decision making both for customers and companies [325].

The growing velocity of real time data analytics will provide companies in the feature the necessary insights to optimize their products and services. Furthermore, this will allow them to add more value to their products or to enrich it with new functionalities. Lastly, companies will be able to provide their clients with customized products and it will increase their satisfaction [314].

Various new revenue streams make the usage of real time data attractive for companies. On the B2B side one of the possibilities to monetize real time Big Data is to exchange or sell it to other companies who need it for better predictions. On the B2C side the gained information could help prevent churn, allow further personalization of products and advertisements and also facilitate the use of tools for cross-selling, up-selling, next-best offers, customer attraction and attrition management [337].

Impact on data marketplaces in Smart Cities
In the context of Smart Cities, money is not the only motivation for the further exploitation of real time data. There are other key influencers like the possibility to automate some areas of our life within a city, which leads to a continually improvement in the analytics tools. Moreover, better and faster data analytics will make existing cities in the future more energy efficient and more sustainable.

5.3.1.2 Improving predictive analysis

Many use cases where Big Data finds application implicate the combination of data from different time frames. Acquiring data is only the first step. Furthermore, the combination of past and real time information brings to companies higher value and enables them to predict better the future. Because if innovation is the final target, predictive analytics needs to be part of the equation[359]. Additionally, predictive analytics represent one innovative approach for data monetization and they have the potential to create new business model where companies aggregate data from different sources for mutual benefit[336].

In the energy sector, companies are already using predictive analysis. For example IBM and Space-Time Insight are turning to data analytics to fully leverage the capabilities of the Smart Grids [320]. Based on whether predications in combination with old weather data, energy companies can optimize the usage of the green energy by lowering the produce of traditional energy, they are going to produce. Furthermore, this optimization can lead to totally new business models. For instance the opportunity to pay for the exact consumption of green energy and the possibility to better predict activities in a households according to this green energy.

The combination of real-time and historical data has a clear value proposition. It allows better prediction of the usage of goods and services. On the other side, it leads to cost reduction and time saving for providers. Furthermore, combining data from different time frames and sources will create new, optimized value offers for the consumers by giving them faster and cheaper services[324].

Predictive analytics are beneficial for a B2B and on a large scale for the B2C environment. They create the possibility for exacter payments. A good example is the so called “pay as you throw” system where everybody pays for the exact amount of waste he produces. On the other hand, city councils can better predict the amount of trucks and employees they need to take care of this waste. This business model allows costs and time savings for both parties and is possible only because of the combination of real time data and past data. Moreover, predictive analytics creates various revenue streams for the companies which enable them. Some companies offer the need software for the data collecting and storage for free in order to win more clients. Afterwards, they offer their clients crossed analytics, which are the main challenge that companies face when it is about Big Data. This service is no longer freemium but premium and represents the main revenue stream of analytical companies.

Impact on data marketplaces in Smart Cities
Prediction base on real-time data and historical data are essential for Smart Cities and their infrastructure. They will lead to improvement across various industries. Furthermore, the possibility to predict consumption and production will increase the efficiency of a Smart City. This will allow citizens and businesses to save time, cost and energy[317].

5.3.2 Further vertical integration in data marketplaces

Vertical integration can be observed in both directions of the value chain - towards a higher degree of data analysis as well as towards the underlying infrastructure for the aquisition of raw data. Data vendors upgrade their analytic services for their customers by aggregating data from various sources and introducing real time analysis. Therefore they have to gain control about the supporting infrastructure in order to ensure availability and reliability of different data sources. This is of particular importance against the increasing amounts of data generated by sensor networks in the area of M2M generated and human sourced data. The distribution of systems in these networks is highly correlated to complexity and deferment of data delivery. Reducing complexity and avoiding deferments is facilitated by segregating third parties that cover single steps of the value chain. At the same time pricing models are going to shift from payment-per-data towards payment-per-information, i.e. customers pay for the insights and recommendations generated by the analytical process of raw data. Recommendations and predictions with a higher informative values sold to customers have therefore a higher financial value with greater impact on revenue streams. Besides data and information-as-a-service, business models are going to include analytics and recommendations-as-a-service. In order to provide these high-end services to their customers, data vendors step into the offering of predictive and prescriptive solutions to better support decision processes of their customers.

5.3.2.1 Further forward integration of data marketplace value chain

As clients of data vendors demand concrete results and implications derived by data for their businesses, data itself – even structured – has less value. Customers are more willing to pay if concrete insights can be derived. Therefore recommendation and prescriptions based on data analysis have more value. In order to deliver this value data vendors are forced to offer additional services in the field of data analysis and have to cover additional steps of the value chain for the delivering of value-added services to their customers. Several acquisitions of startups by larger companies in the field of data analytics, such as the acquiring of Infochimps by CSC [329] or several acquirements by Twitter [354, 330], indicate this development. The underlying business models can increase revenue streams coming from an improved product portfolio.

Impact on data marketplaces in Smart Cities
As small, specialized companies are often bought by larger corporations, acquired service portfolios are added to existing product portfolios of larger corporations. These integrated companies are able to offer a variety of services on a data marketplace in a Smart City. The standardization of technical requirements, e.g. data format increases efficiency and reduces complexity. This development might be able to stimulate a better environment for the acceptance of data usage for Smart Cities. On the other hand the early acquisition of small firms might lead to monopolistic market setting and hinders innovation.

5.3.2.2 Further backward integration of data marketplace value chain

The amount of data which is acquired through sensor networks, such as M2M sensor networks or smartphones, increases and rises challenges to companies within data marketplaces. Heterogenity and intermittent connectivity of sensor networks as well as systemwide security are the main challenges that players face in data marketplaces [333] and hinder the utilization of Big Data. To face this problem, one solution for software and data analytics are activities that increase the level of contro over sensor networks. This backward integration can be observed in different industry segment, e.g. the acquisition of Motorola by Google [334], the transaction between Microsoft and the devices and service business of Nokia [344] or the acquisition of ChipSensors by Silicon Labs [302]. This trend can often be observed as entry into the hardware business for better synchronizing requirements between hardware and software and making resources work more efficient. This trend leads to integrated companies generating more sources of revenue and creating lock-in effects for customers due to a broader service portfolio.

Impact on data marketplaces in Smart Cities

The consequence for Smart Cities could be the existence of only few players setting the standards for sensor networks in order to guarantee full utilization of sensor networks and avoiding inefficiency caused by heterogeneity.

5.3.3 Building Big Data analytics infrastructure

Most of the companies are not yet ready to manage the incremental changes confronting them regarding new information infrastructure because the potential of economic value behind the quantified information out there is not yet seen [299]. To gather and analyze Big Data and gain the needed information, great changes have to happen on both sides - hardware and software. To benefit from the possible potential of Big Data, the capacities of the current infrastructure have to increase. This section will provide two future trends which are starting to develop in the area of infrastructure for Smart Cities - the expanding utilization of mobile sensor networks and software to gather all kinds of information from raw data.

5.3.3.1 Increasing need for software analytic services

In their core, Smart Cities like Songdo in South Korea are all about connectivity [315]. In the perfect Smart City every device is going be connected with others trough wireless sensors and microchips. This will reflect in innovations like for example streetlights that adjust automatically to the number of people on the street. Furthermore, the Smart Cities of the future will use innovative garbage systems for waste management, which will allow that everybody pays according to the amount of disposal he produces – known also like pay-as-you-throw system [311]. The interconnectivity between the devices in the city will create a perfect environment for the creation of urban surveillance system, which should provide more safety in big cities. This connectivity will lead to a massive amount of data, which on its side comes with the need for software, powerful enough to analyze this data [328].

In order to satisfy this need, businesses are working for the creation of the right tools to capture and organize a wide variety of data types from different sources. These tools not only have the possibility to collect and combine relevant information. They are going to be able to easily analyze it within the context of all their past enterprise data, which will provide them with valuable insights about customers patterns. Some first mover companies in this area are Splice Machine which raised $4 million to develop its SQL Engine for Big Data apps , Cloudera and also Karmasphere.

Freemium and premium services

Companies start to introduce different techniques to monetize these analytical tools. Splice Machine uses its SQL Engine to enable companies to find insights in their Big Data and to monetize these insights. It charges for each one of its services. On the other hand, Claudera distributes the 100% open source Apache Hadoop for storing and processing Big Data [326]. But a part of this free piece of the cake, that aims only to show a small part of the opportunities which Big Data provides for businesses, the company offers a lot of additional products that empower the fully exploitation of Big Data. These additional services like management applications for real-time delivery with Apache HBase, database integration, Back-up and Disaster recovery represent the main revenue stream of the company.

Pay-as-you-go

Another interesting business model in the area of software for Big Data analytics is provided by Karmasphere. It works in cooperation with Amazon. It uses Amazons EMR to enable Big Data analytics on a “pay-as-you-go” basis. This solution is faster and more cost-effective than others are, because the clients do not need to build the technical infrastructure for Apache Hadoop. The client just uploads its data in the cloud and pays only for the resources that Karmasphere used for the analytics [326]. Paying options like this will emerge in the future, because they allow the user to pay only for the results he wants, without having to take care for the technical details.

Impact on data marketplaces in Smart Cities

Analytic software that is powerful enough to manage impressive amounts of data is crucial part of data marketplaces in Smart Cities [350]. To derive a business value from Big Data tools for capturing, organizing and analyzing data are needed. Without these tools, it is going to be impossible to extract the useful insights from the data streams of an enterprise. These data analytic tools are especially important for the existence of Smart Cities.

5.3.3.2 Increasing utilization of mobile sensor networks

Over the next years, as the Internet of Things is moving towards to the Internet of Everything, wireless sensor networks will play an important junction for gathering all kinds of new data. Cisco predicts global mobile data traffic will grow three times faster than fixed traffic within the next years [305]. Global mobile data traffic was one percent of total IP in 2010, and will be eight percent of total traffic in 2015. The cost and time spend to establish such a large scale sensor network can be easily monumental. As science estimate and new startups indicate, a solution is arising: mobile phones serve as sensors. They already provide a ready-made, powerful and pervasive wireless infrastructure with a massive potential. They are able to work in nearly every environment and already making decisions based on contextual data like location etc. [303][323]. Since 75% of the world's inhabitants have access to a mobile phone, the opportunity to gather geospatial data with much higher exactness increases constantly [368][303]. As mobile phones are becoming even smarter over time, experts suggests that they will be equipped with even more sensors such as altimeter sensors which provide information about your current location in buildings detectors which monitor your excitement level and mood. Researchers are already working on solving social problems by putting extra sensors into the cell phones to control the spread of diseases or collecting data regarding air pollution [295]. A Mexican city called Tuxtla Gutiérrez uses already mobile phones as sensors unter the cities "Vigilante Taxi Driver" program, in which cab drivers are using GPS-enabled mobile phones to report accidents, downed streetlights etc. to support the government [303]. Those new ways to collect data will bring new business models in a broad range of areas such as environmental monitoring, shopping, health care and gamification.

Environmental sensor networks One of the first movers in environmental monitoring are startups like Intersoft Eurasia, Vaavud or Lumu. All three developed environmental sensors which are able to connect as plugin-hardware to a usual smartphone [335]. With those sensors they are already able to provide wind meters, light meters or in the case of Intersoft Eurasia radiation exposure [338][312][363]. The approach by Intersoft Eurasia is to take measurements everywhere by crowdsourcing the needed sensors to users of mobile devices and make the collected data accessible for everyone [312]. All three mentioned startups provide different data, still the their approaches are quite similar. They provide an external device which can be used by everyone with a smartphone. Even though all mentioned startups are still in their beginnings, there is a great upscale potential by selling the crowdsourced data with a payment-per-data or payment-per-information pricing model to companies which could use the data to optimize their products or to the government which could optimize the cities infrastructure. Another possibility would be to include analytics and recommendations based on the specific need of the customer.

Shopping behaviour measuring Recently a couple of startups arised using a variety of technologies to track people in-store. RetailNext, one of the first mover in real-time store monitoring enables retailers and manufacturers to collect, analyze, and visualize their in-store data by tracking consumer movements through video cameras, WiFi devices and other sources [356]. Startups like Nomi and Path Intelligence are using mobile phone signals to gather mobile device IDs as people enter or pass the store through WiFi or small sensor networks that can track the phones radio signals down to a one to tree meter proximity [348][353]. Using machine learning to intentify areal relationships of consumer footpaths, the stores have totally new possibilities to improve their services. By using the gatherd data to run A/B test on window displays, shops could determine which display result in higher window-conversion rate [327]. By further developing these technologies, new possiblities can emerge which could help shops optimize the customer shopping experience, in return increase revenue and therefore stay more competetive against the increasing electronic commerce. Regarding the business models for shopping behaviour monitoring providers, there are different possible pricing models. Path intelligence charge their customers in monthly rates for providing the needed infrastructure to track the mobile devices and therefore the customer is allowed to use their software for analyzing the raw data on freemium basis. Other possible pricing models could be a one time fee for the needed hardware and monthly fee for the software or an one time fee for hardware and software but therefore a payment-per-information pricing model for the analyzation of the raw data. Recommendations-as-a-service as well as commission-based-payments for improving the return on investment of the shop could also be possible scenarios for future pricing models in this area.

Impact on data marketplaces in Smart Cities

The expanding utilization of mobile sensor networks in Smart Cities will create and merge to new business models. Since the sensors will be already provided by the ready-made mobile phones, no need for great investments into infrastructure is existing. Instead the current movement of startups indicate a shift from initial investments in infrastructure to investements into tracking of sensors. Regarding pricing it seems to move to more flexible models such as payment-per-information, payment-per-data or even commission-based-payments if the provided service has an positive impact on the return on investment.

5.4 Conclusion

The realization of a Smart City concept will require a centralized data marketplace infrastructure as a primary source for secure access to reliable information. However, a big and complex project like that, is very likely to be a joint technology created and owned by several companies providing services and infrastructure on a different level of the data marketplace value chain. Most of the current business models in data marketplaces will remain profitable for the next years but as underlying technologies get more mature, businesses will experience further forward and backward integration of data and infrastructure services, i.e. larger companies with enough resources will try to provide more services along the value chain of data marketplaces in order to add more value to their business. This research shows that companies providing real time analytic solutions have promising business models as real time analytic services will be an important component of data marketplaces in Smart Cities. Clients will be more willing to pay for predictions, reccomendations and prescriptions derivded by data analysis, whereas the value of raw data decreases. Real time analytic solutions for data generated by sensors as a busniess model will be very profitable because it is obvious that senors are the next big thing. Current transportation systems in city areas are burdened with growing urban population and increased needs for mobility. Real time traffic information obtained from various sources can significantly improve efficiency and safety of transportation. Moreover, real time monitoring of water supply grids and energy networks can prevent serious infrastructure damages, uses geospatial data for fast problem localization and better predicts future demand.

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Part II

Scenario Planning

Chapter 6

6 Introduction

Based on trends in the field of data marketplaces in Smart Cities described in the previous chapters, this chapter focuses on creating a foundation to challenge potential business ideas. Using the scenario planning methodology, it targets at envisioning futures of the world in 2030.

The scenario planning methodology

First developed and applied in warfare, the scenario planning methodology found its way to the business world in order to make flexible long-term plans. Scenarios are plausible, relevant and challenging stories of possible futures and help to understand how the world might look like. They are used as a vehicle to highlight critical uncertainties on the path into the future.

The scenario planning methodology provides a process, common language and tools to anticipate the important external dynamics that will shape the future. Then, potential business ideas can be tested in these different futures, hence possible weaknesses may be determined and opportunities may be observed in detail.

The approach used in this report

The scenario planning methodology consists of several steps. First, a timeline of the past is outlined, starting from 1900 to 2013, containing major events related to data marketplaces in Smart Cities in the categories society, technology, economy, environment and politics (STEEP). Second, challenges for data marketplaces in Smart Cities resulting from these events are described, again using the STEEP categories. Third, considering the past events and future challenges, drivers for the future are elaborated. Each driver is described by a bipolar outcome, which defines the two directions in which it can develop. Fourth, all drivers are ranked in a matrix (Figure 7.1) by their level of uncertainty of the outcome and their impact on data marketplaces in Smart Cities. Fifth, key drivers are identified among all discovered drivers. Key drivers are those with the highest impact and the highest degree of uncertainty. After determining key drivers, their extreme bipolar outcomes are combined, generating four scenarios of 2030. For each of these extreme scenarios, a vision is generated. The plausibility of each scenario is backed by the development of an individual timeline for each scenario starting from 2013 to the year 2030. This timeline contains relevant events which lead to the envisioned scenario in 2030. These scenarios are outlined in this report.

Structure of this chapter

This chapter describes drivers and future developments in the field of data marketplaces in Smart Cities. These drivers of the future are identified and separated into two categories. First, key drivers (Section 7.1), which have the highest impact on data marketplaces and also the highest level of uncertainty in their outcome. All other drivers belong to the second category, known as additional drivers (Section 7.2). Key drivers as well as additional drivers are described in general and then analyzed with all implications for the both extreme outcomes they may have.

Afterwards, the four scenarios are described, beginning with “Data as an individually controlled public good”, which describes a vision characterized by one non-profit data supplier and the concept of high control over private data for each citizen. Then, “The Big Brother” describes a world dominated by a single data supplier where no privacy exists. Next, “The Smaller Brothers” is a scenario with no privacy and therefore high transparency, but a huge number of data suppliers. The last scenario is “The Data Stock Exchange”. It outlines a future world where data is treated as a new currency and first people became so called data-millionaires.

For each scenario, several characters and their daily life in the world of 2030 are introduced in order to picture the envisioned futures. For a deeper understanding of how the future visions have evolved, a timeline will be provided and explained for each scenario, describing the causal linking of events from 2013 to 2030. Finally, different signposts are outlined for every scenario. They are future indicators that suggest a development towards a specific scenario. Therefore, strategy planners have to carefully look out for them and understand what implications they might have for the future.

Chapter 7
Driver Analysis

Drivers are forces that shape the future of the world significantly. They can develop in two opposite directions to envision the world's evolution in the next decades with respect to data marketplaces in Smart Cities, it is crucial to understand the drivers' level of uncertainty and impact. Drivers as such and their two opposite trends have different probabilities to influence the future. Furthermore, they are not always independent and hence shape the outcome of each other. In addition, they may be influenced by events in the fields of society, technology, economy, environment as well as politics and legal. In this section, ten drivers are introduced and ranked by uncertainty and their impact on data marketplaces in Smart Cities (see Figure 7.1). Then, two key drivers which have the highest impact and highest uncertainty are identified. The combination of these distinct key drivers and their bidirectional outcomes leads to four completely different futures.

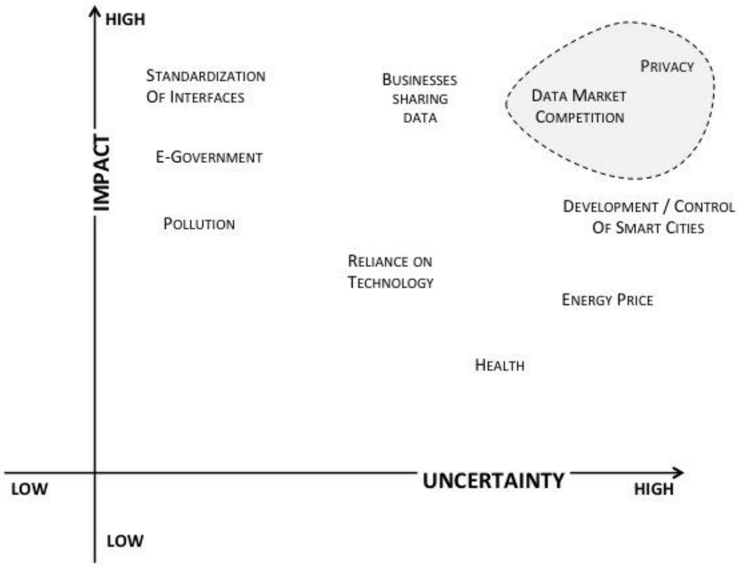

Figure 7.1: Drivermatrix
Source: Own illustration

7.1 Key Drivers

Several drivers influencing the implementation of data marketplaces in Smart Cities have been identified as shown in figure 7.1, of which two were chosen as key drivers for two reasons. Not only has their evolution high impact on the realization of smart cities, but they were additionally influenced by unforeseeable forces and thus remain uncertain. Since they are relevant but unsure, the key drivers privacy and competition between data marketplaces are explained in the following sections.

7.1.1 Privacy

Private data represents both a valuable resource and a vital nutrient for Smart Cities. Traded in data marketplaces, citizens' information is used to ensure the high quality of life and sustainability, characteristics of a Smart City. Within this context, the scope of information provided and the positive and negative influence of privacy regulations are of paramount importance. Over the past centuries, privacy has become one of the central concerns of modern society. It was supported by a law in the French constitutions in 1789 and was adopted in the constitutions of the German Empire in 1849 [423, p.9] [418]. At that time, privacy was defined by law as the inviolable personal freedom, inviolable personal residence and it was also extended to the secrecy of letters. The privacy law later became the 8th article of the European Convention on Human Rights. Defined as "Right to respect for private and family life" [421], this article is a main pillar for privacy laws that govern our society. But there is also an unwritten law of trust. People decide who they want to disclose their private data to based on trust. The mass use of free services provided by Facebook and Google shows that a majority of today's consumers are willing to give up parts of their privacy if vendors offer a sufficient incentive and project a trustworthy image [419]. Both formal and informal laws determine the restrictions that affect data marketplaces of Smart Cities. These restrictions become apparent in terms of the data being offered, the necessity of customers' consent and associated levels of security.

Many business models of companies dealing with data are based on information of the individual preferences on their customers. At the same time, privacy is under regulation. This leads to a trade-off between monetization and anonymization of personal data. In order to provide advertising companies with an efficient targeting of potential buying groups, data providers have to offer individualized information on their users to these advertisers. The degree of personalized data for each individual is positively correlated to revenue potentials and potential markups in prices. In contrast to personalized information, legal privacy regulations reduce the potential of revenue streams coming from users' personal data.

In the following sections, two extremes of the possible developments for the driver privacy are depicted. The key point of divergence between the two ultimately lies in privacy regulations. As regulations are a main responsibility of the government, which in turn reflects the needs and structure of society, there are some key questions that have to be answered in order to distinguish between the two directions towards which the society develops. In the context of data marketplaces and data value chain, one can pose the following questions: Who is allowed to store personal data? What restrictions apply when exchanged? How do these questions affect innovations in Smart Cities?

Total control over personal data

The case of total control over personal data is developed as an outcome of the simultaneous increase in data protection laws and value of data. As previously mentioned, data privacy is a highly sensitive subject and it is not farfetched to assume that data security regulations evolve to the extent in which citizens have full control over their personal data. As both society and companies realize that personal information presents monetization potential, data becomes more of a modern currency. Therefore, people pay as much attention to data transactions and data usage as they do with financial activities. Citizens of Smart Cities store private data in private clouds and choose what information is shared with whom. Even if secure storage and exchange are guaranteed by companies, there are strong restrictions by law, especially for passing on data to third parties.

As a result, companies are forced to have a detailed agreement with all customers that share their personal data with them. Often businesses can only get anonymous data, which makes this situation even more difficult. It leads to a customer basis being less transparent and to less value being generated from each user. Overall, this total control over personal data raises a challenge for further improvement and personalization of provided services within Smart Cities.

No control over personal data

This "no privacy" case takes into consideration the possible security threats facing a Smart City that is highly reliant on ICT. In the context of a volatile political climate under the constant pressure of digital terrorism, it is also imaginable that data privacy laws undergo a radical shift: all laws protecting individual data are abolished and new laws are put into place, enforcing that all data has to be published. As a consequence, increasing security regulations come at the expense of privacy. Nevertheless, even though citizens have no control over the generation and publication of their personal data, this data is not necessarily freely available for the public. Another aspect that can contribute to this scenario is people's willingness to share private data on various social networks. Motivated by the virtual closeness and intimacy that these networks offer, and influenced by the herd behavior, it is possible that people are willing to completely give up their privacy by actively feeding all their personal data into social networks. Parties that can afford and need the data can freely acquire it. Through these means, the government and security agencies can more easily identify threats and prevent cyber-attacks, while companies can come up with innovations for Smart Cities, combined with business models that include the acquisition of relevant personal data sets of citizens.

Within the business world, unrestricted access to personal data leads to a greater competition between companies that can afford certain data. Furthermore, by combining data sets, companies can increase the reliability and coherence of their user data and the quality of their services subsequently. The health industry can epitomize the inner workings of the new system. Nowadays, very high privacy restrictions are applied to the health sector and these often lead to superfluous expenses both on the patients' side and on the side of the service provider. With access to private data, medical research and customer service is accelerated and enhanced. On the downside, if an electronic medical file is available, citizens could be discriminated by insurance companies or even blamed for their medical conditions. It remains to be seen what regulations and policies need to be created in order to protect private citizens from abuse and misuse of their private information. Overall, this scenario not only provides new opportunities for Smart Cities, but also raises new risks that have to be mitigated.

7.1.2 Data market competition

Smart Cities are complex mega-structures based on the interconnection of various city segments. Underlying the effectiveness and efficiency of Smart Cities is however the constant stream of data with high quality and volume. Hence, suppliers who collect and resell this data on data marketplaces play a crucial role for the development of Smart Cities. A data marketplace in a Smart City is the place where data supply meets data demand. Depending on market regulations and industry dynamics, these marketplaces within Smart Cities can rely on data suppliers ranging from only one data supplier, i.e. no competition, to an almost infinite number of data suppliers, i.e. perfect competition (see figure 7.2). In economics terms, competition can be described as the rivalry among sellers that try to achieve goals like increased profit and increased market share [388]. In a data marketplace context, an infinite number of data suppliers hence implies a high level of rivalry for data acquisition and data resale on a marketplace. The existence of only one data supplier, on the other hand, corresponds to a monopolistic market constellation. Some of the key questions that emphasize the difference between a low and a high data market competition environment in a Smart City are: What is the data demand? What are the government laws and regulations for data suppliers in Smart Cities? Which entry barriers and other industry dynamics do suppliers on the data market face? These and other important implications of the different levels of competition in a data market on the Smart City scene of the future are further discussed below.

Single data supplier

> *"Number one, cash is king... number two, communicate... number three, buy or bury the competition"*
> - Jack Welch

In economy, monopolistic constellations are typically characterized by high product prices, less product diversity and a sub-optimal number of buyers [388]. In terms of a Smart City, that means that there is a situation with no or little competition between data suppliers. Low competition in the data supply field brings benefits in terms of easier interface standardization, higher market transparency, facilitating the discovery of relevant data, and lower transaction costs for the resale of data. The unique positioning as a monopolist however implies a higher potential for power misuse by the supplier as well as corresponding higher regulatory attention by the respective authorities.

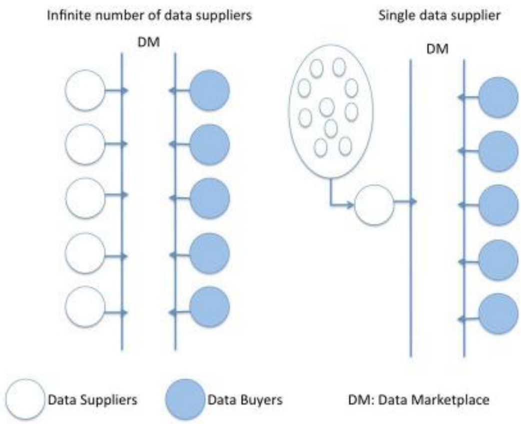

Figure 7.2: The difference between an infinite number of data suppliers and one data supplier

Moreover, it is likely that a single data supplier has slower innovation processes and slower improvement of products and services and thus reduces the pace of the Smart City intelligence improvement [402, p.1]. In addition to that, a single data supplier might have the power to set the profit margins and sales quantity for data based on its own optimum. This can reduce the demand on the customer side, thereby increasing social inequality, as well as hinder the pace of innovation in some Smart City segments.

Infinite number of data suppliers

> *"Competition is not only the basis of protection to the consumer, but is the incentive to progress"*
> - Herbert Hoover

In the "Infinite number of data suppliers" scenario, the high number of data suppliers implies high levels of market competition. This typically motivates data suppliers to continuously improve their products and processes as well as invent new and better ones. Also customers have access to a better quality and greater selection of data. Competition likely leads to lower prices for data and corresponding services compared to a monopoly constellation.[381, p.1]

High data market competition also hugely benefits Smart Cities as a whole, due to the better data quality it is likely to ensure. Many of the data suppliers in a competitive environment focus and specialize on specific Smart City areas, thus providing end customers with better data quality and easier access to otherwise rare data. However, one of the challenges that such a scenario faces is interface standardization between the variety of different data suppliers (see section 7.2.6).

A further central aspect of Smart Cities is "smart economy", which is based on the vision of high coordination and cooperation between different market actors. An infinite number of data suppliers facilitates such a development, since companies thereby can cooperate more easily, share R&D knowledge and develop joint innovative products and services. In conclusion, this "high competition" scenario would have a tremendous impact on the speed of improving the Smart City intelligence.

7.2 Additional Drivers

Apart from the key drivers above, several additional drivers are introduced in the following section. The relevance and outcome of these additional drivers differ within the four future scenarios.

7.2.1 Businesses sharing data

In order to foster the development of data marketplaces, the willingness of companies to share their data with others is crucial. Therefore, without any businesses sharing their data, few data marketplaces will emerge. This however is still hindered through data protection policies in many companies. Nowadays, companies that collect a lot of data, like Google or Facebook, keep most of their data for themselves. Data is their major business and the fewer people have access to the information from it, the more valuable it becomes. In general, they are eager to achieve a higher personal and competitive advantage out of it. However, companies recognize the value of combining data in order to gather more information, which has already led to the creation of alliances to exchange data, for example between Facebook and Microsoft. The way companies will deal with this in the future is not clearly predictable. The following two paragraphs describe two possible extreme outcomes.

Businesses sharing all data

A change of companies' attitude towards sharing all their data will result in a more innovative environment. The public as well as the private sector will have full access to all business data. This leads to more transparency, an enhanced productivity, more efficient decision-making and in general to a greater public prosperity. Financial crises or frauds will no longer be possible and everything will be apparent right away.

Businesses sharing no data

In the case that no data is shared, companies will achieve competitive advantage and generate value by collecting, storing and keeping their data. The resulting system will be less transparent and difficult to control. Each business hides the collected data and a detailed insight in a company will not be possible. All companies will protect their corporate know-how, hence learning from other companies' mistakes will be impossible. The overall technological progress will stagnate due to a lack of knowledge. Small companies with less data and start-ups will have difficulties to enter markets. Before they can establish their business, more powerful companies can use their data prevalence to clone the services and products offered by small companies and start-ups.

7.2.2 Development / Control of Smart Cities

For the development of Smart Cities, it is crucial to define who is in charge of current and new projects – the public sector or the private sector. Nowadays, the public sector, which is represented by governments and city authorities, is aware of sustainability threats and strives to find solutions that address these issues. The transformation of cities into Smart Cities leads to an overall higher efficiency. However, this is only true if the whole transformation process is precisely planned and afterwards carefully executed, which requires not only an involvement of the public sector, but also its prevailing leadership.

While beneficial for the citizens, the high degree of involvement of public authorities in Smart City projects is not always welcomed by the private sector whose primary concern is to make profit by selling new technology. Therefore, it is not surprising that large technology companies often try to convince the public sector that their own Smart City vision is the right one by launching various political initiatives. As an example, IBM has launched the Smarter Cities Challenge, which supports 100 cities over the world by providing IBM expertise over a three-year period [382]. This, of course, gives IBM the possibility to shape the Smart City vision of these cities.

Although the majority of Smart City projects are rather based on technology push than being pulled by the demand at the moment, the exact future development of this trend cannot be precisely predicted [371, p.20]. The current situation may be inverted by a more responsible attitude of the public authorities or greater involvement of citizens.

Total control of the public sector

If the public sector manages to take total control over Smart Cities, an overall improvement of the efficiency of the cities can be expected. By providing leadership and by determining the problems the cities are facing, the most efficient measures available can be chosen. It will also increase the competitiveness among technology companies and force them to focus their resources on the research and innovation relevant for current needs of the cities.

Total control of the private sector

The second extreme outcome is that the private sector assumes total control over the Smart City development. In this case, companies will decide which path the future Smart City development should take. In such a scenario, the governments will be more or less passive players that only provide the necessary political framework and support. Large technology companies will be free to implement and try out all the technology they want. This constellation will lead to the creation of oligopolistic competition because only a few companies will be able to gain the necessary power.

7.2.3 Reliance on technology

Since the industrial revolution the question of technological dominance raises periodically. With the dominance of technology, the question of dependence and reliance on technology arises.

Today, technology is mainly used to make worpk simpler and more efficient. In most cases human beings are in control and technology plays a supporting role. But in some areas algorithms play an active role and make decisions on their own. One example is the stock exchange market, where high-frequency-trading algorithms buy and sell stocks within milliseconds. Today these algorithms are responsible for over 50 percent of the U.S. equity trading volume [416, p.2]. Transferred to data marketplaces in Smart Cities, the smartness of the cities is mainly driven by better analytics, a better database and real-time responses. It is uncertain whether humans will rely totally on technology or if they will always keep an alternative plan for the case of failure. These two possible outcomes are described in the following section.

Total reliance on technology

It is easy to imagine that people use algorithms for decisions in their daily lives. With increased data volumes, Smart Cities will stimulate the development of intelligent solutions, supporting our daily activities as well as business live. For instance, the complete supply chain will be driven by sensor equipped industrial machines. This results in a simplified life, since these devices will take over necessary decisions in the value chain such as how goods get from A to B or what companies will order. This causes direct dependency from technology - a failure would mean severe consequences.

No reliance on technology

On the other side, society may refuse to truly rely on technology and will keep an alternative plan in the case of device failure. For instance, in traffic management there will always be enough police officers to organize the traffic if all devices break down.

Since automated data-driven decisions are only additions but not replacements of the classical approach, the demand for the algorithms will be rather low. According to this, there are less cases, in which the algorithmic approach is economically sensible and this significantly reduces also the applications of a data marketplace in a Smart City.

7.2.4 Energy price

In 2008 the energy consumption of ICT in Germany exceeded 55 tWh, amounting to over ten percent of the total demand for energy [425]. Hence, the energy price has an impact on the implementation of new ICT solutions. The exponential growth of data and devices with the trends of Big Data and the Internet of Things leads to a need for greater computational power and thus to an increase in the demand for energy. The price of energy for industries in Germany increased by 150 percent between 2000 and 2013 [424]. Also, the EU government expects that energy prices will continuously increase [417, p.28]. On the other hand, society can witness the emergence of highly efficient innovative energy sources. For example, a relevant start-up that tackles this problem is Bloom Energy. They offer a scalable solution that produces on the spot sustainable energy out of hydrocarbons from biological sources [415, p.6]. According to these technologies, one might foresee that there will be sustainable and lower priced energy in the future. Hence, there are two possible outcomes: continuously increasing energy costs or their dramatic reduction.

High-priced energy

An international rise of green governments, the lack of fossil resources and political conflicts will lead to a continuous increase of energy prices. Finally, electricity will become the most expensive part of operating costs of data centers and the Internet of Things. Therefore increasing costs for electricity will slow down the rollout of Smart Devices and Smart Cities significantly. Unnecessary devices will be discarded and analytics will only be made if they are relevant or bring a sufficient monetary gain. This causes less available data and less demand for data marketplaces. In the extreme case, the development of Smart Cities will be reversed.

Low-priced energy

On the other hand, new technologies or retention of conventional energy sources could increase the availability of energy. This will lead to an inexpensive supply of energy and a decreasing operating cost of devices, which will therefore speed up the penetration of internet-enabled devices. Since the operating costs of data centers will also fall, predictive analytics will be used more extensively and for a higher amount of data. With low priced electricity, the number of smart devices will rapidly grow and thus deliver more data for the analytics in data marketplaces. The low operating costs also lead to lower entrance barriers for small companies and to faster innovation overall.

7.2.5 Health

Health care is and will always be one of the most important topics in our society. The World Health Organization describes health as the “state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” [405]. With regards to healthcare systems, countries around the globe have different opinions on how a health care system should look like. In Germany, everyone has to have a health insurance, but in many countries are no mandatory health insurance [377]. People nowadays live longer than their ancestors, because healthcare has improved. However, there are also some negative developments. Especially psychological diseases have reached an all-time high [376]. Furthermore the sharing of data between doctors and hospitals is also a huge topic. Therefore, it is not clear how the health of the society will develop in the future. The next paragraphs will describe these two developments.

Everyone is ill

In this case, the average health of people is worse than today. The main reason for this is the growing number of psychological diseases, which are often caused by an increase in workplace demands. One of the most classical and widespread psychological diseases is the burnout syndrome. Burnout causes feeling of exhaustion and depression [407], which are mainly caused by stress. Multi-tasking at work is a major cause. In 2013, a German health insurance company observed that 41% of people who do not work until retirement age stop due to psychological diseases [376]. If people are less healthy, their life expectancy decreases. Also the overall productivity of a company decreases, which drives costs and decrease competitiveness.

Everyone is totally healthy

Another possible outcome that everyone is healthy. Continuous improvements in medical technologies have increased the average life expectancy of all citizens [373, p.379]. Furthermore, health is ensured by the employment of an increasing number of doctors per person [406]. This allows more easy and fast access to healthcare services. Another positive effect is the sharing of data, which allows better access to the patient’s data and also can be a great opportunity for data marketplaces in Smart Cities. Sharing of patient data helps doctors to make better and more personalized diagnoses. Since every healthy human being is a potential customer, the Smart City and the companies within it generate more revenue due to the improved health services. New business sectors that focus on elderly people will develop.

7.2.6 Standardization of interfaces

Standardization of interfaces is a very important issue for exchanging data between different information storage and analysis systems. There are two apsects to it: The standardization of software interfaces and the standardization of hardware interfaces. With regards to software, for instance XML is a standard format for data exchange [404], while the Universal Serial Bus (USB) is a hardware standard for data transfer. If companies use standardized interfaces, they can easily share data with other companies. By using proprietary interfaces they can restrict data exchange . Smart Cities will proper with increasing standardization. Today, it is not clear whether interface standardization or proprietary interfaces will dominate the markets. The following two paragraphs will describe these two alternatives.

High standardization of interfaces

High standardization of interfaces is one possible future outcome. Companies use shared interfaces. They can easily access the data from each other. Another positive effect are decreasing costs for developing interfaces as once an interface is developed, it can be used many times and for different companies. Furthermore, the quality of interfaces increases with higher interest in standardization [397, p.5]. Competition between companies grows because of low switching costs for costumers. The downside of a high standardization of interfaces are its hindering effects on innovation, as new technological developments cannot reach the market quickly, because of verifing a global standard takes time and using an old one can decrease the willingness to develop something from scratch.

No standardization of interfaces

Every company develops its own proprietary interfaces. The advantage of non-standardized interfaces is the facilitation of innovations. Companies can easily create new interfaces which are not restricted by any regulations. Furthermore, companies are now able to create a lock-in situation. Once a costumer buys a product from a specific company, he or she can only buy complimentary products from the same company. For example, the Apple iPhone chargers differ from the standard interface of other companies and also differ across the Apple iPhone versions. With proprietary software interfaces, the costs for developing an own interface are much higher than for using an already existing interface. Furthermore, developing basic solutions for general software problems can be developed once and distributed to all developers, because interfaces can be designed as needed. If only a few developers work on a closed interface, the risk of bugs and critical security holes increases. Finally, the average prices for software and data within a company's eco-system can be higher due to the lack of competition and customer lock-in system[403].

7.2.7 E-Government

E-Government describes the information exchange and transactions between state, municipal and administrative authorities mutually as well as to citizens and companies through the use of digital technologies. It incorporates administration, democracy, participation and voting.

The aim of E-Government is higher citizen involvement in political processes. Through offering easy and omnipresent access to information and by offering participation services, citizens will become more motivated to do so. This contributes to a higher political awareness and citizens will have more well-founded opinions. Additionally, E-Government serves to simplify and accelerate transactions with public authorities. Since most processes are largely automized and less personnel is necessary, noteworthy cost reductions can be achieved.

Initiatives like BundOnline 2005 and Deutschland-Online, as well as online platforms such as e-demokratie.org already point in the direction of E-Government today.

Provided that there are more initiatives to set up an E-Government, the technological capability to exchange data will be a critical requirement. Furthermore, privacy and data security concerns will have to be taken into account. While the government may not be able to address these challenges by 2030, service providers related to data marketplaces will be able to provide the services essential to ensure the necessary data exchange and ubiquitous availability. The manifestation of E-Government will change the way politics and administration work.

Considering extreme outcomes, there will either be a government handling everything online or one that abolishes the use of the internet.

Government being only online In this extreme, all governmental matters will be handled by the use of online tools. All information will only be accessible online and administrative processes will be increasingly simplified, automized and therefore accelerated. Therefore, citizens are obliged to use the internet to get in touch with politicians and authorities. Businesses will likely benefit from economic advantages because of accelerated process handling. However, people may be easily overstrained, especially those who are not familiar with online tools.

Unlimited availability of information contributes to political transparency, which will influence citizens in forming an opinion. On top of that, transferring and storing data sets rather than printed paper will furthermore reduce the authorities environmental footprint, but it will make exchanging digital data essential. Privacy and data protection concerns will have to be considered since the establishment of an E-Government will pave the way to an extensive surveillance of the users.

Completely analog government In this outcome all governmental matters will be handled without the use of internet. Even though the use of technology is reduced to a minimum, privacy concerns have to thought about. Intrusions into connected computer systems do not have to be considered as there is simply no electronic data exchange. Since not even e-mail services or blog systems will remain, citizens and businesses have to get an appointment and to come to the authority's office for every single concern. All documents, such as tax reports, have to be handed in as stacks of paper. In the end, any means for easy interaction of citizens with their city will be omitted. Thus, politics and administration will remain intransparent and accountability for incidents will be unclear. Furthermore, public gatherings may gain popularity again as a means for information exchange.

7.2.8 Pollution

An important factor for Smart City development is pollution. There are many diverging definitions for pollution. However most authors agree that pollution can be understood as the introduction of contaminants into the environment thereby evoking negative consequences. Contamination can comprise chemical substances and energy. For instance, in a fire emergency poisonous smoke is usually accompanied by heat, noise and light. One can distinguish between point source and nonpoint source pollution. Point source pollution originates from a set of identifiable sources, such as oil tanker accidents. Contrary nonpoint source pollution, for instance smog, has many diffuse sources. [395]

The level of pollution critically influences the living conditions of inhabitants in Smart Cities. For example smog is mainly generated by traffic and heat emissions and contains numerous poisonous chemicals that affect people's health[387]. Besides, smog prevents sunrays from reaching the ground. This does not only decrease people's happiness, but also disrupts the ability of photosynthesis of plants, resulting in even worse air quality [386].

Over the last years several catastrophes resulting in massive point source pollution occured. The consequences for humans but also for flora and fauna are fatal. For instance, the explosions of the nuclear power plant in Tschernobyl (1986) and the oil platform Deep Water Horizon (2010) in the Mexican Gulf contaminated whole swathes of land, dramatically affecting living conditions in surrounding areas.

In March 2011 a tsunami led to a series of defects at the nuclear power plant of Fukishima Daichi. Today, the problems have still not been resolved and endanger more than 40 million people living in the Tokyo area. It is important to note that the effects of natural disasters are not limited to the physical level. Lower productivity and potential investors turning away are likely due to the persisting fear of a nuclear catastrophe in Tokyo [398].

Smart Cities can implement various strategies to tackle pollution. According to a guideline published by the European Comission, cities should install waste prevention and waste management programs. Following this approach, cities are encouraged to avoid waste wherever possible. In case generating waste is unavoidable, resource recycling and recovery programs are to be favored over disposal. [378]

Even though pollution can only be addressed on a local level, it is a global phenomenon that disregards national frontiers. Local changes often require tremendous efforts and pay out only in the long run. This makes them hard to implement in today's fast moving competitive economy. One of the biggest challenges for future generations will be to find a solution for that dilemma.

Lower pollution

Signs for the necessity for a more sustainable lifestyle can be observed all around the globe - e.g. the conference "ICT as an Enabler for Intelligent City Development: Perspectives from Germany and China" discussed several ways of sustainable Smart City development [392]. But while coming slowly the change is happening on several levels. For instance Germany decided as one of the first industrialized countries to completely withdraw from nuclear energy production after the incidents of Fukushima. In the low pollution scenario other countries will follow that example and deploy more and more renewable energy sources. Additionally regulations and higher taxes for pollution will be introduced which will have to be encompanied by control standards and strict penalties for unauthorized pollution. This will change the whole producing industry as there will be demand for more resource efficient and sustainable products. For instance electrical motors will replace the conventional combustion engines in cars leading to a better air quality. This together with many other measures will help the flora and fauna to slowly recover from the last decades of massive pollution.

Higher pollution

On the other hand, there are also indicators for a higher polluted future. In 1997, the Kyoto protocol was a first major step towards international regulation of greenhouse emissions. However some big polluters such as the USA and Canada withdrew their endorsement, fearing potential disadvantages for their heavily industry-dependent economies. Assuming that pollution continues in that manner global warming will melt glaciers and polar ice. This will lead to a rise of the sea level which will have massive consequences for people living in costal areas as they either have to build dams, or swimming homes or move further inland. According to the urbanization researcher Creel, the majority of the world population will live in coastal areas by 2030 adding to the severity of the problem[375].

Additionally the rapidly changing climate will increase the frequency of natural disasters and thereby contribute to the detereoriation of the planet. Within only a few decades many places which are inhabitable now will become so heavily polluted that the inhabitants will be expelled. This will lead to higher population concentrations in still functional areas which will amplify the severity of local problems. The sites of natural disasters like Tschernobyl, Fukushima and the Deepwater Horizon provide helpful hints how such a future could look like.

Chapter 8

8 Scenarios

Based on the previously identified key drivers, “privacy” and “data market competition”, four different scenarios are developed to give impressions of the world in 2030. Depending on the influence of the key drivers, the perspective on the future varies. Concerning privacy, control ranges from total control over own data to no control over own data at all. In terms of data market competition, it ranges from one single supplier to a virtually infinite amount of suppliers. By combining the extreme outcomes, four different scenarios result. In addition, there is an influence from secondary drivers. The following chapter describes fictive personas for each scenario, living in this future world. A timeline for each of the four scenarios outlines the events that lead up to that scenario. Furthermore, signposts are described which may serve as indicators for the occurrence of the respective scenarios.

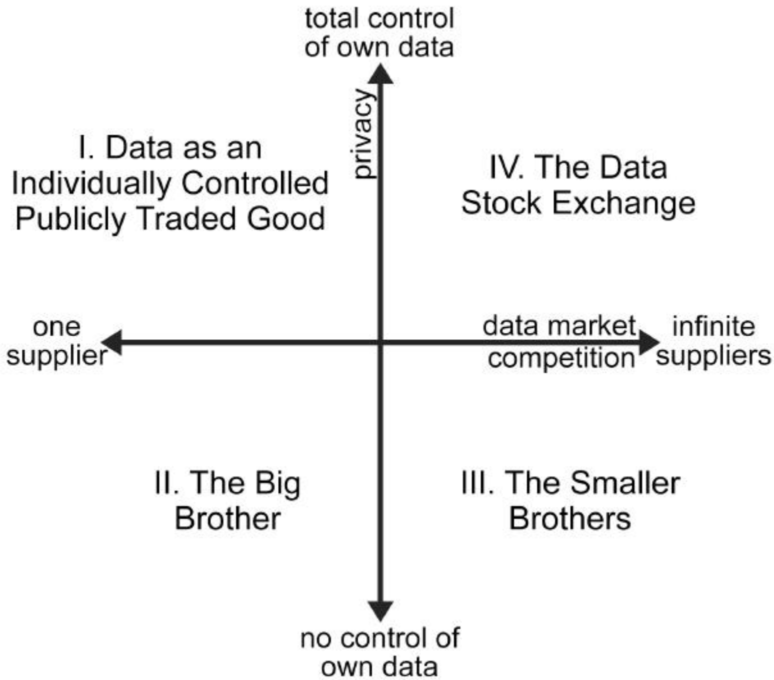

Figure 8.1: Scenario Matrix

8.1 Scenario 1: Data as an individually controlled publicly traded good

In the following section the scenario "Data as an individually controlled publicly traded good" is described. This scenario is characterized by one non-profit data supplier and the concept of high control over private data for each citizen. To illustrate citizens' life in this scenario, the day of Carlos, a 41 years old bartender, is described.

8.1.1 Scenario Description

Carlos wakes up sweating in the middle of the night. He sits upright,looks around and then falls back in his bed, relieved because it was just a dream. Sometimes he has these flashbacks of the past, when he lived in the upper east part of Madrid - at that time one of the most dangerous places within the capital of Spain. Luckily these days are gone. With the new security system the government introduced, based on the data shared by citizens, robberies were drastically reduced and for the last two years they were rather a goodnight-story to scare naughty kids. Just to be sure that everything is fine, Carlos puts on his mBracelet to measure his health. The mBracelet, although very small is able to check all important body functions of Carlos. It compares them with the standard values for Carlos and with the values shared by other users of his age. Then, it tells him if everything is within the limits or not and what kind of measures he should take. And all this is possible thanks to 90% of the society who trust dMarket, the operator of the centralized data marketplace, and share their health data. Twenty years ago, people would spend at least two hours waiting in the hospital just to get their blood pressure measured."

After assuring himself that everything is fine, he goes back to sleep. A few hours later, his alarm clock rings. He takes a look – 8:37 a.m. "Much better than yesterday", he thinks and smiles. His alarm clock is connected to the uTravel network, so the exact time he wakes up depends on the current traffic. If there is a problem on the way to work, the traffic monitoring company uTravel, which analyzes data shared by other citizens, sends the estimated delay to his home server. The server automatically sets the alarm clock to avoid that Carlos is late for work. In order to enable this, Carlos just needs to share his personal agenda with dMarket, which then sells the necessaryinformation to uTravel.

Carlos' coffee is already waiting for him in the kitchen - the coffee machine automatically started the preparation of his cappuccino when he woke up. While having breakfast he gets a push notification asking if he wants to share his health indicators from last night to improve the efficiency of the public health services. He presses yes as he enjoys the idea that his personal data can be used to help other people.
Right after finishing breakfast he gets another notification, saying that the xTrain he has to catch will be two minutes late. He doesn't need to turn off the light in the kitchen or the TV, because as soon as he leaves, the house server detects his absence and switches off all electrical devices. This server also controls a special sensor, supplied by uWeather, the private weather forecast agency. The sensor reacts intelligently to the predicted changes of the outside temperature and regulates the temperature in the appartement, so Carlos saves a lot of money from his electricity bill as the energy consumption of his appartement is much more efficient.

On his way to work the xTrain he is traveling on automatically sends delay notifications and knows how many people are waiting for it. If needed, it easily adds some back up wagons. The company operating the xTrains buys data stored in the dMarket, which citizen provided in order to improve their individual mobility. Thanks to that most people choose xTrain to commute and the company is able to increase its efficiency and raise profits. Carlos smiles involuntarily. “What a change”, he thinks. “Back then, before the dMarket was created, the NSA was watching everybody for its own purposes and people were really worried about their personal data. Today, it is up to you if you share it or not.” Back then, people had a different attitude towards privacy and were more interested in keeping their personal data private. But then significant improvements in data security and in cloud-based services were achieved and worries were swiftly forgotten. “A quarter of a century makes quite a bit of a difference”, Carlos thinks and smiles again.

When Carlos arrives at work, everything is still quiet. He works at a bar close to the industrial zone of his neighborhood. The first hours of the daily shift are normally quiet. Today is going to be a tough day, because he will have a double shift. His colleague Jan asked him for this favor, as he wanted to go to the local branch of the dMarket to get a personal introduction to the dMarket system. Untill now, he was one of the black sheep, keeping his data secret. But yesterday an old man came to the bar and only a few minutes after ordering an ice cold Pilsner he collapsed. He wasn’t wearing an mBracelet, which in case of an emergency sends individualized first aid instructions to the nearest smartphones. As a result, people around were not able to help him immediately. When the medics arrived they didn’t find any data about him in the database. Not knowing his medical record, they had to start analyzing his condition on the spot. This took them too long to provide necessary help. As the guys at the bar learned later, the old man passed away in the ambulance. This scene really shocked Jan and so he decided to start sharing his medical data on the dMarket on the very same day, but only for the improvement of the public health services and not for commercial purposes. In the end as he is not that young anymore, he wants to make use of all the additional services the health system can provide him with.

Suddenly, Carlos was ripped out of his thoughts of yesterday. A few minutes after 10 a.m. the first clients enter. A woman sits at the bar and orders coffee and a piece of cheese cake – as usual. Carlos knows her. It is Maria, a 39-year old stand-alone mother, living right behind the corner. Her daughter Alice just turned 18. Maria got divorced eight years ago and since then she has not found another partner. In the end, who would be interested in an unemployed ex drug addict, with no higher education? All this information about her is available, because she is attracted by the possibility to share her data on the dMarket hoping to receive micropayments when companies use it for commercial purposes. But today is a good day for Maria. She can nott stop talking about her daughter who started her studies at university last week. Alice was awarded a scholarship based on her good performance and now she is attending the best university in town. On her smartphone, Maria can look up the information about her daughter’s university life, her grades and performance in all the classes she is taking. On the other hand, all parents are asked to share information on the financial situation, health records and other important factors that could influence the performance of the students.

Maria keeps talking and so Carlos does not even notice that the bar got crowded. From the other side of the bar, three young men wearing dark suits are calling him. He recognizes one of them, who spent a really long night at the bar a few years ago, drinking alone because of the bankruptcy of his company. It was at a time when data oligarchs were still controlling all the data. Those were tough years for small companies. The full potential of Big Data had just been uncovered and a few powerful companies took control over the data flow in cities. As a result, prices of data were skyrocketing and a poisonous environment for smaller companies was created. Luckily in 2022, the first Data Summit was held in Singapore, and world leaders decided to take again control over the data. It was a long process, but finally in 2026 the publicly controlled data marketplace was created. Today, there is only one regulated nonprofit organization that is allowed to deal with data. This essential change brought along the growth of many start-ups, because they were given special discounts for buying the data. In a representative of of these innovative new companies one sits right in front of Carlos. For a moment, he is really happy that such a powerful tool like Big Data is controlled by only one publicly regulated organization which strives to improve the lives of citizens. He turns towards the celebrating guys and asks them about their business. It turns out that they combine different types of data that they can cheaply buy on the cloud-based dMarket with the aim to optimize the water usage in cities and to reduce water waist. After their first success in the south of Spain they managed to sign a contract with the city of Bangalore in India and now their technology is available in many other cities. This kind of services, which need huge amounts of information in order to function well, would not be feasible if all the data was not stored in one centralized institution. If the company have to collect data from various sources, it would be very difficult to collect all the needed information, it will take a lot of time and the service would not be cost-effective for citizens. As skeptical as Carlos is, he would never believe that something can benefit both the society and the business.

Carlos's attention is attracted by a noisy group of teenagers just entering the bar. They occupy the closest table and the first thing they do is to take out their smartphones. He notices that they are sharing their location. They are all wearing mHealth bracelets and one of them is synchronizing his personal agenda with the cloud in order to obtain more precise information on the xTrain he needs to get to arrive home in time. They are part of the new All Share generation. Nearly everything in their life is digitalized and shared in the cloud. They were born at a time when the concept of personal data was about to disappear. Off course, people can still decide if they want to share their data and for what purpose, but today less and less people are still having these concerns. Mainly older people still see data as something personal. The young generation does not mind to share. They trust the system and take advantage of all services it provides to them. They live in a transparent society, where everybody contributes.

In his former job, Carlos worked for an organization which introduced smart-meters and sensors in the city. He was also contributed to the development and popularization of the first applications for the sharing of personal data. Back then, 15 years ago, he was not sure that this was the right thing to do. Now, seeing the first results of this change, he feels pleased. Today, he is happy as a barkeeper in a local bar. The bar is one of the few things around that haven't changed much and it seems that it won't change anytime soon. People will always like to share their concerns and emotions with strangers. This will never change. Or will it?

8.1.2 Timeline

This section briefly describes the developments in the years 2013 to 2030 leading to a scenario which is characterized by the total control of personal data and one central data supplier (see also figure 8.2).

The amount of personal data shared on the internet rises significantly in the years between 2013 and 2030 due to the increasing usage of social media services, online banking or governmental services. Although all these services claim to consider data privacy rights, their usage still leaves a personal trace. After the PRISM-scandal in early 2013, the concerns about sharing personal data sharing on the Internet grow. However, breakthroughs in file-encryption technologies using personal identification such as fingerprints, lower these privacy concerns. Thus, more and more services requiring data sharing, like mobile payment or personal analytics for one's leisure time and health monitoring, are established. The amount of personal data individuals share on the internet drastically increases by the year 2018. This development triggers increased data trade between private and public institutions, personal data the most valuable asset for various companies. Data is a key element for the development of Smart Cities. By 2020, the data market can be described as an oligopoly dominated by few big players like Google and Facebook, which force data prices to stay high. Additionally, concerns in the society arise, as companies are misusing data and do not ensure privacy rights. Data trade between countries with different laws leads to increasing problems, which cannot be solved by individual countries. These developments bring up the need for international collaboration, resulting in the first international conference on data laws in 2022, the World Data Summit (WDS). Originating from this forum, a law regulating the international data market is passed in 2026. A globally and centralized data market as well as the unconditional control of personal data by individuals are the two main outcomes. From then on, a nonprofit-organization (NPO) originating from the WDS ensures the fair trade of data.

In this regulated market, data prices are set according to a company's revenue, stimulating an innovative and efficient business environment. Therefore, various start-ups emerge which base their business on the cheap availability of data. Start-ups can solve severe problems, for instance by applying serious games to encourage users to reduce waste. Simultaneously, established businesses can generate revenues both from exploiting their own data, as well as from selling data on the central data marketplace. In 2030, large parts of the society trust the data marketplace. This trust also builds upon improvements in cloud-based services.

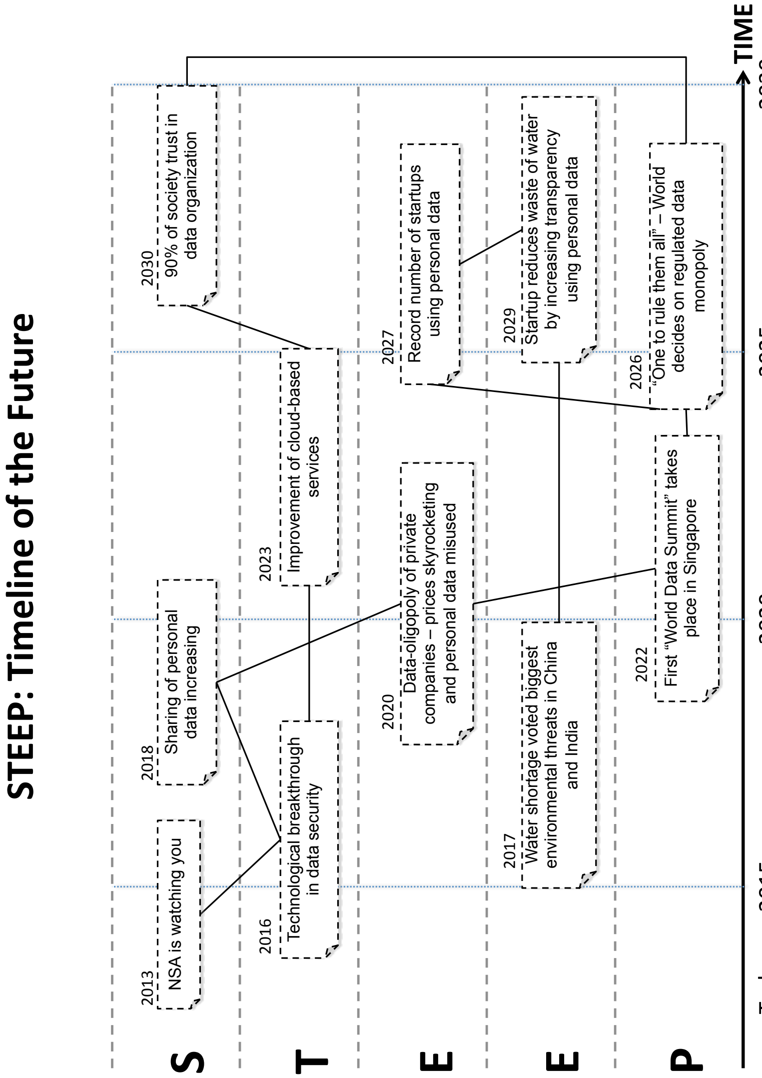

Figure 8.2: Timeline of the future, scenario "Data as an individually controlled publicly traded good"

8.1.3 Signposts

The scenario description pictured a world in 2030 and the timeline explained events in the years 2013 to 2030 that led to this vision. In this section, indicators that suggest a development in the direction of this scenario are presented.

Individuals are increasingly sharing data
As a result of technological breakthroughs in data security, people are willing to increasingly share personal data. This is also reflected by the number of internet services they use. This leads to a growing market for both user data, like name or individual preferences as well as contextual data, for example location or current activities. In addition to personal data, companies also collect data from non-personal sources like sensors and store it both on local servers and in the cloud, where it is not sufficiently protected. For many companies, data becomes an increasingly important asset and is key for their business models. In order to prevent a loss of trust, it is important to guarantee people the total control of their personal data. Additionally, this brings up the necessity for a functioning data market.

Governmental intervention is required in order to secure functional market conditions
As data becomes an important asset for companies, a few large actors gain control over the entire data market. Established companies like Facebook, Google and Apple have large collections of personal information that give them a competitive advantage. The price for this data is getting higher and a growing number of companies does not have access to it. Thus, innovation and the overall business performance is stagnating.

Global organizations are formed to tackle data regulation
As data does not stop at national borders, it is not sufficient that countries pass laws individually. Since data traffic is routed through more than one country, it is not possible to stop the misuse of data due to different national privacy laws. A first step to counter this problem is an international regulation between several countries, for example within the European Union. However, these associations are not enough and global organizations are formed in order to tackle this problem.

8.2 Scenario 2: The Big Brother

In the following section we depict “The Big Brother" scenario by offering an insight into the life of Ben and his daughter Adele. This possible scenario is characterized by no control over personal data and a single supplier from where all the information accumulated can be further on acquired.

8.2.1 Scenario Description

Ben is a 52-year old engineer who has moved to the city as a young adult for his first job. He has grown up in the countryside, so his bike was his first choice for transportation to get to school, go grocery shopping, or to meet friends. As a kid, he wasn't allowed to watch TV before finishing his homework. He has always welcomed new technologies and adapted them quickly, but his fear grew constantly that he – and the rest of the society – were becoming too transparent and thus too foreseeable and manageable. With the digital technologies evolving, he has been very cautious about information concerning his personal life. He tries to avoid technology whenever possible, sometimes wishing to turn back time and live on the countryside like a kid again.

His daughter Adele is a 25-year-old student of architecture and the complete opposite of her father. She was born into the post-millenial generation and has lived in a big city since her birth. As a kid she played games on a tablet PC and watched her favorite TV shows on demand instead of waiting for the broadcast on regular TV like her father used to do. She would not leave the house without her beloved Smart Life Device (SLD). The device facilitates communication with third parties, so it does not only let her make arrangements with friends or stay in touch, listen to her favorite music, take pictures of her daily life, but it also helps Adele manage her appointments, keep all e-keys together, make e-payments in stores and keep record of her e-health records. She can authenticate herself with the built-in fingerprint detector. Even though Adele prefers using her personalized blue device, she can use any SLD to access her documents, digital services or applications from her e-cloud. The government introduced these personal spaces in 2018 when Adele was still in school, and it has stored all of her personal information on there since. Children born after 2018 were assigned a personal space already at their birth. The parents manage their children' e-clouds until they achieve the e-maturity age of eight. Ben had his doubts when he and especially his teenage daughter received their spaces. He remembers some of his friends who had a hard time getting their first job because they had shared too much personal information on social networks, as companies feared that being represented by a person with certain views (i.e. political) would harm their image. Ben is scared how carelessly Adele handles her privacy, uploading hundreds pictures of her and her friends. In return, Adele can't understand why her father is being so restrictive and limits his options by minimizing the use of his SLD.

Ben and Adele live in a nice neighborhood with many middle-class single-family houses. The city has been evolving very quickly since it established a public private partnership with a leading data storage and data mining company, DataPal, in 2019. Factories have been moved to industrial parks outside of the city, and the council used the free spaces for shared work spaces and smart civil convenience services. City optimization is the responsibility of the analytics department of CityLytics, where Carl, a friend of Ben's, works.

His company buys data from DataPal. Carl processes the city's statistical data, analyzes the needs of the society, optimizes space, transportation, costs and general satisfaction of citizens. DataPal has grown to become a giant source of information, not only satisfying the needs of the city and its inhabitants, but also those of private companies. Businesses can buy raw or pre-analyzed data sets to get a precise vision of of the market, competitors, and clients. Carl has often relied on Ben's engineering advice to improve CityLytics' services, but Ben's privacy concerns have remained unheard.

The house that Ben and Adele live in has an integrated Smart Home System that collects data from various sources to optimize overall performance and comfort. Sensors in Ben's bed detect REM phases, so the alarm rings at 8:12 am when Ben's sleep is shallow and he's about to wake up, feeling relaxed. Ben goes to the bathroom and steps into the shower cabin. His body temperature is measured automatically and the water temperature adjusts to keep a constant body temperature. Last week when Ben had a fever, his data was transmitted to his employer so he could take the day off work to recover. He remembers how a few years ago, he called in sick at work and pretended to have the flu because he wanted to take Adele on a day trip to the countryside. Since the automatic detection system was introduced the company was able to cut 8 percent of their expenses due to decreasing absence rates. They have also increased their employers' productivity and creativity by introducing mobile work spaces that are now used by over 75 percent of all employers.

Ben prefers to work at home, he has set up a working room for this. Ever since, he has been saving close to two hours on commuting that he can now use for his hobby, gardening. At home everything is at hand and Ben feels more comfortable than in his small cubicle where he used to work. Now he can cook at home every day, using his self-grown vegetables, and is happy to see Adele eat his healthy meals instead of fast food. Meanwhile, Adele is working on a team project for her class. Her team has coordinated their work via e-clouds and shared subspaces and communicates via video conferences. Today, they are practicing their presentation at aт open work space provided by the city council. It's easily accessible by all team members as the system assigned them this space based on their location history and average daily schedules. Adele is even registered with her favorite park, as admissions of tourists and non-frequent visitors are regulated by the system.

Ben is about to finish working early today, his project has been going very well and he wants to enjoy the afternoon sun. Ben goes to the coffee machine that has pre-set his favorite beverage, with the exact perfect amount of milk and sugar. This time though, the machine signalizes a conflict: he has already had two chocolate bars today, and with a family history with diabetes, his daily recommended sugar intake has already reached the limit. He goes with the sugarless option – he doesn't want to risk his health insurance rate going up. Or even worse, having to pay the full cost of medical therapy in case he really gets diabetes in the future. Ben could also work out for 45 minutes to extend his sugar limit for the day, but he sticks with the plan for a lazy afternoon.

The healthcare system has been greatly optimized for efficiency over the past years. Having processed countless amounts of medical history records over a period of almost 20 years, it has precise information on diseases, conditions, triggers and therapies, and has thus far increased the success rate of treatments and disease prevention. On the other hand, governmental spendings on health care have been reduced due to a very economic model that Ben had to adopt with his high diabetes risk. His daughter Adele suffers from asthma. Her predicted medical conditions will cause higher expenses to the system, so her health insurance rate is slightly higher. The last time she experienced an asthma attack, Ben had to take her to the doctor. There he could rely on the data collected by her SLD to reconstruct how the attack happened and to adjust her medication. Respective data was forwarded to a pharmacy and Adele received her medication after authenticating herself with her fingerprint. Luckily, thanks to the efficient system, she hasn't experienced any symptoms in a long time.

Ben decides to visit the park where Adele hangs out frequently. She has been very busy working on her project and has not been home much, so Ben wants to spend some time with her face-to-face. He checks his SLD and checks the capacity of the park. It admits other visitors today, so he invokes the mobility system and says "to Tolstoi Park, one person". Since DataPal started collecting all the information about people's daily schedules, the public transport system simply adapts the routes to people's needs. Ben heads downstairs as a driverless minibus will pick him up in 2 minutes. He will have to change the bus and then cycle a short distance, but it only takes him 15 minutes to get to the other side of the city. His SLD shows a plus of 10 GoodCitizen (GC) points for using the public system. Ben has been saving his GC points for over two years in order to receive a GC FlyPass. He wants to take Adele on a trip to the Philippines in 3 months when she finishes her degree, but it's not easy with Adele being so irresponsible about environment protection. Her environmental record might look not good enough to afford a long-distance flight, even taking into account Ben's great environmental record, who's accompanying her.

Entering the park, Ben takes his phone out of his pocket. It is fully charged from the kinetic energy the jacket absorbed. He calls his mother to check how she is doing. His parents are almost 80 years old, but they have managed to stay in their own home instead of moving to a nursing home. If they slip and fall, they can rely on a personal emergency robot that will help them up. Before they installed it, Ben was very skeptical about the robot, considering it too invasive to his parent's privacy. Equipped with all the sensors and cameras, it collects even more personal information about his parents' lifestyle and provides it to DataPal. Ben cannot control what will happen to the data. He wonders what will happen in a few years when the percentage of elderly people reaches a critical point. He is scared that DataPal will use their power to affect people's lives, but would they possibly stop supporting the robot? Would they be cruel enough to do this?

Ben wakes up of his terrifying daydream as he spots Adele on a bench by the lake. Like many others, this space used to be a parking lot. It was changed into a park because of the decreasing amount of privately owned cars, when the government introduced the GC point system to encourage sharing services and using public transportation. Ben saw in Adele's location data that she had skipped her drawing class after meeting with her group, and he wants her to understand that the consequences can be quite serious, as the records will be stored in her e-cloud forever and can be used as a reference whenever she applies for a job. All the effort Ben has put into Adele's general education would have been in vain, and even though her genetic profile was very promising, her future employer may prefer one of her hard-working classmates. A modern career is hard, he thinks: Based on your performance, your profile is matched with the best option that suits you, so bad entries in the e-cloud can even block you from some career options. Ben is about to give her a talk about her childish attitude when he notices she is not quite herself today. Adele tells him that she had just met her new teammate for the class project and she really liked him! But when her SLD noticed her heart rate increasing and started playing classical music to relax the atmosphere. What if the embarrassing moment happens again when Adele is on a public bus? Not that she uses the bus system very often; she prefers driving her own car on the highway by the river. Even if Adele would not admit it, she really enjoys getting lost in the beautiful historical streets, driving around for hours. Unfortunately, the old city has severe restrictions on traffic and pollutants, so this comes at a high cost for her GC points. It has happened more than once that Adele's car just would not start the route. Relying on drivers' data collected by DataPal, the city has managed to maximize the protection of the old city and the environment.

After a walk in the park, Ben and Adele head home. On the way, they pick up David who is in town for summer school. A housing platform has matched his profile with Ben and Adele. Unlike her dad, Adele is glad that they have a spare room to share in their apartment. The platform, acquiring data from DataPal, has always done a great job matching profiles, Adele has made some really good friends and even improved her French. She wants to introduce David to her friends too. As she enters her room, she enthusiastically tells her SLD to switch on the living room layout. The bed folds into a couch and the table folds down to leave enough space for a holographic meeting with her clique. Their e-cloud has optimized their schedules to squeeze in their spontaneous meeting.

Ben enjoys being back at their house. He has always loved the wonderful view of the garden that he planted with Adele a long time ago. He checks the solar panels that are located on the roof, Ben is very proud of his eco-friendly smart home system. It has helped him save a lot of money too. The energy generated while nobody is at home is sold based on the information about energy consumption peaks in the city provided by DataPal. Just as Ben goes to the balcony to enjoy the last sun rays of the day, his SLD notifies him of his next appointment: his online course. Ben feels a strong desire to throw the nasty device out the window and forget about that overly efficient schedule, but he reminds himself that it was his choice to get an extracurricular degree in medicine. He goes to his study room and starts the digital study station. An e-learning company offers a smart course search platform, and so Ben chose a basic course given by a retired expert in medicine. The teacher has recently added some additional topics to his lectures, adjusting them according to the feedback from his growing body of students. People from all parts of the world, with different nationalities, backgrounds and ages have joined the virtual study group Ben's plan shows that he is a little behind his classmates, so he opens the next chapter and starts reading it. At the end of the study block, a small testing block appears to check his knowledge. He is doing very well, so he decides to skip the additional explanatory material.

Ben wonders how much he could increase his efficiency if he subscribed to an advanced educational service, where sophisticated analytical algorithms create a special learning plan adjusted to him, picking times of high productivity according to his biorhythm. Those advanced services rely on personal information about the student's personality, psychological and emotional portrait, using the data that DataPal collects through a distributed set of sensors, constantly monitoring Ben during his work hours, leisure time, even when he is out of town. This advanced courses could help him a lot, but for now, they are too expensive to consider and no cheaper alternatives are available.

After a stressful day, Adele takes a shower. She is annoyed by the water saving system that switches the lights in the bathroom from green to yellow after ten minutes, and to red after 15 minutes. Her life would be much more relaxed if her father just upgraded to a more expensive water plan, she thinks. It annoys her that Ben insists that she has to save enough GC points for their trip to the Philippines and learn to assume responsibility. Sometimes she is even careless enough to throw biodegradable waste into the recycling bin, instead of feeding it into the fertilizing system located in the basement of the building. For the past three years, Ben has been using the system to fertilize the garden. He even managed to improve the performance after buying an analytics report, originally made for farmers, from DataPal to fine tune the chemical properties of the soil, and his garden slowly started turning into a jungle.

Getting ready for bed, Ben notices a green sign, alerting that they haven't reached the monthly water limit yet. Thanks to DataPal's services and a set of smart sensors, he can now keep track of all utility costs for the apartment easily, save time and money. The devices distributed around the house communicate with each other and track the usage of all resources. The high level of standardization, as well as the existence of one data exchange portal helped to make the whole procedure of installation and configuration of them very easy.

No wonder that Ben installed the system the very first day they moved into the apartment.

8.2.2 Timeline

Terrorism moves into the virtual space and digital attacks on IT infrastructure of both private and federal institutions increase. This primarily causes financial damages by shutting down bank infrastructures, stock markets and energy systems. A nuclear meltdown of several power plants can be barely avoided after unknown terrorist groups had gained access to the operating systems. These cyber attacks are hard to detect – the question whether governments or independent terroristic associations are responsible for these attacks remains.

In order to increase safety, European governments adopt laws to collect data generated by citizens more efficiently. Several legal approaches used in the US serve as role model for these laws. Regulations are adopted not only affecting the collection of data but also technical standards supporting the collection of data. Private IT companies, especially large players are forced to convert and save their data according to an industry-wide data format to facilitate the comparability and integration of data from different sources. As the collection of data continues, the ICT sector in developed countries represent the biggest part of the economy in the year 2018.

An increasing number of private-public-partnership projects is set up in several countries around the year 2019 in order to increase the efficiency of data mining and the facilitation of early detection of unusual patterns in data. These actions are not only motivated by the need for greater efficiency but also by governmental regulations. As the preventive collection of personal data is legalized, further technical developments support the automated collection by the year 2020. Most of the public administration processes and official requirements regarding documentation of business processes are fully digitalized around the year 2020. The underlying technical infrastructure in developed countries is established.

Underground movements, often spin-offs of smaller political protest parties radicalize by starting attacks trying to damage and shut down technical infrastructures. This development is caused by stronger collaboration of private and public IT sectors and the abolishment of data anonymization at the end of the second decade of the 20th century.

Increased market regulation in ICT industries slows down innovation and hamper the market entrance of young companies. Several small and medium sized companies struggle to keep up with competition and go bankrupt. As the creation of individual movement profiles of citizens is enabled, limited emission certificates are offered to citizens and additional individual taxes linked to the emissions caused by individual mobility behavior above average are introduced.

In comparison to the year 2013, privacy laws are completely redefined in the year 2023. As more ICT players and data companies have gone bankrupt, they are often saved by fiscal financial support packages but integrated into public-private-partnership projects. As a result, nearly each state forms one major supplier of data. Small and medium-sized data suppliers lose importance.

Nearly 100 percent of relevant consumer generated data is captured by the year 2025. At the same time, stricter regulations on the technical requirements of Internet of Things technologies and M2M communication are adopted by governments replacing standards created by private industry cooperations. In the year 2027, first cities in BRIC states are able to decrease the level of smog to norms as accepted in the EU by the help of the limitation of personal emission certificates.

Most cities in the US and EU are fully digitalized by the year 2028. The early detection and forecast of possible criminal acts reduce the level of registered criminal acts offences close to zero. Since the financial crisis in the first decade of the 20th century, markets stay highly volatile. Besides other non-monetary assets, the ownership of data becomes an instrument for hedging currency risks on international markets.

Due to increased safety in most cities of developed countries, now including China and Russia, citizens trust their governments at a maximum, compared to the last 30 years, but subgroups of society still protest against the wide collecting and use of personal, non-anonymised data by a few international public-private institutions.

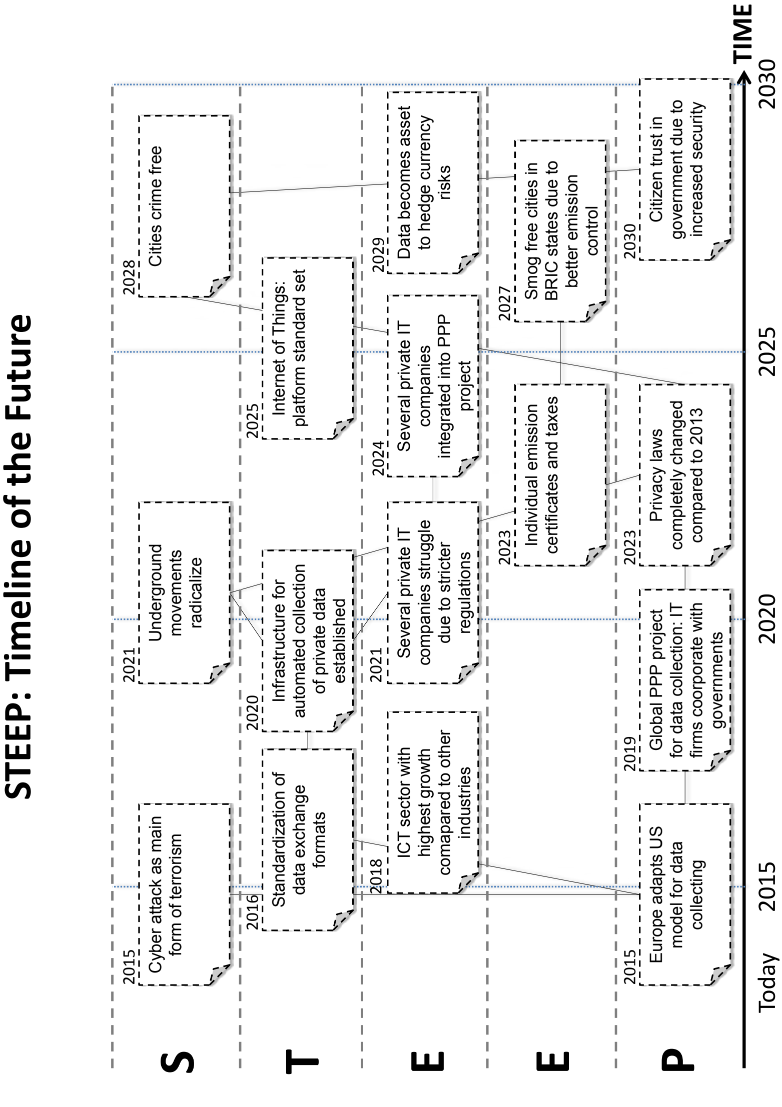

Figure 8.3: Timeline of the future.

8.2.3 Signposts

The following chapter describes signposts, that point towards the "Big Brother" scenario.

Protests against privacy regulations by subgroups
Although public safety can be increased by the utilization of data, concerns regarding the expanding central collection of personal data motivate the foundation of radical formations trying to damage the underlying technical infrastructure. Besides these radical formations, some parts of the society are highly polarized by the question whether the collection and monopolistic collection of data in particular is justified to this extent or not. The majority of society accepts the holistic collection and the central storage of data, but some small groups are repeatedly able to attract media focus by conducting cyber attacks on large internet companies and federal institutions. Some households decide to disconnect from the Internet and terminate service provider contracts.

Introduction of industry-wide standards
Technical standards are highly regulated in order to guarantee the availability and stability of the underlying data infrastructure. Starting with several industry-wide cooperations for developing technical standards, fiscal regulation tailored to the characteristic of leading market players increases and hampers the introduction of new technologies by young companies.

Increased market entry barriers
As small and medium-sized companies fail due to higher regulations, they are acquired by larger players. This leads to a reduced number of market players and less competition due to coordinated industry agreements thus resulting in increasing market entry barriers for young companies and less innovation. Data markets are unbalanced and can be described, due to the monopolistic situation on the supply side, as seller markets, leading to less transparency and inefficiency in price allocation, thus resulting in higher prices for buyers.

Personalized tracking of environmental damages
Climate issues and urban pollution are tackled by introducing limitations on individual emissions and mobility based on personal movement profiles. This leads to a higher pursuit of environmental damages and individual pollution and enables cities, especially in economically emerging countries, to become cleaner.

High governmental activity in ICT industry
On the one hand, one can observe more regulations concerning technical standards and the enforcement of private companies to provide governmental access to personal data. On the other hand, politics takes an active role in the market by entering public-private-partnership projects and restructuring failed players by merging them into monopolistic public-private-partnership formations.

Market licenses for datamarkets are limited to a few data suppliers and in the course of time will be given to only one supplier in order to ensure the central availability of data.

8.3 Scenario 3: The Smaller Brothers

The following scenario is called “The Smaller Brothers”. It is characterized by a society with no privacy and an infinite number of data suppliers. The daily routine of the fictional, 45 year old character John illustrates the life of people in this future scenario. Furthermore, an imaginary timeline from today until the year 2030 as well as a description of signposts explain possible developments which may lead to this scenario.

8.3.1 Scenario Description

Like every day, John wakes up to the sound of his alarm at 7 pm. The first action of his day leads him towards his bathroom to a digital scale, which his insurance gave him two years ago. This little measuring device not only checks his weight, but also determines his blood pressure and some other values that are relevant for his personal health. John is happy. Doing sports every day seems to help him stay fit and he knows that the positive daily health reports will decrease his insurance payment contributions. On the other hand, the scale is warning him that his blood pressure has slightly increased over the past weeks. “I definitely should try to reduce stress at work somehow”, John thinks.

At breakfast, John reads his e-newspaper while eating cereals. His favorite daily newspaper is now well-known for a collaboration with his insurance company. It purchases the daily health reports of their customers to create personalized contents for the readers. An advertisement on the first page of the newspaper immediately presents John with a solution to his high blood pressure problem: a brand new blood pressure reducing medication for people in his age group.

Before leaving to work, John checks the TV for traffic congestions on his way to work. Few years ago, a company started placing public cameras at every street in the city. A yearly payment to this company allows John to access every camera to get an idea of the current situation in the specified area. Today, the situation in the city center is not really relaxed and going by car is therefore no option for John.

His mobile phone provider tracks all customers. As a subscriber to this service, John can immediately see the position of his friends. Two of his best friends, Sam and Mike, are on the way to the subway station, so John finally decides to take the subway as well in order to catch them for a short conversation.

John works at the main building of his company. At the entrance, he is forced to insert his passport into a scanner to get access. It authorizes John to enter the building and updates him with the most important information he has to know to start his working day. The message "no restrictions for entrance" on the display signalizes him and especially his company that no negative entries in his certificate of good conduct were added and that he can continue working for the company.

Today is going to be a tough working day for John. He has to prepare the launch of an advertising campaign and calculate the demand for a new product. To solve this task, John needs data on the current health status, hobbies, purchasing behavior and financial situation of potential customers living within his company's markets. John does not really like this kind of work because he has to contact different data suppliers which sell the necessary but fragmented data. "Every supplier has totally different purchasing processes. That makes it so complicated to order the data I need right now", John complains while starting the search. After a lot of work, John finally gathers enough data sets that contain the necessary customer information, but he is still missing information on the target group of elderly citizens, which he is specifically responsible for. He has to search at other suppliers for data and combines this information with the previously gathered data. This subtask takes him a while because of different file formats provided by the suppliers and compatibility issues. Aggregating these sets and performing quick data-mining is tedious and annoying work. John is very thankful that a new data aggregation company will soon offer these services to his company.

"The big advantage of stressful work is the fact that time passes by very quickly", says John to his new colleague Sandy while they go together to the canteen at noon. Both of them grab a vegetarian plate and sit down at the table where their boss is sitting, as he waves them to come over. Before starting to eat, John wants to look at his e-newspaper to get the results of this year's environment challenge for his neighborhood. Different energy companies started publishing the energy consumption of all inhabitants, allowing for direct comparisons. Whichever household has the lowest consumption gets a big discount for the next energy bill. Unfortunately, John only has the second lowest consumption. On the other hand, John feels good again after realizing that his unpopular neighbor has one of the highest consumptions and therefore has to pay more taxes.

Luckily, the afternoon turns out to be less stressful for John, so he spontaneously decides to leave work at 5 pm to do some grocery shopping for his wife. John already knows that he only needs to go to the butcher because of an application that tells him that nothing but meat is missing in his fridge. Like every modern household, John's fridge is equipped with sensors to evaluate its current inventory. The butcher, an old friend of John, already prepared two beef steaks for John and welcomes him upon noticing him. "Hi John, I saw you coming to my place on my augmented reality tracker. I checked what you had for lunch today to prepare something different for this evening. You know, I have recently started buying health reports from doctors in my neighborhood to improve my offers to customers. I can tell that you definitely need more iron in your nutrition. Since you did not eat meat for lunch I was so free as to prepare two very fine beef steaks for you and your wife. I'm sure you will enjoy them!" The butcher smiles at his favorite customer. John appreciates his help, but he declines the butcher's offer. "Sorry, but I prefer something else", explains John. After buying some chicken and a side dish for the evening, John continues his journey home.

John hopes that his wife Christine will like what he bought. He unlocks the front door with a hand gesture and enters their house. Christine does not seem to be in a very good mood. For the last few months, John and Christine have been living with a lower income. Saving money has become an important issue and the couple often discusses it. John, who loves his old smartphone, spends a lot of money for classical video calls to get in touch with friends from all over the world. To reduce these expenses, Christine convinced him to use a tracking software to better monitor the calling costs. "In the last days, you quite often called your new colleague Sandy to talk with her about your lunch plans", Christine complains. "If you cannot imagine lunch without her, at least you could ask her personally", she adds in an aggravated voice. John, who is amused regarding her jealousy, apologizes and promises to avoid unnecessary calls in future.

An excellent dinner, jointly prepared by Christine and John, increases the couple's mood immediately and all their problems do not seem to be important anymore. There are more important topics to discuss. The next week's election prompts both to think about who they should vote for. "There are so many different options, to be honest, I do not have a clue who to vote for", Christine admits. "Luckily, all elections are public. This allows me to see whether my friends will vote for my preferred candidate", notes John. "Well, I don't think it makes any sense to base your decision on the decisions of others", Christine disagrees. "I prefer to check the personal information of candidates to get a better picture of them. Most of the parties offer interesting information about their candidates, such as their income and their current health status. This helps make the elections and their candidates more transparent."

Still trusting his friends more than the personal information on the candidates, John checks his favorite political social network to know the current preferences of his friends. He decides not to spend too much time talking about politics and switches to a dating social network, which he has been using as a premium member for a long time. The website helped him get to know Christine who became his wife. Based on a calculation of his and her personalities as well as life histories, the website was able to determine their combination as a good fit. John never stopped paying for his account, but not in order to find other women. He is more interested in tracking his brother Marc who is still single. John keeps his fingers crossed for him.

Before going to bed, Christine and John still want to watch TV. Their favorite TV show "Funny Families" already started. With a special remote control app, they can choose between different camera teams who are secretly filming people on the streets in embarrassing situations. Sometimes, John and Christine can identify family members living close to them, like the Andersons or the Davidsons. Today, the TV channel is featuring their unpopular neighbor with the high energy consumption. "I pray that we are never going to be filmed by this show", Christine sighs while shaking her head.

8.3.2 Timeline

The following timeline describes how a world came to be, in which privacy has been abolished and personal information can be sold to the highest bidder came to be (see also 8.4).

Citizens of the year 2013 witness the exposure of US and European secret spying programs by key whistle blowers. With the help of these tools, governmental agencies are in a position to infiltrate computers and networks of individuals and groups respectively. Such agencies legitimize their spying activities with a need to ensure the safety of individuals within their states. In Europe, the general public is outraged and urge their governments to ensure the citizen's privacy. The following decade witnesses worldwide discussions on privacy, while governmental agencies continue to use spy programs. The discussion ends in 2021, when the world experiences a biological attack. A lab-engineered virus kills millions worldwide. Investigations reveal that the terrorist had been keeping correspondance with fellow scientists via mail, describing his future plans in detail. In the face of millions of deaths, the general public agrees to give up their privacy for the protection of their society. A corresponding law officially legalizes the spying activities of governmental agencies in 2022. Market forces also start pulling at the individuals privacy in the same decade. Companies see great business potential in non-anonymized data and actively try to convince the public of their new business models. The necessary software and hardware to generate added value to the customer based on his/her data continuously develops throughout the second decade of the 21st century. In 2019, complex real time analytics are able to generate usable results in under a minute. Large online players such as Facebook, Google and Amazon start capitalizing from their customer data by setting up massive data marketplaces in 2017. Just two years later, the data market is estimated to generate USD 2 trillion in revenue. Although governmental agencies are able to spy freely in the name of state security, crime rates still increase and terrorist attacks continue throughout the 2020s. In 2024, a European law is passed that makes individual private data public. The rationale behind this law is the fact that one-to-one monitoring is much more effective in identifying potential threats than large governmental anomaly detection software. A study from 2027 reveals that

80% of all crimes are preventable if no privacy would exist. Such news heavily influences the public opinion. In 2030 the UN passes the "No Data Privacy" law. The law prohibits citizens to retain any kind of personal data from the public. Such measures dramatically reduce the sky rocketing crime rates that have been triggered by the 2025 world economic crisis. These developments see a shift in public perception regarding privacy. The tremendous destructive potential that each individual holds in the 21st century leads to the trade of privacy for security. The newly available personal data generates whole new market segments that allows companies to flourish. Data marketplaces from companies and individuals emerge, while data is increasingly perceived as a valuable resource that can be bought and sold. Political and economical drivers have massive influences on the reality of 2030.

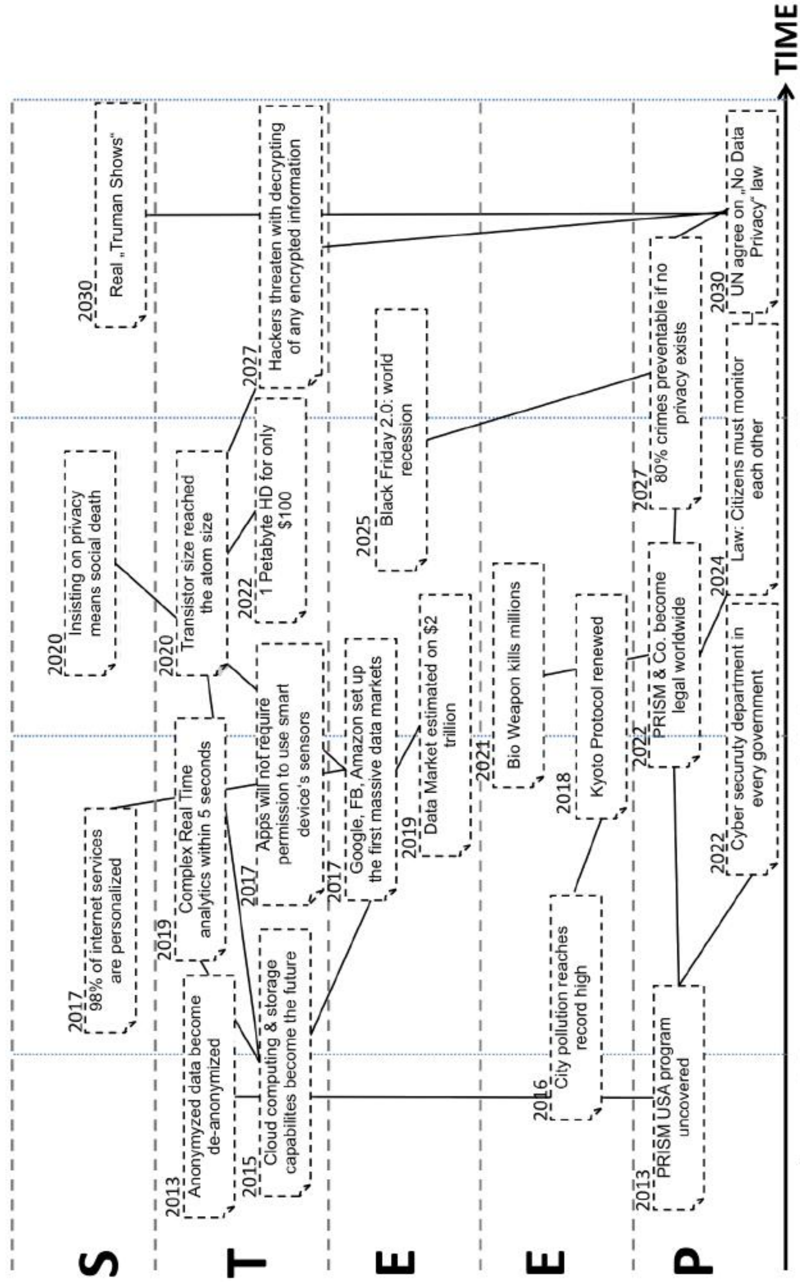

Figure 8.4: Timeline of "The Smaller Brothers" scenario

8.3.3 Signposts

Emerging data-dependent Smart Cities attract even more companies to data market

The amount of data in the world is proliferating and so is its usability. Its prevalence in data-driven cities has influenced companies to gradually realize the potentials behind Big Data. Enterprises, regardless of which industry they belong to, are researching on the prospects and utilities that data can bring. Influenced by a new giant market, several companies are already establishing their data solution units. Social networking platforms and web search engines are using clients' personal data for personalized advertising. While this may also be expected from other technical companies, it is striking to observe retailing giants and insurance companies entering the data market. Besides, every other company is collecting and selling as much data as possible to aid their profits. Considering the ever increasing technological growth and relatively small costs, companies are investing on data collection and storage facilities. Furthermore, with the assistance of easily available data analytic softwares, they can effortlessly build data solutions platform and use it to their benefits. In Smart Cities, data is like a commodity and one can witness emerging business models in this field. The possibility to trade data as well as weak privacy regulations puts the individual's privacy at stake.

Low-cost quantum computers enable faster data processing

In the past few decades, science has changed people's perception of information. Currently, it mostly concerns data and the ways to store, analyze and use it. Quantum computers and smallest possible transistors – a single-atom transistor – as predicted by Moore's law bring a major change[389]. Such developments signal the increasing storage capacity for ever increasing data as well as faster data analysis of Big Data. Moreover, the fact that appeals most to companies is the manifestation of Kryder's law – the decreasing cost for data storage [390]. In addition, the growing data market has captured the attention of software companies. This has led to an increasing number of data analysis and visualization software solutions in the market. Supported by technological developments, most cities are adopting high-tech sensors, actuators, and computing components for surveillance and other purposes. Any enterprise can now gather and analyze valuable data with the assistance of technology – the simplicity with which these technologies can be employed also attracts many other companies to the data market.

Technological developments are generally accepted as a sign of prosperity. However, some current developments indicate the opposite. Recent studies are challenging the anonymity of personalized data and hence the privacy of individuals. Studies show that an individual's identity can be determined from a large enough set of anonymized data. Furthermore, the development in computing speed with the rise of quantum computers increases the possibilities of cybersecurity: personal data that were once encrypted for security can be decrypted in matters of seconds.

Public security concerns give rise to anti-privacy legislation

Since mass threats to public safety such as terrorism and natural catastrophes have surged, a clear trade-off between privacy on the one hand and public security as well as safety on the other hand is being noticed by both government and society. Considering that security and order are important aspects to the "smartness" of tomorrow's overpopulated cities, new political and legal developments undermine individual privacy in favor of better public security. For example, many countries give an official legal standing to governmental mass electronic surveillance programs, similar to the controversial program PRISM in the US that was uncovered in 2013 [370, 396]. . The EU's Data Retention Directive, which requires communications providers to retain the data of their users for a period of at least 6 months [379], is amended to allow the dynamic screening of personal correspondence and extend the retention period to 50 years. Finally, this leads to international anti-privacy laws, agreed upon by the United Nations and designed to enable the authorities in Smart Cities to prevent and quickly react upon any security threats.

Voluntary abandonment of privacy dictates the social and cultural reality

An increasing number of people is willing to trade off their long-term privacy for short-term, usually charge-free, benefits from data-selling service providers [369, p.82]. In search of short-lived publicity and social recognition, users share with friends, acquaintances and strangers all intimate details of their lives as well as their health condition on different social networks. TV entertainment revolves around non-staged, on-demand reality shows, where – given the right price – people can observe each other's private lives. Consumers only use highly personalized services, which allow solution providers to acquire non-anonymous personal information. Furthermore, this raises switching costs, thus exploiting customer's laziness [394, p.181]. The various service providers gather personal information and participate in the data market business with data sets unique to their service. Hence, the personal disregard of long-term privacy gives rise to an almost infinite number of data suppliers enabling a potentially transparent society, where all kinds of personal data can be bought.

Governments enact laws against data supplier monopolies

Anti-trust government regulations are further contributing to the establishment of a great number of fragmented data suppliers within tomorrow's Smart Cities. Following concerns over the misuse of market power by influential private corporations and their entry into the data supply business with gathered customer data [383, 391], governments intervene. Laws ensure that no single data supplier gains market dominance as in a monopoly. By introducing a market share cap that a company can have, governments have created a more fragmented landscape of providers in a lucrative data marketplace business.

8.4 Scenario 4: The Data Stock Exchange

The following section describes a future scenario „The Data Stock Exchange“. This scenario describes a world, where each inhabitant has total control over his personal data and an infinite amount of suppliers exist, who are selling raw, filtered and analyzed data. To give a feeling on how life would look like in this specific scenario, the following chapter describes an average day of Tom, a man living in the year 2030, who works as a data supplier.

8.4.1 Scenario Description

"Good morning, Tom. It's 7:23 am on Friday, September 10th 2030. According to your natural sleeping phases, it's the perfect time to wake you up. It's 15°C outside and it will rain between 11 am and 2 pm. Would you like to hear the news of the day?" Tom opens one eye and yawns. "No, thanks. . . " He turns over to stretch one more time, before taking off the small clip-on sensor for tracking his sleeping movements for the alarm clock from his pyjamas. He dresses, gets up and walks into the kitchen where hot coffee is already waiting for him in the machine. What a great invention to link the alarm clock to the coffee machine, he thinks. It saves me at least five minutes a day.

He takes the milk out of the fridge and shakes it - it is almost empty. With a swipe of his finger the touchpad on his fridge comes to life. Tom holds the box to the scanner, waits for the beep and presses "Add to shopping list". Thinking about the upcoming weekend he decides to send in the shopping list to be able to pick up the food after work. He looks at the different options on the screen and decides again for the big food chain Rowo. The quality of food is always great there, the price is ok and he gets the best recommendations for his shopping list and recipes that fit his purchases. There is another "Ping!" on the touchpad, reading: "Do you want to delete any of your data-footprints or do you want us to save your data for future recommendations?" As always, Tom presses "Save" and the touchpad goes black again.

Tom's smartphone vibrates and he takes it out to read the message: "Please log on to your WorkData account". Tom accepts and clicks the heart-rate sensor under his smartwatch. He gets 150 Euro if he lets WorkData track his heart-rate every day for three months from morning to evening. Tom found the offer of the research institute on an internet platform for data trading. WorkData is studying if the work-life balance of workers in Germany is good enough and which companies are good or bad examples. Tom is pretty content with his work, but he just does not mind the extra money and besides that, it is nice to get a report on his stress level in the end and at which activities he felt most relaxed. These internet platforms are actually pretty nice, Tom thinks to himself. At the moment he has his fitness and workout data for the last two months up for sale, but he did not get the price he wanted so far. Tom would not say, he is rich, but his financial situation is good enough that he does not have to sell every piece of data and accept every price they offer. How desperate must I be to sell data on the regularity of my visits to the bathroom, Tom reflects. Well, there are always people, who do so. Tom remembers his time at university, when he went to a lecture called “Sell your data, not your soul” for one semester. Today, “Dignified data trading” is a course that every kid has to take in school, after it happened more and more often that the economic system knew more about some people than they realized. This even led to some people running off to remote places, isolated from data tracking, trying to give themselves back some dignity and new identity. That is one reason why Tom does not allow them to track his sleeping patterns or relationship details.

Tom sighs, walks in the bathroom and steps onto the scales. 79 kg, 12% fat, 67% water… not bad. “Ping!” The touchpad in front of him starts to blink even before he can step off the scale. FunForFit, HealthTracker and GermanWeight are competing for his attention, displaying their offer to encourage Tom to sign a contract with one of them. This would allow them to follow Tom’s daily weight details for three, six or twelve months and actually offers are pretty good today. Ever since Tom founded his company and made good money, he is offered far better conditions for his data. One contract even offers 99 Euro for one month plus a free bagle every day. The other one offers only 10 Euro per month, but a free twelve months gym contract, if you decide to send your weight data in every day for one year. There is also a 14 days break possible! He definitely has to reconsider his options at DiabetesData. He opens the app on the touchpad and pushes send to transmit his weight data. He has been partnering with DiabetesData for three years in a row now, pausing only for some days here and there. He decided for DiabetesData because his father sufferes from diabetes and this data supplier analyzes the data for the drug manufacturer to come up with the best available diabetes medication. He likes the idea of supporting them, even though the payment is not that good. Grumbling, he decides he’ll need to talk with them in the afternoon after his meetings.

Outside of his apartment building, Tom steps on the conveyer belt in the direction of the next Starbucks, an old and traditional coffee-chain. While some people speed by on the left side of the conveyer belt, Tom takes his time to check the SocialRadar on his smartphone and arrange a spontaneous meetup with friends at Starbucks. He spots Caroline and Michael about one kilometer away, moving in the direction of their office buildings, apparently they had their coffee already. Oh well, Tom thinks, I’ll just stop to get a muffin before work. He enters the café and approaches the counter, where a young man turns around. “Tom, hey! Over here!”. Oh no, it is Kiro, his neighbor, who never stops talking. Tom actually blocked Kiro from seeing him on the SocialRadar, he is just too much to handle in the morning. “Hey Kiro. Actually I’m quite in a hurry. I-”, Tom replies, but Kiro is already studying his smartphone, frowning. “I didn’t see you on the SocialRadar. Wait, did you block me?”. – “Uhm, of course not!” Tom manages to laugh and looks at his watch. “It must be broken or something. Oh, look at the time! I have to get going!” Tom hurries out of the café without the muffin, thinking that no matter how good the invention of SocialRadar is, 20 years ago they did not have that problem.

Tom rented two large rooms in one of the many co-working places in the city. He founded his small company DogAppreciationData just six months ago and now runs a team of ten people. Most days during the week at least half of his team works remotly, using virtual communication tools. Only once per week, everybody must be in the office for a face-to-face meeting. DogAppreciationData is one of the many companies that buys, aggregates and processes raw data, offering data packages as value added services to companies, the government or insurances. They are collaborating with a producer of dog collars with built-in sensors and they are buying raw data on pet statistics from the government, veterinarians and animal clinics. Even though there is a huge variety of data on the market, there are often differences in quality. Most of the data from official sources is incomplete and of low quality as clinics and the government do not offer great incentives for people to disclose their data. Compared to that, the dog collar sensors provide high quality data, which is also part of the success of DogAppreciationData. The dog owners can activate the built-in sensor and select the age and breed of their dog. Once activated, the sensor constantly gathers data about the health and movements of the dog. In return, the dog owners can track their dog with their smartphone and get information on the health of their dog, like abnormalities in the musculoskeletal system or an increase in temperature indicating a fever. The data is then aggregated by Tom’s team in combination with the purchased data. It is then sold to pet insurances who use the data to predict a dog’s lifespan and illnesses, depending on specific breeds and the gathered data.

Right now, business is very good, but the market is quite unstable, anything can change within the next year. His employees consist of a team of freelancers, which is typical in today’s working society. Sometimes they are working for two or three data suppliers at the same time. Ever since the law which forbids a certain size for data suppliers has been passed, the economy has changed a lot. There are a huge number of data suppliers that consist of sole individuals, competing against each other, forcing suppliers to specialize and only allowing survival in niche markets. At the moment, there is not much competition within his niche and he can sell the data pretty well. But data suppliers grow like mushrooms on the market, compete fiercely with innovative analysis tools until others leave the market. Tom is used to that. He has already owned three data suppliers, but he is positive that DogAppreciationData will survive another three years easily. Just today he had a meeting with a pet insurance and could negotiate a better price for his dog data.

After a long day of work, Tom just does not feel like walking home. He gets into the next electric car parked on the street using his carsharing app and clicks on “Track my driving data”. He earns points for each time he does it and can later trade them in for a Starbucks voucher or a giftcard from a grocery store. As most people work from home or on the go, the traffic is realtively constant and at a much lower level, compared to the city 20 years ago. Every non-electric vehicle is banned from the city and the government now provides a carsharing service for the citizens.

Tom passes by a small group of angry-looking people, holding up signs saying “Data trading marks the end of our world” and “Your data is your identity”. Tom sighs. Another group of these extreme people, who think our society is doomed because people are receiving good money or services in trade for their data. He sometimes wants to yell at them, that 20 years ago companies were simply gathering data and did not even ask. Thanks to our law system, everybody is in total control over their personal data and can have them delete it at any time. It has never been so secure to share your data – even a cyberpolice was introduced by law, punishing the misuse of data. People are so much in control of their data that they can even delete their records from the city council and become an anonymous citizen. What a crazy world, Tom ponders. A lot of criminals are hiding out in this anonymity unable to be tracked and found – the downside of this system. Tom thinks about his father, who is still from the generation that was very worried about giving away their data. Prism changed everything for them. After a few other incidents happened, such as Apple selling the data from their iPhone sensors and the discovery that China was observing all Europe they went on the streets to demonstrate. Even after they reached their goal of total control and complete security over private data, a small fraction of that generation lost their trust in the system completely and shared as little data as possible. His father was one of them. I should call him, Tom decides, touching the call button on the car. “Markus Baker?”, his father answers the phone. “Hi, Dad, it’s me. Just wanted to check in. I’m on my way home”. – “Son? Are you driving one of those cars? Are you being tracked?” – “No”, Tom lies. “I’m not.” – “Good. Well, I was about to nap for an hour. This grocery shopping today was awful. I’m done for today.” Tom frowns. “Dad, did you actually walk through the aisles? Why don’t you just use the shopping list and pick up services from the fridge I bought you?” – “They will know what I like then! I don’t want that.” – “Just let them delete it then, Dad. And who cares, what you have on your shopping list?” Markus Baker does not reply, sulking. They have had this discussion far too often. Tom sighs. “Allright, Dad, I’m about to get to the store to pick up my order. Can I get you anything?” – “No, thanks. Just drive carefully. And… take care, son.”

Tom hangs up and parks the car in front of Rowo to get his groceries at the front counter. A pretty woman hands him the bag with his order, smiling at him. “Thanks for fridge-shopping, Mr. Baker. Here is a recipe that goes perfectly with your selection of groceries and a 20% discount for the next time you decide to fridge-shop with us.” Tom hesitates. He knows from his dad that 20 years ago it was very common to ask a girl out without even knowing if they would fit as a couple. Unthinkable. Today, you use a special matching service that compares profiles of your Partnersearch network accounts, before you even talk to a girl. Tom clears his throat. “Thanks, uhm. I’m Tom.” The woman looks up, confused. Then she smiles. “I’m Heidi.” They look at each other, feeling a bit awkward. Tom finally takes the courage and asks: “Do you maybe want to match?” – “Sure”, Heidi replies, beaming. “Will you give me your Profile ID?” Tom holds his phone against Heidis to transmit the ID and left for the car, feeling pleased with himself.

While opening the door to his apartment, he sees that he got a mega-encrypted email from the cyberpolice. While the message is decrypting, Tom hangs up his jacket and takes off his shoes. Curious, he then reads the message that his weight-data has been illegally sold by DiabetesData to a different company than the designated pharmaceutical corporation. Right! He remembers he wanted to call them and then he completely forgot. And now that! At the end of the mail the cyberpolice asks him, if he wants to press charges. He pushes “yes”, feeling a rush of disappointment, even though he knows, that DiabetesData will be punished severely.

Tom turns around as he hears his phone doing a “Ping!” again. It’s a message from his Partnersearch Network: “Congratulations, Tom! You’ve been matched with Heidi and you achieve 95% as a couple!” Tom smiles broadly as another message comes in from Heidi: “Quite some rank we achieved, huh? Wanna meet?”. Tom replies: “Wanna cook? I got a nice recipe from a beautiful woman in Rowo today and I happen to have everything we would need at home.” As Tom types in his address and sends it off to Heidi, he thinks to himself that he might not need the sensors on his pyjamas tonight after all.

8.4.2 Timeline

In this section we review events that lead to the scenario of total control over one’s personal data in a highly competitive surrounding of infinite data suppliers. The events are illustrated in figure 8.5. The surveillance scandal of the NSA in the United States in 2013 marks a starting point for increasing global public awareness of data privacy. The concerns are further fueled by the Chinese surveillance scandal in 2016, during which the Chinese government spies intrude US, UK and German authorities. As a result the EU establishes the “Data Taskforce” to work on laws for data security of their citizens. In the meantime, the dominance of a few data collection companies, namely Google, Amazon and Facebook leads to an oligopolistic market environment of data suppliers that squeeze out smaller companies’ efforts to establish a solid market share.

Rumors about a merger of Facebook and Amazon emerge and are extensively discussed by the press. The threat of every individual's data in one big data pool scares governments and citizens.

At the end of 2017, it becomes public that Apple used iPhone sensors of customers to gather camera recordings and track location data without permission of the user. Movement patterns as well as media contents are then sold to third parties. With an average number of 90% of a city's population owning a smartphone, Apple provides the majority of these devices. Single technology providers manifest their place in society, but their legal boundaries for handling data are not regulated sufficiently. Data privacy law suit after law suit is filed at the European Court of Justice but charges are constantly dropped. Strikes and walkouts of millions of people go on for several weeks in Berlin, Paris and London. The recent scandals trigger German voters to elect the Piratenpartei into the German coalition. Due to public pressure the EU reacts by establishing international data protection laws and their prosecution. A data ownership law, that enforces personal data to be every individual's property, is finally implemented and ratified by all EU member states in 2019. As of then people can revoke permissions they have provided to a service at any time.

Furthermore, the centralization of data suppliers is tackled. In order to ensure security for its citizens the European Union aims to fragment the data supplier market. Even though protests of the big market players slow down the process, they cannot hinder the "Marketshare Data Supplier Law" from being established in 2020. The law states that a single company's market share in a clearly defined data market segment is not allowed to exceed 10%. In addition to that, the trade volumes of a single company on the data supply market as a whole are legally limited. 10,000 European Cybercops are employed to work on the prosecution of the laws. This law has a massive impact on the big traders of data: Dominating companies are forced to split up their data supplier activities into separate companies. For example, Google sells its maps, mail and social network division to public and private entities. Thus, the aforementioned law is regarded as the biggest intervention in a free market economy since the Standard Oil ruling in 1911.

The reopening of the market rapidly increases the level of venture capital investments dedicated to data supply startups and data marketplaces and accounts for 40% of all capital investments in 2022. The entrance barriers for new startups tremendously drops. Specialized data suppliers gather all kinds of information such as body weight data, food consumption data or people's pet data, whereas other suppliers vertically integrate and offer enriched data. Consumers actively participate and soon the first billionaire makes his fortune through trading his individual data and to be featured on every news channel in the world. One of the first trading points where suppliers and data demanding firms meet, is offered by the visionary legend Elon Musk. His marketplace

DataPay quickly counts the first 10 million trades in 2022.

To further promote data sharing acceptance and trust towards data suppliers in society, a short version of a service's "terms and conditions" comprising a maximum of 300 words becomes obligatory in Europe. Moreover, the cancelation period of data supply contracts is legally diminished to two weeks. Regaining faith and well incentivized, a critical mass of people starts to sell their data. A Forbes study concluded that people pick the company they sell their data to based on aspects such as trust, transparency and if their friends use it. With the recognition of data sharing benefits governments and industry players manage to provide open data pools within the health sector. Anonymized sensitive patient data and their advanced analysis enable medical treatments to be custom-made to a specific DNA profile. Creating a competitive ecosystem around data trades, data demanding companies now have an overwhelming freedom of choice in equivalent service offerings differing in price and quality. A downside of the plurality of data suppliers and thus different companies is remarkable: Many redundant infrastructures such as data centers emerge resulting in data centers making up 30% of a city's energy consumption in the late 2020s.

Because of the superior development stage of electric cars, the number of sales of petrol-driven cars drops to 10% in 2024. Petrol fueled cars are finally banned in European cities with more than 500.000 inhabitants in 2025. In the following years, smog pollution decreases to levels which have last been measured in the early 20th century. With the boom of electric cars, smart grid infrastructures are put to a new level of network stability and balanced energy supply of renewable energies. The energy price stabilizes and energy contracts become tailored to personal demands. Data availability at fair prices accelerates the development of Smart Cities that account for 70% of all cities in Europe in 2027. Smart mobility systems and decentralization of office spaces reduce the average commuting time of office workers to 20 minutes. The intelligent infrastructures also have drawbacks. The 2028 power blackout in Munich enters today's history books as it reveals people's high reliance on modern technology. However, superior backup mechanisms evolve, but also result in a movement of technology education and emergency handling.

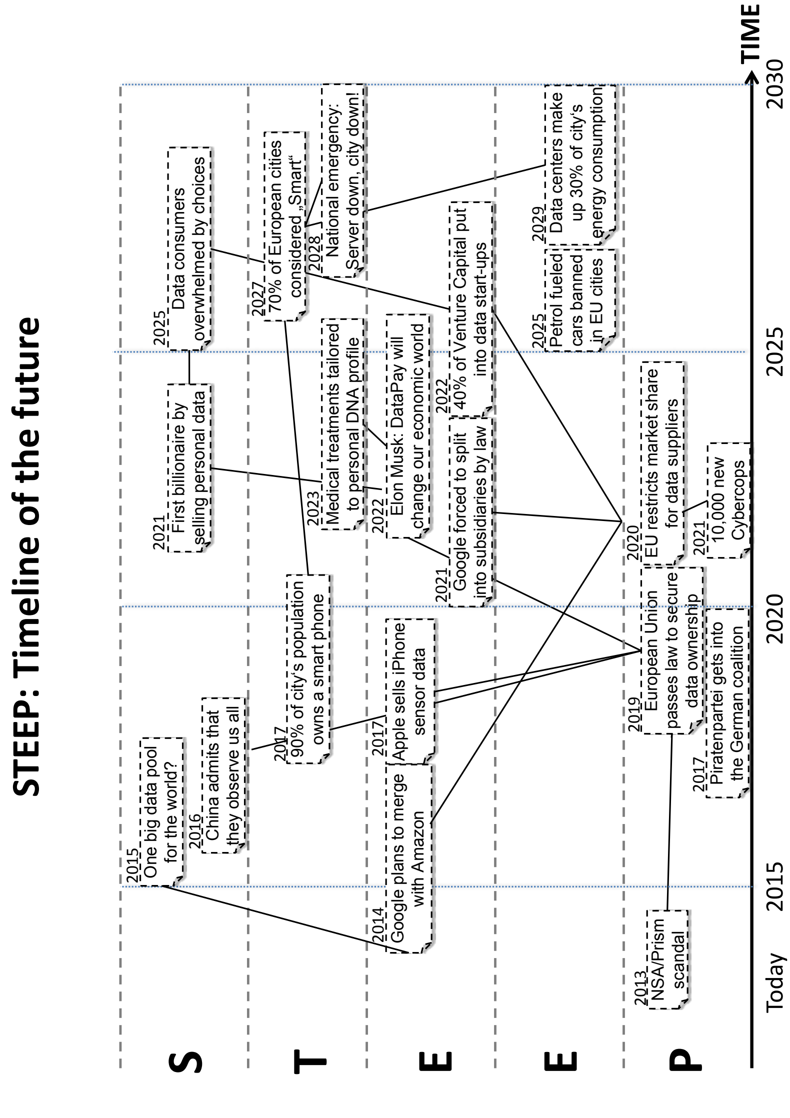

Figure 8.5: Timeline of the future,
“The Data Stock Exchange”

8.4.3 Signposts

The following sign posts will serve as indicators for the future development of this scenario.

Obligation for data collection dashboard on smart phones
As technology becomes more mobile, there will need to be a greater level of security to ensure privacy. Currently, smartphone operating systems (e.g. Android, iOS) have proprietary access to sensors on their respective phones. This does not allow individuals to identify what data is being recorded at what times. There will be thee obligation for a simple dashboard displaying data collection, that will allow users to directly monitor gathered data. This level of monitoring will be necessary for users to be in total control, while collecting data with mobile phones. The importance being that mobile phones will be a major data source in Smart Cities.

Anonymized data standards
Data will be bought and sold much more easily than it is today. To be successful, private data will have to be sold in two ways: non-anonymized and anonymized. In a non-anonymized format,the user can be identified by the provided data set. In an anonymized format the provided data set would not be able to derive the individual. As privacy is a major concern, users will want much of their personal data to be anonymized before it is offered by data suppliers. This will only be effective if the anonymization cannot be reversed. Therefore, legal standards must be generated for information-sensitive data sets. For instance, specific rare diseases may be easily combined with birthdate to identify identity. This data set would then never legally qualify to be called anonymized. These standards will instill much greater trust in data exchange, encouraging individuals to use data marketplaces.

Anti-data-trust legislation
For there to be an abundant amount of data suppliers, no data monopoly can exist. While individuals want leverage over suppliers and a wider selection of data suppliers, this will not be enough in the rapidly growing digital market. Legislation will need to be passed to ensure no monopoly can exist. The legislation will guarantee a fair competition amongst data suppliers. With this legislation in place, individuals will be able to exert power over suppliers and quickly change when they become unsatisfied. Additionally, the healthy competition will allow niche markets to develop, allowing individuals to choose data suppliers that cater to specific lifestyles and needs.

Data usage and data privacy education
Currently, there is discontent about the extent to which data has been collected and sold, without the individual's informed consent. This is the case with Facebook, where users have no control of which personal data is gathered and

sold to third parties. This discontent will continue to grow exponentially, as data collection systems and data markets become more complex and widespread. Educating the masses on the power and uses of personal data will severely change this effect, restoring public confidence. As soon as individuals understand the new level of security in the cyberworld, individuals will feel more at ease. Another effect of the growing complexity is confusion. Education between data suppliers differences will be necessary for individuals to decide what fits best to their lifestyle. This will instill a new level of confidence, encouraging more users to enter the data supplier ecosystem. In summary, education will be necessary to rebuild confidence in personal privacy and alleviate confusion from the wide variety of data suppliers.

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Part III

Ideation

Chapter 9

GreenPeak

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Executive Summary

GreenPeak provides a solution for traffic jams during peak hours. It does so by collecting a road charge from car drivers within Smart Cities employing an advanced RFID technology. The road charge is priced dynamically, highly dependent on the time of day, the events of the city, current weather and road conditions. At peak hours, the road charge is more expensive than at times when street capacities are not fully used, thus balancing traffic loads. With less traffic jams, the Smart City benefits from reduced car emissions and energy waste. It also educates the citizens to avoid meaningless journeys. Furthermore, the city earns the majority of the collected tolls. Citizens benefit from an improved traffic flow and hence reach their destination faster. In addition to real-time charging, car drivers are incentivized to book their vehicle routes in advance, which lets GreenPeak predict future traffic loads. The predictive data combined with personal data of the respective driver is of immense value for data purchasers: Advertisers tailor their advertisements, event managers adjust their planning and public authorities leverage their public services. GreenPeak establishes a major revenue stream by trading these data sets on data marketplaces. Further revenue comes from a commission fee for each ride a car driver takes. Public authorities pay an installation fee to GreenPeak to set up the system. In turn, GreenPeak runs the full service package on behalf of the city council ranging from research over advertising to billing.

The most robust scenario for GreenPeak activities is given when an infinite

amount of data suppliers and no privacy over personal data exists. Privacy concerns would not hinder the pervasive tracking of cars and the selling of this data to third parties. Moreover, the existence of many data suppliers results in fair market prices for data sets that GreenPeak sells. Hence, a scenario of high privacy and only one data supplier least facilitates the business idea.

9.1 Introduction

For the first time in history, more than 50 percent of the world's population is living in cities [412, p.2]. Urbanization, the trend towards a higher urban population, leads to more traffic and congestion in cities. New and innovative mobile concepts are therefore critical to ensure an optimized traffic flow in the city.

Today, traffic congestion in cities is likely during certain time frames of a day. Figure 9.1 shows the load of the traffic system in a typical urban city and demonstrates that congestion occurs when the maximum capacity of the traffic system is exceeded. In this example, traffic peaks occur in the morning and in the evening, in high correlation with the city's commuter traffic. Consequently, congestion slows down the traffic flow during these times. However, in the afternoon and especially during night, traffic is reduced, leaving unused capacity of the traffic system. It is desirable to shift load from time frames where the maximum capacity is exceeded to times frames characterized by unused capacity in order to develop a constant load of the traffic system throughout the day.

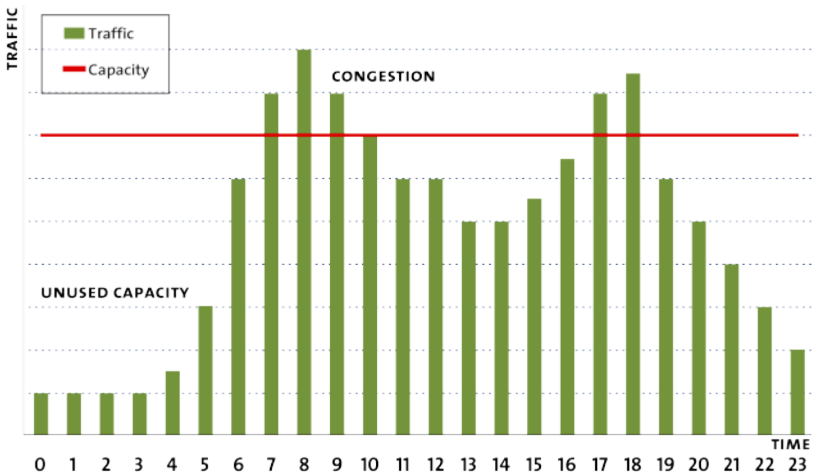

Figure 9.1: Traffic congestion in a typical urban city
Source: Adapted from [411]

Traffic congestion leads to disadvantages for car drivers and the city itself. Next to the obvious loss of time caused by lower speed during the journey, the environment gets more polluted. Traffic congestion leads to a higher fuel consumption and thereby CO2 emissions may increase by up to 300%. [409]

GreenPeak addresses these problems. The dynamic traffic charge system balances the daily traffic load in Smart Cities by motivating the drivers to focus more on unused capacities and in addition, it facilitates predictions of the future traffic flow. This valuable data can be purchased by advertisers or event organizers on data marketplaces to adapt their offers according to the profiles of the passing by road users. Furthermore, GreenPeak aims for an intense cooperation with the city council and public transportation to improve traffic within the city and to finally create a greener and less polluted environment.

9.2 Business idea

GreenPeak introduces a dynamic road charge system for cities in order to balance the daily traffic loads and to predict future load by selling routes in advance.

The billing is realized by an RFID technology in the vehicles and the city infrastructure. RFID sensors at relevant parts of the city, e.g. at crossroads, allow to determine the vehicle's current position and the distance covered. The final amount to pay is calculated with the current road charge. The process of building up the whole infrastructure in the city will be outsourced to partner companies.

The road charge per kilometer is calculated dynamically. It respects historical, real-time and predictive data. More concretely, the algorithm is optimized by taking into account several factors that influence the traffic load in a city: The driver's type of vehicle, the current traffic flow, building sites, weather data, local events, road conditions and the public transportation in the city. GreenPeak gets a share of the actual road charge paid by the drivers to the city council.

In addition to charging drivers in real-time, GreenPeak offers the possibility to purchase routes in advance. Drivers can commit to a time period when they want to drive a specified route. Therefor, they pay the charge for this route calculated for that timeframe in advance. The commitment to specified routes binds the drivers to predefined parts of the infrastructure. This idea reduces unpredictability and allows a prediction of future movement patterns. Different pricing models motivate drivers to prefer a long-time planning in advance by purchasing routes beforehand instead of occupying traffic capacities spontaneously. Drivers can subscribe to their preferred routes or can receive information about fastest or less polluted routes. Higher discounts are possible if drivers buy routes a long time before departure to make early and accurate traffic predictions possible.

The prediction of the future traffic flow and the recording of drivers' movement patterns represent a second valuable revenue stream. An accurate prediction delivers valuable data which can be sold on data marketplaces. Potential customers are advertisers who want to adapt their advertisement to their target groups' movement patterns, operators of public transportation to dynamically estimate the demand for public transportation and organizers who want to estimate potential attendance and travel time for their events. Furthermore, insurances already show interest in getting more detailed information about their clients' movement patterns to adjust their fees [410].

Finally, a frequent basic income is guaranteed by a fixed payment from the city council for the operating and maintenance of the road charge system. In addition to the basic support for the city council, GreenPeak provides a premium offer. This service includes a white-labeled support channel for all citizens offered by GreenPeak. All citizens can contact GreenPeak to inquire about the road charge system, the current prices or the billing.

To sum it up, GreenPeak implements a road charge system which calculates dynamic prices influenced by several factors. Figure 9.2 shows the business idea by illustrating all relations between GreenPeak and its partners. Aside from the fixed payment from the city, the percentage share from the road charge and revenues from selling data about drivers' movement patterns and predicted traffic flows allow an additional, promising income for GreenPeak.

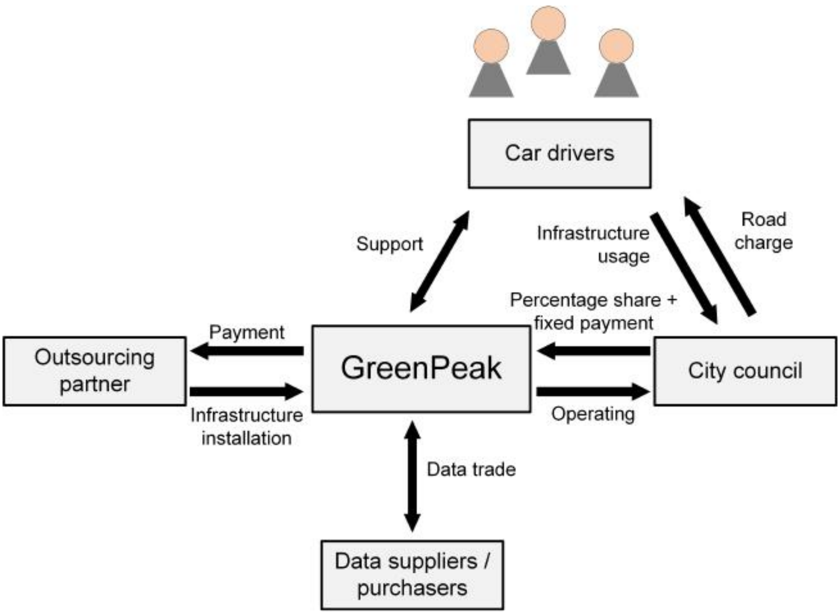

Figure 9.2: GreenPeak's business idea
Source: Own illustration

9.2.1 Value proposition

GreenPeak is a solution for smart traffic, designed to improve the mobility within cities. It is the first full services company, which aims to enable control over the traffic in the cities through a dynamic pricing model. It offers its clients several advantages.

One of the main values that GreenPeak generates is a better balanced traffic load. To achieve this, GreenPeak introduces a dynamic road charge with higher prices for rush hours and loaded streets. Furthermore, GreenPeak's technology provides reliability and at the same time simplicity for its users. The RFID technology enables an automatized process of road charges without the need for manual toll stations or even cash. Besides, the possibility of human mistakes is minimized, because the whole process does not require human interaction.

As an additional value for the drivers, GreenPeak permits the reduction of fuel consumption, mechanical attrition and vehicle exhaust, because it minimizes the amount of time cars spend in traffic jams. This makes driving with GreenPeak within the city timely, more efficient and reduces citizen's environmental footprint. It furthermore provides drivers with real-time road condition data and also gives them recommendations on the fastest or shortest route according to these conditions. This information enables better time management for the driver, because it allows them to avoid traffic jams and other obstacles such as accidents. Consequently, it saves time and eases the pain of driving within the city.

But not only drivers benefit from the usage of GreenPeak. It also provides a cheap and highly efficient way for road charge collection to city councils. The usage of the simple RFID technique replaces costly tollbooths. Recruiting and educating employees for road charge collection is not needed. It will not only save money otherwize spent on necessary infrastructure improvements but it will also generate additional earnings for the cities. Finally, it will have a great influence on the improvement of the overall environmental conditions within the cities, because it will allow drivers to avoid peak hours and crowded streets. Through real-time charging, citizens are incentivized to avoid meaningless journeys. This will automatically lead to less congestion and hence loss fuel consumption and thus CO2 emissions, which will be cutted by 300% [409].

Finally, GreenPeak provides its business clients with valuable datasets. The generated data is unique by itself, because, in contrast to the Telco providers, it not only provides businesses with the location of a possible client but it also does so in advance. The special routes reservation system of GreenPeak, which will be presented in detail in section 9.2.6, enables the predictive analysis of drivers' movement patterns. This information in combination with the personal profile of the users, which is created when signing up for the GreenPeak Platform, permits the development of entirely new business models for companies e.g. in the advertisement or retailer sectors. For example, advertisers could tailor advertisements to customers better and event managers could optimize their event planning.

9.2.2 Customer segments

GreenPeak serves several interdependent groups of customers and consumers, which represents the multi-sided nature of the platform. The customer base is classified into three different categories.

Firstly, public authorities of a Smart City and its corresponding federal state government build the initial entry point for GreenPeak's road charging system. In Germany, the federal state governments decide upon the introduction of a road charge within cities [408]. It is essential for GreenPeak to get in touch with these federal politicians and city councils to convince them that GreenPeak is crucial for a greener city in a world of individual mobility. However, once the federal state government has decided upon the road charge, we mainly work closely together with the city councils, which we see as our main customers in order to negotiate the details of the contract. On the long run, it will be GreenPeak's ambition to convince the German Government to decide upon road charges in everyone of their congestion-critical cities.

However, the end consumers of GreenPeak's intelligent charging system are the car drivers. Since the company offers the service as an "all-inclusive" package for the city, it is in direct touch with the car drivers with regarding all business activities. It provides them customer support throughout the whole buying, billing and after-sales process and markets its products accordingly. For example, it aims to sell as many routes as possible in advance. Although these prepaid routes are cheaper than the charges upon spontaneous street usage, the predictive data of routes are of immense value for the third customer group.

This group consists of data purchasers, which buy various forms and types of GreenPeak's data on a data marketplace. The predictive data that is generated through prepaid booking of routes, is mainly bought by public authorities, advertisers, event organizers, gastronomes and public transport providers. Furthermore, historical data is bought by the aforementioned players as well as additional data purchasers such as insurance companies, car manufacturers or public authorities. The data GreenPeak sells on the marketplace is analyzed and prepared based on the current demand of the market and the requests it obtains from the data purchasers.

9.2.3 Channels

GreenPeak relies on a mix of own and partner channels through which it reaches out to its customers. First and foremost, the federal governments and city councils have to be convinced to implement a road charging system. In order to raise awareness that every major city needs GreenPeak, it dedicates its own and direct sales force towards acquiring public authorities as customers. It is the same staff who helps authorities to evaluate the value proposition and assists them during the contract negotiation process. However, a team of additional experts is put in place to respond to the individual needs of the city during the contract negotiation and in the execution phase.

Car drivers are reached via direct and indirect channels. Firstly, GreenPeak raises awareness for the prebooking of routes through an online-offline marketing mix. Thereof, the company thoroughly tracks the range of influence of online measures, such as adwords, banners or newsletters that use targeted advertising. Consequently, car drivers can purchase their routes through a web interface, which delivers actual conversion rates of the respective marketing tool. Offline campaigns, such as advertising screens or TV spots promote GreenPeak's image of an environmentally friendly and sustainable company. Secondly, the company has a number of indirect sales channels through its partnerships with gas stations, public transport offices and navigation system providers to expand its reach. The partners at gas stations and public transport provide facilities for the purchase of routes and display current road charges. The navigation system providers are an integral source for ad-hoc purchases made by the drivers while sitting in their car. In contrast to that, after sales activities are exclusively executed by GreenPeak. It reaches out to customers through email and on-platform recommendations for future sales based on the customer's profile.

Regarding the data trade branch of GreenPeak, the sole sales channels are data marketplaces that offer and deliver the company's data to the market. However, in addition to that, GreenPeak raises awareness and informs about after sale services through brochures, targeted newsletters and an online B2B presence, where the company actively promotes predictive and historical data sets.

9.2.4 Customer relationships

GreenPeak has three main customer segments that require different levels of customer relationship management ranging from dedicated personal assistance to service over a web interface (as shown in table **??**).

GreenPeak is well aware of the importance of the city councils and federal governments for its future success. These need to be courted through a dedicated effort of sales staff. The staff visits political, cultural and environmental events as speakers and guests aiming to build up close relationships that convert into acquisitions and are maintained even after sales. Once a contract is established, GreenPeak sets up a branch that handles the planning, setup and operation of the system in the respective city. By doing so, it can individually tailor the system to fit the city's infrastructure as well as to please the customer's needs and wishes.

For the drivers, GreenPeak provides a platform and automated services accessible through the web interface. In addition, the web site displays historical route prices and expected route prices. Moreover, every driver can book online routes for a discounted price compared to the predicted price that is estimated

	Car drivers		Smart Cities	Data purchasers	
Channes	Online-offline marketing mix / purchase through GreenPeak's web interface	Partnerships with gas stations / public transport / navigation system provider	Own sales force	Own marketing & after sales efforts	Purchase through external data marketplaces
Customer relationship	Self-service / customer support / after sales	Self-service / personal assistance	Dedicated personal assistance	Personal assistance / customer support	

Table 9.1: Overview of GreenPeak's customers, channels and customer relationships

for the specific date. Every driver has a virtual profile, where he can adjust his personal data and overview his track record as well as his invoices. Based on the personal profile, the driver also gets route recommendations to ease the customer experience. Since GreenPeak cooperates with major navigation system providers, the drivers are also able to book their routes with the respective navigation device. Furthermore, partnerships with gas stations and public transport aid drivers who prefer to book physically with assistance from the respective partner institution. In case of general problems with the system, the drivers finds solutions in the self-explanatory help section. Secondly, if the problem is not solved, customer service staff will assist him during the sale via telephone.

Data purchasers buy GreenPeak's data through an external marketplace. However, GreenPeak gets in touch with the data purchasers after the sale to inform them about products related to their shopping cart. Many data purchasers do follow-up purchases of updated predictive or historical data concerning street utilization. This data build a unique foundation for business intelligence and predictive analytics. Hence, many customers will acquire data regularly. Electronic feedback is collected in order to improve the service offering and to tailor it to the market's demands.

9.2.5 Key resources

The business model of GreenPeak requires mainly intellectual resources, which are critical for the success of the company.

First of all, the dynamic road charge is influenced by a number of factors like traffic load, road conditions, weather or local events. An intelligent and accurate calculation of the price, based on these historical, current and predicted factors is necessary to determine a fair and comprehensible price. The algorithm which calculates the road charge can be understood as the core product of GreenPeak. It aims to determine a road usage price which can influence the drivers' movement behavior in a way that will shift traffic flow from peak times to unused capacities. Being a unique selling proposition at the introduction of the business idea, the algorithm can be developed further with increasing experience. It has to be guaranteed that the algorithm always considers most current environmental and technological developments as well as the inhabitants' movement behaviors. In this case, the algorithm is a powerful means to optimize load leveling and to ensure a competitive advantage against new market entrants.

GreenPeak does not only introduce a road charge system with a dynamic pricing model. As stated before, drivers can also purchase routes in advance. The bonding of drivers to specified parts of a city in advance of time allows GreenPeak to predict future traffic flows and to create movement patterns of the drivers. The predictions and the movement patterns are a critical resource for the business idea since GreenPeak generates significant revenues by reselling the generated information.

The creation of strong political relations is mandatory for GreenPeak in order to introduce a road charge system in cities. In Germany, federal state governments are in charge to pass laws for the introduction of road charge systems [408]. As the implementation is realized per city, strong relations to city councils are important in order to be selected as the provider for the road charge system and to stay partner for maintenance and customer support. Therefore, "lobbyists" are a key resource, keeping good contacts to decision makers at the city councils and within governments.

Finally, the RFID infrastructure in cities is a physical key resource for GreenPeak to realize the idea of a dynamic road charge system. RFID sensors at important spots in the city, e.g. at crossroads, are necessary to communicate with the transponders inside the vehicle and to track their current position while moving in the city. This information is used to bill the drivers and to create movement patterns. Therefore, the availability of a running RFID infrastructure is indispensable.

9.2.6 Key activities

The focus on a dynamic road charge system demands for a permanent charge calculation. The calculation and the billing has to be comprehensible and reliable.

GreenPeak's business model is highly depending on data. On the one hand, GreenPeak appears as a data purchaser on the market. Different input is necessary to calculate the road charge. It has to be purchased on different data marketplaces. On the other hand, significant revenue is ensured by reselling generated data about the drivers' movement patterns and predicted traffic flows on the market. Dealing with data is one key activity of GreenPeak, which includes ensuring data security on the whole value chain.

Generating new data and reselling it on data marketplaces is only possible if GreenPeak is able to predict traffic flows. This key activity guarantees the other main part of GreenPeak's revenue. Promoting the purchase of routes in advance is a main task. After convincing the drivers to bind to specified routes, GreenPeak needs to analyze the collected data to create the future movement patterns which then can be sold on data marketplaces.

The dynamic road charge of GreenPeak represents a unique and innovative way of leveling traffic load. Drivers will need some time to gain experience with the new road charge system. Questions concerning the system cannot be answered by the city council itself, especially when complex questions regarding the calculation of the road charge arise. Therefore, offering support for drivers is another key activity of GreenPeak.

9.2.7 Key partners

GreenPeak's business model is built on a trustful collaboration with selected key partners.

An intense partnership between the city which implements the dynamic road charge system and GreenPeak is formed. GreenPeak is a service provider which is commissioned by the city council to implement the road charge system in the whole city. A succesful partnership is hereby important. The city is not only a client of GreenPeak. Instead, the relation between the two players can be described as a public-private partnership with the common target to improve the road charge algorithm together. The city acts a data providers. It has access to different information which influences the traffic flow in a city, like current and future building plans, road conditions, accidents or local events. The city can share this data with GreenPeak in order to let them integrate it into the road charge calculation. This helps to improve the whole algorithm and consequently to provide a fairer road charge calculation to its inhabitants. Hence, both partners can profit from this partnership.

The algorithm to calculate the road charge is furthermore dependent from other external data suppliers. Examples are meteorological stations or event organizers. GreenPeak needs to build relationships with these stakeholders since their data is necessary for an accurate road charge calculation. The partnerships between GreenPeak and these key partners help GreenPeak to get the necessary information. A unique access to this data might also be negotiable for GreenPeak. The partnerships can then lead to a critical competitive advantage for GreenPeak.

The installation of the technological infrastructure is not done by GreenPeak's employees themselves. This task is outsourced to a partner who is paid by GreenPeak. The outsourcing partner is another key partner of GreenPeak since a working infrastructure is indispensable.

9.2.8 Revenues

GreenPeak has multiple revenue streams.

The initial revenue stream of the company is directly connected to the toll collect function. In exchange for the creation of the algorithm, the platform and also for their maintenance and improvement, GreenPeak receives a share of each road charge transaction. In addition to this variable sum, the city council is obliged to pay a fix monthly rate, which is used for the maintenance of the customer support center and also for the calculation of the dynamic prices.

A secondary but very important revenue stream results from trading the collected data. Selling routes in advance creates consistent statistics about the movement patterns of citizens and also shows reliable information about their future routes within the city. This permits GreenPeak to say who is going to be where and at what time. Furthermore, this information in combination with various personal data and the citizen's car enables GreenPeak to provide appropriate predictive analytics. Enriching and combining this information makes the predictive analysis of GreenPeak very valuable and unique. Selling this data on the market represents the biggest part of the company's revenues.

One of the biggest and most valuable components of the concept of Green Peak is its pricing model. The company believes that it's a question of charging the right price to the right user at the right moment. It all depends strongly on the ability to do an accurate forecast. This is why GreenPeak combines different pricing models. The first one is "the earlier the better". In order to convince people to book their routes in advance, GreenPeak offers them higher discounts. Earlier reservations enable the company to make better forecasts about the movement patterns of its customers. Another price model is offered to people who book the route the day before the trip. They are being charged more. This financial driver stimulates the early booking and supports the balancing of the traffic load.

For the calculation of its prices the company takes into account different segments. Some of the customer segments are willing to pay more for a given service, such as higher prices for routes with less congestion or faster routes. Some customers may be willing to pay more for the more scenic routes or routes with recommended restaurants and shops.

Last but not least, GreenPeak applies the "peak user" pricing model. This model is very important for the main mission of the company – to reduce congestion whin the cities. This pricing strategy is common in transportation. The strategy consists in charging higher prices to travelers during rush hours or at the beginning and the end of weekends or holidays.

9.2.9 Costs

Since one of the key resources of GreenPeak is the algorithm, which enables the dynamic pricing and route calculation, its creation represents the biggest initial cost that the company is facing. Additionally, GreenPeak has to provide the RFID infrastructure and to make sure that this corresponds to the requirements of quality. For the production, installation and maintenance of the RFID infrastructure GreenPeak is partnering with an external partner with a good expertise in the production of high quality RFID technology for the end user. This partnership will lead to a significant costs in the initial phase of the project and regular costs afterwards. Finally, to create a favorable environment for GreenPeak, a high investment in lobbying and marketing measures is required.

Once the algorithm and the RFID infrastructure are ready, the operation costs for its maintenance remain low. The company has additional on-going costs such as the maintenance of the website and the costs that the establishment of the customer support center. Once the customer is using GreenPeak's system, he can use a large offer of additional recommendations. Hence, another big part of the on-going-costs is being invested in Customer Relationship Management as the company provides a lot on top propositions like recommendations for sights, restaurants and shops. There will also be expenses for data aggregation and analysis, which will be sold in form of predictive analytics, to the business customers of the company. Further costs on B2B level is the recruiting of new business partners as well as the promoting of data sets.

Finally, one of the biggest expenses of the company are the marketing measures it uses to reach out its customers and to increase the awareness for the prebooking of routes.

9.3 Scenario robustness check

The following section describes the robustness of GreenPeak's business model regarding the four scenarios described in this trend report. Some scenarios will work better for GreenPeak while some can be harmful to the basic business idea.

9.3.1 Data as an individually controlled public good

The vision pictured in this scenario describes a world where a high level of privacy exists and at the same time only one governmentally controlled supplier can trade data. This means that citizens freely decide if they want to share their data or not. On the other hand, companies are highly restricted in the way they use the collected data. GreenPeak would need to adjust its activities according the given conditions in this scenario. For example it will have difficulties to execute one of its main activities – the creation of predictive analysis. Probably, it will be forced to destroy all the information gathered from people who are not willing to share their data. This will strongly reduce the quality of the gathered data, because it will no longer cover the entire population. Nevertheless, the fact that there is only one data supplier will influence the price of data. If

GreenPeak wants to sell the data it collects from traffic regulation, it will not be able to decide on the price and will have to accept the price the data supplier offers.

To create a better environment for the development of GreenPeaks business model, privacy concerns should be addressed. Moreover, the value of the more balanced traffic loads and the value of a greener city should be highlighted.

9.3.2 The Big Brother

Two drivers play an important role for 'the big brother' scenario. First, the data market developed into a monopoly. Second, the citizens have no control over their personal data since privacy is not protected by law anymore. These factors lead to a highly automated society, where data is available without any restrictions and is provided in one standardized format.

This scenario facilitates access to data demanded by GreenPeak. There is only one data supplier to negotiate with and data is hence provided in a standardized format. Low privacy regulations allow the use of detailed personalized data for the pricing algorithm and therefore to increase the value of GreenPeak's data offer. Thus, from a technical perspective, this scenario supports the growth of GreenPeak. From a business perspective, the low privacy leads to a better optimized pricing system and therefore higher revenues from the road charge share. On the other hand, the opportunities for GreenPeak as a data supplier are very limited. Since the 'big brother' company has the monopoly of data trading, this company is the only possible customer, allowing them to dictate the price for the data. This absence of an open market leads to lower revenues from data trade.

In summary, the idea of GreenPeak fits this scenario. The core business of a dynamic road charge system benefits from data standardization and low privacy. The major constraint is the lower revenue from data trade, due the monopolist data buyer.

9.3.3 The Smaller Brothers

The scenario "The Smaller Brothers" predicts a future in which no privacy is guaranteed to citizens. Furthermore, an infinite number of data suppliers are on the market.

The lack of privacy in this scenario supports the business model of GreenPeak. On the one hand, GreenPeak's business model is highly dependent on purchasing data from different suppliers for the calculation of the dynamic road charge. Data suppliers can sell their collected data without any restrictions from laws or protests by concerned people. On the other hand, a significant revenue can be generated from selling data about the drivers' movement patterns on data marketplaces. With no privacy issues, GreenPeak can track the drivers' current positions, analyze their driving styles and create predictions about their future movement behavior. This information can be resold to advertiser or insurances.

The high number of data suppliers facilitates GreenPeak's business of buying and reselling data. Purchasing will be easier and usually cheaper if GreenPeak can choose between a large number of suppliers. The opportunities to resell the data are increased as GreenPeak can offer its generated data to a wide range of clients. In contrast to the advantages of an infinite number of data suppliers on data marketplaces, GreenPeak has to face more difficult and complicated data aggregation since the necessary data is not concentrated at one single point.

In case that GreenPeaks can handle the difficulties of collecting and aggregating all necessary data to run its business model successfully, the combination of less privacy and a high number of data suppliers is the most robust scenario for implementing and running GreenPeak in Smart Cities.

9.3.4 The Data Stock Exchange

This scenario depicts total control of individuals over their personal data in combination with an infinite number of data suppliers. The people in this scenario have high control over their personal data, which will lead GreenPeak to have to adjust the system accordingly. After tracking the customers' car movements and billing them, their data might have to be anonymized or even deleted if car drivers demand so. Additional incentives should be in place in order to retain and sell the car drivers' data. In the case that there will be a law, that car drivers have the power to obtain their GreenPeak data and sell it on their own, GreenPeak's margin for selling those data will likely shrink due to individual peoples' sales on the market. Nevertheless, the high value of GreenPeak's predictive street capacity data is maintained and constitutes a major revenue stream. In general, the price for data GreenPeak sells on the data marketplace is determined by market mechanisms of supply and demand. The data GreenPeak acquires to feed the road charge algorithm, e.g. weather or street condition data, might come in various standards and forms because of the many data suppliers in this scenario. Many niche players will provide the specific data sets GreenPeak needs. The unstandardized data sets will demand a high computational effort.

Only if these technical issues are solved and privacy hurdles have been tackled, GreenPeak can prosper. Especially public authorities and society have to be convinced in the first place that GreenPeak's offer outweighs privacy concerns in exchange for a cleaner city and an improved traffic flow.

9.4 Conclusion

Mobility within cities is one of the biggest challenges public authorities are facing today. Cities' infrastructures have grown historically and are not able to cope with the car traffic that increased over the past decades. This issue will further intensify with the increasing number of people living in cities. That is where GreenPeak steps in. The idea is to give control back to the cities and regulate traffic loads by the price. The system is able to reduce traffic jams by charging higher prices during rush hours.

GreenPeak's system is beneficial for all parties involved in this process. Drivers benefit from a constant traffic flow and faster mobility within the city. The unique algorithm calculates best possible route and regulates the price for the trip. Cities save costs and make profit as they earn the major part of the road charges. Furthermore, the predictive data generated from GreenPeak in combination with personal data represents a benefit for data purchasers.

In conclusion, GreenPeak is the next step towards greener, smarter and more efficient cities. People will learn to avoid meaningless journeys or switch to more sustainable means of public transportation. Car traffic will finally be regulated more dynamically and fit the cities' infrastructures.

Looking into the future, GreenPeak's business model will also survive with the revolution of autonomous driving. Technical improvements will even facilitate an easy implementation of the system. Still, challenges will be to gain trust and convince car drivers to accept a loss of privacy. GreenPeak is able to adapt to the various scenarios of the future described here. Citizens in the Smart City of the future have to differentiate between evil and a trustworthy data collectors, with GreenPeak certainly belonging to the latter.

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10 Chapter 10
Sentinel

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Executive Summary

Sentinel is a crowdsourced monitoring service for businesses, governmental organizations and private people. It aims to alleviate the work of security staff and make video surveillance more efficient. The real-time video material is viewed by randomly chosen observers who are rewarded with a point system for their activity and can compare themselves on a score board. SentiPoints and EcoPoints can be collected and exchanged for products and monetary bonuses.

The most important revenue stream of Sentinel is based on individual service packages for observation services. Different subscription levels guarantee a specific number of observers to ensure certain security standards. A large base of observers distributed around the world provides constant monitoring throughout the day. Within the observer group, Sentinel addresses frequent but short periods of micro-boredom and gives the observers a good feeling in addition to the reward points. A high awareness level is reached by multiple communication and distribution channels, enhanced by cross-selling with partners. The quality of the service is ensured by hardware from quality partners and sophisticated software that includes a multi-observer incident detection system and additonal questions to check the observer's attention. Sentinel provides an easy and inexpensive solution that is robust enough to fit all possible future scenarios and will revolutionize video surveillance.

10.1 Introduction

Germany's retail industry is facing an increasing problem. Every day goods of a value of six million Euro are stolen in German grocery stores - which sums up to a value of 2.19 billion Euros per year. The dimension of this problem is gigantic. Mostly small expensive goods like liquor, cosmetics and tobacco are stolen. As a consequence, every year 1.2 billion Euros are spent for prevention and detection. This leads to more expensive products and in the end the honest customers pay the bill for the companies' loss. On average these additional costs sum up to five billion Euros per year just within Germany. [414]

Shoplifting is increasing and criminals are using more and more sophisticated methods. It is necessary to develop a new global system that helps increase awareness and destroy organized crime.

In the following, a new idea is described which will outsource video surveillance by using a gamified crowdsourcing approach. This idea will not only help decrease the number of stolen goods but also decrease vandalism and pollution in public places. In addition, it can also be used for observation in the private sector. The next section will describe a detailed concept of this business idea.

10.2 Business idea

Sentinel offers an easy solution for businesses, governments and private people to outsource their video surveillance and storage to the cloud. The observation process is taken over by a crowd of observers. Thereby, voluntary observers can collect bonus points which are convertible into real money or products from partner shops. In the following, a general overview of the business solution consisting of different software services is given.

The core product of Sentinel allows an owner of multiple LAN-enabled video cameras to stream the real-time video material to a server which provides several services. First, the video material will be collected and stored in the long-term archive SentinelStorage. Thus, the owner of the video material can access the long-term archive of SentinelStorage on a web platform called SentinelLive. This platform allows the customer not only to review all stored camera material of SentinelStorage, but also to access the customer's cameras and watch the corresponding video material in real-time.

SentinelLive is accessible to the public. After a free registration, one can take over the job of an observer. An observer watches anonymized real-time video streams of randomly chosen cameras. Anonymized means that an observer cannot see a person's face in the video stream. This will be achieved by an algorithm which detects and then blurs these faces. The task of an observer is to detect - depending on the given task - robbery, vandalism, pollution or extraordinary situations. These tasks can be conducted by all observers, located anywhere in the world, at any time. In order to avoid inattention, an observer will receive material from new cameras periodically. Furthermore, an observer has to answer questions that are provided with the different video streams. These questions can be formulated by the owner of the camera in the SentinelLive platform. A question can help to create statistics, like a better understanding of the customer behavior, or to draw somebody's attention to a certain object in the video stream. When an observer detects an incident he can report it by clicking the report button. In order to guarantee that the report is not an accident, the last 60 seconds will be shown to several other observers, without informing them about the detection. In the case that the other observers also recognize the incident, the camera's owner will be informed about the incident via mail, short messaging or a phone call. The next time the customer opens SentinelLive the incident will be shown immediately.

For each answered question, fully watched video stream or correctly reported incident the observer will receive SentiPoints. SentiPoints are used to compare oneself with other observers. In addition, these SentiPoints can be converted into real money or products from partner shops. Therefore, a certain threshold has to be reached. Money will be transferred to the observer's bank account at the end of a month. In the case of a reported incident, the camera's owner has to decide if the report was legitimate. If so, all involved observers receive further SentiPoints. All observers who have not reported the incident, reported it wrong, or have missed to answer a question loose SentiPoints. Another type of points are EcoPoints. EcoPoints can be collected by reporting pollution and are also convertible to real money or products from partner shops. These goods are mainly offered by governments and other sponsors. EcoPoints appeal to the observers' ecological awareness. The number of EcoPoints an observer determines his rank in a score board. People with a hight rank will gain fame and access to bonuses.

There are several services a people can buy on the SentinelLive platform. The customer has to decide for a bronze, silver or gold upgrade. Each upgrade will guarantee that more than a specific amount of observers are watching the stream of a video camera at the same time. Also the SentinelStorage package is individually configurable in storage size and sustainability.

Through Sentinel, detection of robbery in grocery stores, vandalism in subways, violent encroachments on public places, pollution in parks or burglars in private homes will be easier than ever before. The observation will take place 24 hours, 7 days a week. An observer can access SentiLive on several kind of devices, for example on the laptop, smartphone or the television. Observation services can be offered at a much cheaper rate than usual as less or no expensive security staff will be needed.

In the future, automatic crime detection will be implemented. The usage of new algorithms like neuronal networks can be trained with the actions of the observers. Criminals will be added to a blacklist and people with previous convictions can be tracked more easily.

10.2.1 Value proposition

Sentinel is a globally accessible, location-independent crowdsourced surveillance solution for stores, warehouses, public spaces and private households. By distributing video material of different locations to a crowd of observers in real-time, it will enable higher security, vandalism prevention, pollution reduction and consequently costs savings. The crowd of observers, located all over the world, can report in real time if they recognize any incidents. By providing the reported stream to other observers for verification, a very high reliability will be provided.

In today's world, mostly external security agencies are in charge of the video surveillance of public places. The same is valid for malls. Observing streamed video material, security staff tries to cover a steadily increasing number of video cameras – in public places as well as shopping malls. Since this growing number of video cameras is not going along with an increasing number of security staff [413], the provided level of security is in disequilibrium to the installed cameras. Sentinel eliminates this asymmetry by crowdsourcing the video surveillance to a huge crowd of observers, with every observer monitoring one stream at a time. On the one hand, this will support the security staff and police, provide higher security and less pollution in public places, and resulting in cost savings by prevention on the other hand.

Value proposition for shops and malls

Shops and malls are facing the difficulty of theft prevention every day. By hiring security agencies or employing security staff and installing expensive monitoring equipment, shops are trying to minimize theft and to maximize their profits in return. However, many thefts stay undetected due to a lack of total surveillance. Even though the installed cameras could detect more incidents, the security staff can not look at all streamed video material at the same time. Sentinel solves this problem by providing shops or entire malls with a crowdsourced surveillance solution. Each of the observed camera streams is being watched at the same time by many several observers all over the world. If a theft is detected by one of the observers, the last seconds of the reported stream will be immediately sent to other observers without notifying them about the incident to ensure neutrality. If a valid number of those second observers report the same incident as well, it will considered as valid. Without any delay the theft will be reported to the security staff via email, short messaging or phone call and is displayed online on the SentinelLive platform. Once the thief has been identified, his face will be saved in a internal data bank. If the thief is detected in any of the cooperating shops, he or she will automatically be assigned a higher number of observers in the future. Therefore thief recognition will improve steadily and economies of scale can be achieved.

By asking observers different questions regarding the current video stream they are watching, additional data can be collected. Questions such as "do you see empty product shelves?" can help the staff identify particular needs or optimize the overall shop structure. The questions can also be adjusted to their needs. As a positive side-effect, observers are focusing better on the video stream and a better overall result can be provided.

Value proposition for public places, facilities and transportation
Also in the area of public places, facilities and transportation an increasing number of video cameras are getting installed to provide a better security level for the citizens. Every new train, bus or public facility has several video cameras to provide a safer environment for the citizens. But an increasing video surveillance goes along with a higher demand of security staff. Caused by a lack of financial resources, most of the time this aimed security level can not be reached even though the needed infrastructure is already existing. Sentinel solves this problem and at the same time helps to save money. By outsourcing the biggest and most exhausting part of the surveillance to the crowd, more time can be spent to be present at the critical places. By getting real time information from the observers, the security level can go from today's more "reactive" approach to a "proactive" prevention approach since a thief will not steal from a shop when he knows that the chance of getting caught is too high. Furthermore the crowdsourced solution offered by Sentinel can be adjusted to many different use cases.

The pollution of the city can be reduced by reports of the observers as they can monitor pollution or littering incidents. Provided with this information, garbage collection can be optimized. By using the crowd of observers to look for soilings, littering and damaged objects, the overall picture of the city will improve. This will lead to savings in public expenses in many different areas, it will create an increase in living quality for citizens and help the city attract more tourists.

Value proposition for observed properties
An other use case for Sentinel are private properties. The poplulation is aging and especially in Germany there is a trend towards old-age poverty since the governmental old-age assurance will not be able to cover the expenses of future generations. Other countries are already facing this scenario today. Additional the number of retirement homes is not enough - they are already filled to overflowing in present. At the same time, an increasing number of elderly people just cannot afford the expenses for living in a retirement home. Also they often do not want to leave their homes, where they have lived their whole life. Nurses cannot be present the entire day at privat houses and accidents may not be detected early enough.

Sentinel solves the mentioned problems. With partners who provide the necessary hardware and installation, Sentinel observers can monitor privat houses in real time. If any abnormality is detected by the observers, a nurse will be informed immediately to come over to check on the elderly person. This would lead to an efficient way to observe elderly without massive expenses.

Value proposition for observers
In today's society, there is an increasing awareness regarding environmental problems and crime prevention. Citizens are increasingly active instead of staying passive observers. Sentinel provides the conscious citizen with the tools to get active and to have a positive impact on society. Observers will be proud to be part of something meaningful. This will help to spread the word about Sentinel, via word-of-mouth. Observers will tell friends about their good deeds, e.g. having helped an old lady in need or having prevented a crime in a public place. By adding gamification aspects such as score boards and rankings, citizens have the possibility to compare their level of positive impact with others. The gamification elements also lead to a better performance of the observers. The competition leads to an increasing popularity of Sentinel. By giving the observers the possibility to trade their collected EcoPoints and SentiPoints for products from Sentinel partners or even for money, an extra benefit is provided to the segment of observers who are more motivated by monetary elements.

10.2.2 Customer segments

Sentinel is a classical multi sided platform, generating value by facilitating the interaction between multiple groups. As the success of Sentinel depends crucially on its ability to grow it is necessary to address a broad clientele right from the beginning. One of Sentinel's key resources are the observers who monitor the video streams. The entry requirements for becoming an observer are low. One only needs a web-enabled terminal device like a computer, smartphone, tablet or smart TV and an Internet connection that can handle video streaming. Many people - not only in the developed countries - fit in these criteria. While the relatively low hourly wages are more attractive for people with lower income such as students or jobbers in low-income countries, the gamification and social engagement aspects are attractive to people of all income classes alike. Due to the short excerpts of the video material it is possible to contribute to Sentinel even when one has only a short time period at disposition. Sentinel addresses micro boredom which affects people in short breaks of their daily life, e.g. when waiting for the bus to arrive.

Then there are the paying customers of Sentinel, who submit their video material for it to be analyzed. The different subscription plans enable Sentinel to cover the needs of a wide customer range, which can be roughly divided into three groups. The first group is corporate customers such as malls or jewelers. The second group is governmental organizations like municipalities who want to survey an area more efficiently. An interesting side effect is that outsourcing surveillance to the public will also increase the public's awareness and therefore contribute to reduce crime on the streets. Enabling more efficient prosecution Sentinel has a huge potential. As a matter of fact crime and its consequences are a major expenditure for governmental organizations, which usually have tight budgets.

The third group of paying customers is private entities like families. They can choose from a variety of services like supervision oftheir children or protection of their property.

10.2.3 Channels

Sentinel reaches the targeted customer segments over various channels. Since the observer base consists mostly of technophiles, primarely online channels are used to attract a wide-spread, global userbase. Ad placement focuses on social media and relevant apps or web portals such as video streaming sites (e.g. YouTube, Netflix), job portals, environment sites, and pages regularly accessed when people are slightly bored (e.g. Pinterest or Flickr) or waiting (food delivery sites). In order to market the service to paying customers, a mix of own and partner online channels is used. Advertisement in search engines and web shops is used to raise awareness, as well as on partner websites such as camera manufacturers (see 10.2.7) or real estate agencies and health care institutions, in order to reach a wider range of customers with specific use cases.

Offline advertisement in form of posters, banners and spaceous ads on the other hand can be placed in strategic positions such as corporate and public places where the service can be implemented. In addition, ads will be placed in locations where micro boredom occurs, such as at bus stops and in subway trains, supermarket lines, in parks or coffee shops. Potential observers are shown the various benefits from participating for even just 3-6 minutes (typical micro boredom period). They can use the mobile application or the web-based platform to sign up, log in to their account, view their own and their friends' scores, exchange points for bonuses, and recommend Sentinel to friends for extra bonuses. Sales to paying customers can also be promoted directly via telemarketing and Sentinel's web presence. On the SentinelLive platform, customers can watch sample videos that provide insight on how the service works and statistics to show functional, economic and emotional value, such as detected incidents, prevented loss or damage and customer satisfaction. The platform also includes a personal log-in area where customers may view their notifications as well as real-time and stored camera material, but it also serves for customer relations and support. Incidents can be reported to customers on the platform, but also via phone or email, and they can be reported immediately to security agencies or the police directly.

10.2.4 Customer relationships

Customer relationship differs by customer segment. In order to attract large players (such as large chains of supermarkets, movie theaters or city councils), personal assistance is provided. The level of personal assistance depends on the subscription level: Gold subscribers are assigned a dedicated personal assistant to ensure best service quality and security, customers on lower subscription levels can use the automated services on the SentinelLive platform or contact the customer service. The level of personal assistance serves as an incentive to upgrade the subscription status. Promotions are used to boost sales among existing customers. In addition, long-term customers are rewarded for their loyalty by special offers. Special offers are also rewarded for recommending Sentinel to others.

Observers do not require personal assistance, but rather rely on group dynamics. Customer relationships with observers aim at improving the SentiCommunity and enhance user engagement. This includes providing a wide base of observers to compete with, a way to identify friends among them, and a fair chance to become a top ranked observer. Observers can share their scores, rank or earnings on social media platforms to enhance their social status and invite friends to join the service. SentiPoints serve as currency and can be exchanged for micropayments or bonuses for tangible goods from partner companies. These bonuses have much higher value than the amount of money that can be earned. Additionally, the competitive, social aspect of Sentinel motivates observers to spend more time on the platform and ensures a loyal user base. Observers can get even more involved by suggesting places where cameras might be placed for monitoring. Sentinel can use these suggestions in order to constantly improve the service.

10.2.5 Key resources

Sentinel's business model needs various key resources in order to function properly.

To satisfy customer demands, the service of SentinelLive and SentinelStorage is based on a large IT infrastructure. This IT infrastructure contains of several servers for streaming and storing the customer's video material. To allow multiple observers to watch the video streams simultaneously, the data speed is crucial.

Before an observer gets the opportunity to watch a video stream, the IT infrastructure has to run algorithms on the video material and anonymize all faces. Therefore, faces have to be detected and the video material manipulated. The anonymized video material is then sent to the observers. Hence, a lot of computational power is needed to guarantee the almost real-time transmission. Also, the algorithms have to be steadily improved.

Sentinel needs to guarantee a high quality standard 24 hours, 7 days a week.

This means that another key resource of Sentinel is the large amount of observers reviewing the video material.

10.2.6 Key activities

The key activities of Sentinel can easily be divided into technical activities and marketing activities. Regarding the technical activities, the main activity is the development of cross platform software applications for smartphones. This is a very relevant activity since one of our target groups, the observers, are technophiles with many short periods of free time. They can earn a little money aside and gain a good feeling for contributing to the society. Effort must be put in the development of the applications in which users can watch camera streams, answer additional questions and report incidents in real time. Additionally, a score board must be introduced, as well as a trade section to convert SentiPoints to bonuses. Another technical issue is the maintenance of the servers where the video material is stored and from where it is streamed to the observers. Also algorithms need to be developed that recognize conspicuous individuals. Another technical issue is the implementation of algorithms that anonymize faces, similar to the Google Maps Street View, but with the challenge to do so in real time.

Another key activity is marketing Sentinel to target groups. It consists of acquiring paying customers, as well as a wide-spread observer base. Providing extra bonuses to users for inviting friends will help reach a high number of observers in a quick and inexpensive manner.

10.2.7 Key partners

Acquiring partner companies is a crucial point for the functionality of Sentinel. With their help, Sentinel can provide material bonuses to observers that are more valuable than the monetary gain. In return for this, Sentinel helps partner companies to cross-sell their services and increase their market share, because their product can lead to lock-in situations for the observers. The partner network can also provide an advertisement channel, as Sentinel can send special vouchers to observers.

Also, security camera manufacturers must be acquired as partners in order to ensure the best performance of the service. Camera units require a fast connection to the internet to stream video material in real time. Another issue is the installation and maintenance of the hardware. It is necessary to adopt the camera setting to the location to avoid blind spots and thus overlook incidents. Equipment from Sentinel's business partners will ensure the high quality of the service and ensure long-term satisfaction with Sentinel.

10.2.8 Revenues

As presented in figure 10.1, the earnings of Sentinel are based on four major revenue streams. As these streams stem from different sources, the business model is stable to handle the failure of some revenue opportunities. The most important revenue stream of Sentinel are service-packages. Customers have the possibility to choose between different packages based on the required security level. After paying a fixed installation fee, the customer can choose how many of his cameras he wants to have observed. Depending on the total amount of observed cameras, the price per observed camera decreases. Next, the customer has the possibility to choose between three subscription levels - bronze, silver, or gold. Those three subscription levels go along with a certain number of guaranteed observers watching each of the booked video streams at the same time. An increasing number of observers who watch the same video stream, leads to a higher incident detection rate. By asking the observers different questions regarding the video streams they are monitoring, useful data can be gathered that can be sold to market research institutions or to shops, malls or government as add-on service to their usual package.

Another major revenue stream is generated from pollution reduction. Advantages will be provided to the government by supporting a cleaner environment, therefore city councils will be a customer. A fee can either be paid based on the detected pollution or as a fixed monthy fee. On top of that, companies can become EcoPartner of Sentinel. Supporting the EcoPoints, companies can improve their image with regards to sustainability and can place advertisments next to the EcoPoints score board.

In the private household market segment, extra revenue can be generated by commercial partnerships with hardware providers. Sentinel sells the hardware and installation services to a commission fee.

10.2.9 Costs

As presented in figure 10.1, there are three major cost segments for Sentinel: IT infrastructure, marketing, wages as well as micropayments to observers. Especially at the beginning, the costs for developing and building up the two core products SentinelStorage, the long-term video material archive, and SentinelLive, the customer plattform for access to SentinelStorage, as well as investments into the server infrastructure will be high. After setting them up, the costs will drop and money on infrastructure will mostly be spent on maintenance services. At the beginning there will be high marketing costs to gain customers, as Sentinel cannot rely on any references or simular products on the markets. Even more marketing spendings are required to inform potential observers about the new service. This is crucial, since observers are Sentinel's backbone and without building up a critical mass of observers the service cannot be provided. Hence, the acquisition of new observers will be the largest cost factor. On

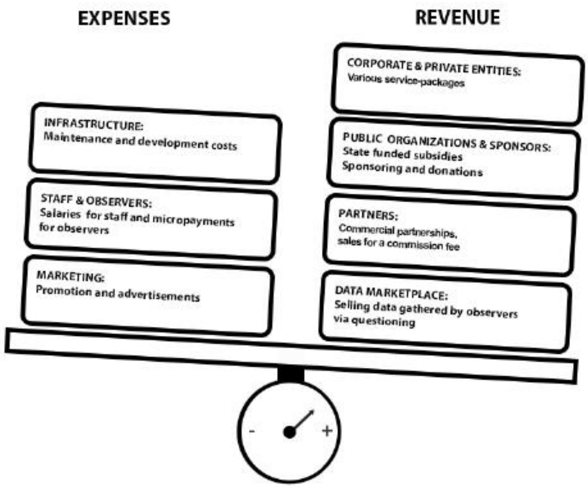

Figure 10.1: Financial flows
Source: Own illustration

the long run, the highest expenses will be the wages to the staff and to the observers. After acquiring a solid base of observers, word-of-mouth advertising will significantly reduce the marketing expenses. Additionally, significant costs, such as budget for marketing agencies as well as for information material and travel expenses will arise to win partners like sponsors and state funds. At a later stage, these costs will decrease, as it will be easier to convince other potential partners based on a track of records and references.

10.3 Scenario robustness check

In the following, the business model of Sentinel will be evaluated for the four scenarios.

10.3.1 Data as an individually controlled public good

The first plausible scenario assumes a high level of privacy and the existence of only one data supplier.

Sentinel will profit from the existence of a centralized data source because only one interface needs to be developed. This will also decrease the initial costs and the running costs as there is no need to implement algorithms that merge different databases.

With a high level of privacy, recruiting new observers can be a big issue, bigger than developing the system. It is possible that users do not want to observe other people as they consider protection of personal information a basic right. Sentinel will face the challenge of convincing the observers with the safety generated by the service and extensive communication efforts. Based on the harsh privacy laws, some services will not be offered, such as tracking back incidents to the suspects, as data is only allowed to be stored anonymously.

Sentinel can be successful within this scenario if the general public can be convinced to participate.

10.3.2 The big brother

The Big Brother scenario assumes a low level of privacy and the existence of only one data supplier.

Having only one supplier, Sentinel can easily combine the data from all cameras and hence quickly react to detected incidents, increasing the performance of Sentinel.

The no privacy policy allows to save user based information and keep track of suspicious individuals in order to prevent further crimes. It is also socially acceptable to observe others. Everybody is used to surveillance. This results in low efforts to recruit a large base of observers, which is one of the most important resources. Another positive effect is that Sentinel is allowed to store all the video material on its servers and can track incidents back to individuals.

This scenario is the best fit for Sentinel.

10.3.3 The smaller brothers

The Smaller Brothers scenario is based on a low level of privacy and the existence of many data suppliers.

With many data suppliers, Sentinel has to combine data from different sources. Various interfaces need to be developed and new interfaces have to be created, which increases the initial costs and the maintenance costs. The merging of the video material in real time also requires high server capacities. This limits the performance of Sentinel.

A more positive aspect of this scenario is the low level of privacy. Sentinel can collect and store all the data on its servers and increase the traceability of incidents. This can also help acquire a larger base of observers who are often towards observing other people.

This scenario requires higher efforts to combine data sources, but the low level of privacy helps increase Sentinel's popularity.

10.3.4 The data stock exchange

The last scenario is based on a high level of privacy and many data marketplaces.

This can lead to a smaller number of detected incidents, mainly due to the small number of observers. This is based on the fact that people are not willing to observe and to be observed. Another limitation is that incidents can not be traced because only anonymous data can be retained. The service can still run in real time, as incidents can be reported and transmitted instantly.

Another technical issue is the fragmentation of data. Sentinel has to provide many interfaces to the different suppliers and some efforts are necessary to gain data suppliers as partners. The matching of data in real-time is more difficult.

All in all, this scenario limits the development of Sentinel, but it does not block it.

10.4 Conclusion

Sentinel is an inexpensive and effective surveillance service that alleviates relevant problems such as theft and damages. It provides a crowdsourced monitoring service for businesses, governmental organizations and private people. It aims to alleviate the work of surveillance personnel and make video surveillance more efficient and even facilitates the monitoring of places that are yet without surveillance, Sentinel can e.g. decrease littering in public parks and contribute values to the society.

Video material collected from surveillance cameras is transferred to a cloud on the SentinelLive servers, from where it is streamed to a number of observers. The material can vary greatly, as it may come from cameras in stores and malls, public places like transport and parks, and even private properties. Sentinel covers different use cases, such as preventing theft, damage, pollution, littering, and even the elderly in their homes.

The material is viewed by observers in real time taking over the task of traditional surveillance personnel. Observers are voluntary individuals who participate for various short periods of time, usually whenever they experience moments of micro-boredom, e.g.g when commuting, waiting in lines, or simply when playing with a phone, tablet or personal computer. Observers are rewarded for their activity with a point system with periodic user rankings and can compare themselves with friends. It not only serves as a measure for status, but also evokes a good feeling for contributing to the society, e.g. helping detect pollution and hence protecting the environment. An even higher incentive to participate are SentiPoints which can be exchanged for material and monetary bonuses. Acquiring partners who provide discounts on products or services, cutting spendings on bonuses. Additional, partners provide compatible hardware. Both groups of partners help by cross-selling Sentinel.

Sentinel is a typical multi-sided platform, with three segments of paying customers. High computational power and sophisticated algorithms to ensure privacy are required. The reliability of the system is ensured by additional questions to observers that check their attention and additionally generate information that can be used for market research purposes. Marketing activities are crucial to acquire a wide-spread and global user base, so that monitoring power is constant and evenly distributed throughout the day.

The business idea of Sentinel is robust enough to fit all scenarios, but some key driver outcomes would improve the functionality and make it easier. A low and manageable amount of data suppliers, preferably one, helps to gather the data fast and make the system more efficient. A low level of privacy helps to cut costs on implementing sophisticated algorithms for anonymization and the retention of data would make tracking conspicious individuals more easily.

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Chapter 11

Smart Spot

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Executive Summary

Urbanization and increasing digitization pose difficult challenges to the real estate market in Smart Cities. These challenges are addressed by Smart Spot, an online platform matching personal preferences and lifestyle of people with neighborhood profiles and data on available housing options to suggest optimal living locations.

Smart Spot uses a complex algorithm that consists of three pillars: user profile, neighborhood profile and real estate offerings. The user profile includes data regarding, for example, family status, friends, workplace, hobbies, willingness to pay for housing, noise- and pollution sensitivity and favorite places. This profile is then matched with an up-to-date database of neighborhoods in a city, containing public institutions, pollution, restaurants and bars, traffic infrastructure, aggregated social data of inhabitants, and workplaces. Based on user and neighborhood data, optimal living locations within a city are identified. These locations are then matched with real estate offerings from online real estate agencies like ImmoScout, AirBnB, WG-Gesucht and properties that are directly advertised on the Smart Spot platform.

This solution targets a two-sided market: people looking for accommodation and real estate providers. For tenants, Smart Spot optimizes living through improved time-efficiency and quality of life. For landlords and property sellers, Smart Spot helps to save time in the tenant search process and provides a higher

quality of selected tenants. Customer awareness is gained through social media marketing and search engine optimization. Service transactions are conducted on Smart Spot's web platform and customer feedback is collected via online communities, ensuring long-term satisfaction. As real estate agencies are key partners, providing dedicated personal assistance through key account managers is essential.

Smart Spot generates revenue through three different channels. First and most important, it relies on fixed, subscription-based user payments for a premium service which enables more comprehensive user preference input and access to the complete recommendation results. A second minor revenue source comes from premium service payments made by landlords or roommate-seekers looking for a suitable tenant who fits their personal preferences. The third revenue stream accrues from selling user data about personal preferences and displaying matching product advertisements on Smart Spot's website.

11.1 Introduction

Urbanization, the demographic transition from rural to urban areas, has been one of the major trends in recent decades. In 2008, for the first time in human history, more than half of the world's population was living in cities [427]. By 2030, urban population will increase to over 60 percent [428].

This rapidly increasing urban population forces cities to develop with greater speed. Thus, neighborhoods change characteristics or completely turn around within few years. Office buildings, warehouses and factories convert into condominiums, abandoned railway stations are replaced by family homes [422].

Inhabitants can only adapt to such developments through more rapidly lifestyle changes. While the average worker today changes his job every 4.4 years, younger generations already stay in one position for less than three years [420].

All these developments make the search for suitable living space more important and complicated than ever before. To date, there is no widespread solution that serves the customer need for an easy and convenient way to find new living space. There are two common approaches for this problem: Using real estate brokers and using online solutions.

Today, about 50 percent of private housing is being rented out through real estate brokers [426]. Even brokers, which are very knowledgable regarding property preferences, only know a city and its different neighborhoods to a limited extent. Although having a real estate broker seems like a convenient and satisfying solution for both the landlord and the tenant, this way of reallocating living space also has certain disadvantages. The main drawback is the broker's fee of 2.38 monthly rent payments, which in Germany is usually paid by the tenants. This fee influences indirectly the landlords as well becase it decreases the tenant's willingness to pay for the property. In Germany, there are political plans to equally split the broker's fee between landlord and tenant. This would especially increase the urgency of landlords' search for alternative solutions.

When no real estate broker is involved in the transaction, a large portion of properties are listed online through real estate portals like Immoscout and WG-Gesucht. These portals do not charge any fees and rely solely on income generated by ads. Although no broker's fee incurs, both parties suffer from certain disadvantages. Potential tenants need to carry the burden of finding suitable, affordable and available accommodation on their own. Moving often involves additional changes, e.g. occupational change, so finding the perfect living location is not that straightforward. Landlords on the other hand suffer from an overflow of potential tenants. The high number and lack of transparency makes it hard for them to choose a tenant matching their expectations.

As today's situation on the real estate market is complicated and does not fulfill the needs of both landlords and tenants, an opportunity for innovative solutions arises.

11.2 Business idea

Smart Spot is a service that matches the personal preferences and lifestyle of people looking for housing with neighborhood profiles and available real estate properties to suggest optimal living locations.

It uses a complex algorithm that consists of three pillars: user profile, neighborhood profile and real estate offerings.

An exhaustive user profile forms the basis for the analysis. Therefore, data regarding family status, friends, education, workplace, hobbies, preferred cuisine, and favorite places is imported from social media profiles. The user reviews this information and fills out a survey about willingness to pay for housing, financial situation, personal health condition, noise and pollution sensitivity and importance of green spaces. Additionally, these results can be improved by using the premium service Smart Tracking, a service that uses the GPS sensor of a smartphone to create a detailed map of movements within a city.

This profile is then matched with an up-to-date database of neighborhoods in a city, containing public institutions, stores, restaurants and bars, traffic infrastructure, green spaces, and workplaces. Additionally, real-time as well as historical data from pollution, weather and traffic sensors is taken into account. Information from other Smart Spot users can be aggregated to display the social status of inhabitants in different neighborhoods. The neighborhood database, which can result in a variety of additional information, serves as competitive advantage over other companies.

Based on user and neighborhood data, optimal living locations within a city are identified. These locations are then matched with real estate offerings from online real estate agencies like ImmoScout, AirBnB, WG-Gesucht and properties that are directly advertised on the Smart Spot platform. The aim of Smart Spot is to have the highest possible number of real estate offerings in order to attract customers. Therefore, Smart Spot neither charges online real estate agencies for the traffic generated on their offerings nor landlords publishing their property directly on the Smart Spot platform. However, Smart Spot offers Smart Filter, a charged premium service for homeowners and roommate-seekers which allows them to specify desired tenant characteristics and will automatically refer the most suitable prospective tenants.

Use case: Looking for living space
Within a few minutes, people looking for living space can create a free user profile, containing limited information on their personal preferences and workplace. Based on this profile, they get a recommendation for one specific apartment in their Top 10 results. In order to get a more exhaustive analysis and to receive all suitable real estate offers, users can detail out their profile and pay for a monthly subscription to the full Smart Spot offer. An even higher quality of recommendations can be achieved when the user additionally agrees to use Smart Tracking. The final recommendation on optimal living spots include offers from external websites, basic postings from landlords as well as premium postings from landlords with specifically desired tenant characteristics. For the latter, an indication regarding the suitability with the landlord's characteristics can be displayed.

Use case: Offering living space
Real estate agencies and private persons who want to reach a broader audience with their offer directly post it on the Smart Spot platform. If they wish to specify desired tenant characteristics, they can sign up for the Smart Spot premium service. A homeowner could, for example, search for a single male person between 25 and 30 years that does not play an instrument, earns more than 50,000 Euro per year and is not sensitive regarding traffic noise. They get recommendations for suitable tenants in exchange for a one-time fee.

11.2.1 Value proposition

Smart Spot serves different user groups and delivers different values to them.

For tenants, Smart Spot offers convenience and time-saving during the apartment search process as well as a higher quality of life, confidence in the decision making process. Convenience and time savings are achieved through high extent of automation in the apartment search process, the integration of all relevant information in one uniting solution, online tool availability, high level of customization to each user's requirements. Quality of life by meeting expectations and finding the most suitable place.

For landlords and property sellers, Smart Spot helps to save time in the tenant search process, and provides a higher quality of selected tenants. Smart Filter, configured by landlords and property sellers, allows to reduce the number

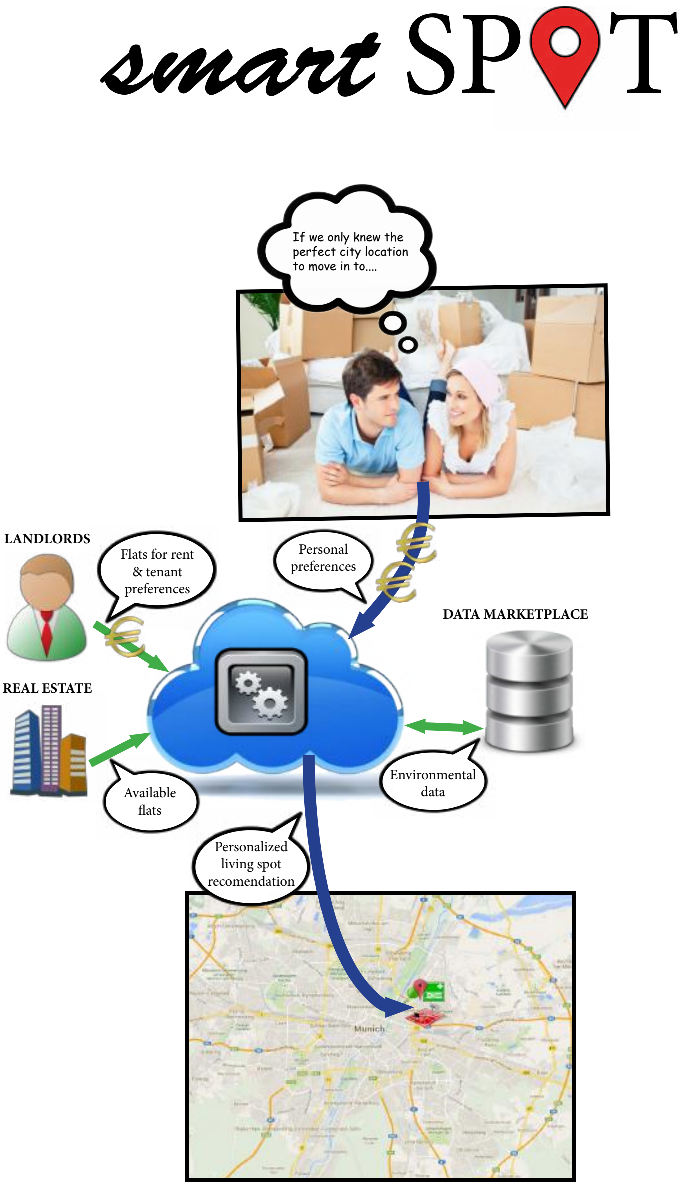

Figure 11.1: Idea description
Source: Own illustration

of unwanted tenants by matching their profile data to expectations of the dealer side. Thereby, it helps to ensure higher quality of tenants and saves dealer's time.

The last user segment is online real estate agencies, which benefit from the service by getting additional website traffic. By advertising their offers on Smart Spot, real estate agencies become accessible to their potential customers. The new customers are redirected to agencies' websites when they are interested in the offer on Smart Spot.

11.2.2 Customer segments

Smart Spot is a two sided platform: It targets both consumers looking for accommodation as well as people and agencies offering living space.

Property seekers use Smart Spot as a recommendation tool, helping them to find the best place to live in. Because the problem of property search is common to a wide audience, Smart Spot addresses the mass market. The typical Smart Spot user is 20 to 60 years old, highly values life quality and efficiency and doesnt have a price sensitive attitude.

The property owners sector can be divided into the following segments: Firstly, landlords who look for new roommates. These are mostly students and young professionals looking for individuals with similar interests. The next segment are landlords who want to rent out their property in large cities to financially strong tenants for a long term . Moreover, Smart Spot targets homeowners who want to sell their property. Another segment is represented by medium sized real estate agencies which sell or rent out properties in large cities.

11.2.3 Channels

Smart Spot uses three channels to reach its customers: The Smart Spot website, social networks and search engines.

The Smart Spot website is a main channel for service delivery. It provides the opportunity for evaluation of the service by offering part of its property-search services for free and it supports online payment.

The website is also used as a channel to collect user feedback, ask for customer satisfaction and provide support service.

Apart from its website, Smart Spot utilizes social networks and search engines. Social network marketing as well as search engine optimization are used to increase the awareness of Smart Spot to online audiences. Optimized for each customer segment, these activities should generate users for the service.

11.2.4 Customer relationships

Smart Spot supports a wide range of customer segments. Thus, different types of customer relationships are required.

For tenants, Smart Spot uses automated online surveys to identify problems at an early stage and to measure customer satisfaction. It provides online help and support for its users.

For real estate agencies, the service offers dedicated personal assistance, in order to ensure a high quality of service and the optimal integration of IT infrastructures.

For landlords, Smart Spot provides support by online manuals, support services via emails and automated surveys on satisfaction with the service and recommended tenants.

For all customer segments, the service provides a feedback platform via an online community, hosted on its website and on social networks.

11.2.5 Key resources

Smart Spot has to ensure that key intellectual and human resources are secured.

The most valuable resource of Smart Spot is its platform, which merges diverse data sources for the recommendation tool. The high complexity and cost of such a platform serves as a main entry barrier for competitors.

Partnership Agreements with real estate agencies and data providers help Smart Spot get access to a unique combination of information assets that are not easily accessible to other parties.

Since Smart Spot is a two-sided platform and highly depends on network effects, a large user base is another key resource for Smart Spot. Providing unique recommendation service for a mass market, offering part of its services for free will help to rapidly acquire a large user base.

The last critical asset of Smart Spot is a team of highly skilled developers required due to Smart Spot's highly sophisticated analytics engine. Deep knowledge of technology as well as product expertise play a crucial role for the long-term success of Smart Spot.

11.2.6 Key activities

Smart Spot should perform five key activities.

The key activity is proactive data acquisition. It includes the identification of promising new data sources, as well as the support of existing ones. New data sources are important for service enhancements by providing a broader picture on apartment search and helping tenants to make better decisions. Acquisition of diverse information is crucial because it forms the basis for Smart Spot's offering.

Next critical activity is a continuous development and enhancement of functionality and usability - both for tenants and property owners. In order to outdo competitors on the market of property search, Smart Spot has to deliver qualitatively better user experience.

Another activity is the development of an analytics engine. By merging different data sources to provide recommendation both for tenants and property owners, it forms the basis for Smart Spot's service. The analytics engine will hence provide key benefits to all customer segments and needs constant improvement to be able to attract new customers and avoid competition.

Additionally, Smart Spot should maintain good relationships with a whole set of different data providers and real estate agencies. Being a uniting platform, Smart Spot is highly dependent on its partners and has to maintain these relationships.

Last but not the least, Smart Spot needs to proactively promote its service within the web by conducting SEO (search engine optimization) and SMM (social media marketing) as well as developing online customer relationships. With the web as a key customer acquisition channel, Smart Spot needs to constantly enhance its web presence.

11.2.7 Key partners

Smart Spot needs to maintain strong partnerships with different data suppliers.

First of all, to be able to provide a real estate search service, Smart Spot has to establish partnerships with existing real estate companies such as ImmoScout24 and WG-gesucht. This step is essential mostly in the beginning of operations because it fills Smart Spot's recommendation system with relevant apartment data. This, in turn, is critical for attracting users and ensuring first sales.

Next, to be able to provide broad and relevant information within its recommendation service, Smart Spot has to aggregate a wide range of different data sources providing information about a city. Information on quality of life, socio-economic factors, prices of goods and other data needs to be gathered from relevant data suppliers. Smart Spot has to identify key partners within this data marketplace and establish relationships with them in order to deliver its main product.

Finally, in order to represent social data, provide up-to-date and precise picture about a district's inhabitants, as well as to fetch information about the potential tenant, Smart Spot will need to establish relationships with social networks. Both conventional ones (such as Facebook) as well as professional ones (such as LinkedIn, XING) are used to acquire private data.

11.2.8 Revenues

Smart Spot generates revenues over three different channels.

The first and most important revenue stream is based on fixed, subscription-based user payments for a time-limited use of Smart Spot's premium service. Users' willingness to pay for the premium service is driven by two-fold advantages over the free version: the premium subscription enables a more comprehensive user preference input for more accurate recommendations and full access to all recommendation results.

Users of the premium service can feed more exhaustive information about their personal preferences into the recommendation system. They have more environmental factors to select from (e.g. pollution levels, crime rates, aggregated social network data about other neighborhood occupants, etc.) as well as the ability to assign different weights to these for the final recommendation. Moreover, the premium version of Smart Spot gathers additional personal preference input with an authorized data pull from the user's social network profiles, such as Facebook, LinkedIn and Xing. Last but not least, in order to gain a more complete picture of users' daily routines and to optimize , Smart Spot premium service offers an integrated GPS-tracking option. Realized within a smartphone application, this service gathers personal GPS data about the user for a period of up to one week, plots the data on a map and cross-references the user's path with his digital check-ins on social network websites such as Facebook or Foursquare as well as with cartographic data about nearby places matching his taken road (e.g. schools, stores, office buildings). In sum, these premium options thereby allow even more comprehensive and accurate recommendations for users' optimal living locations.

Second, users who pay the subscription fee are able to see and fully access all of their personal recommendation results. Unlike the free version, the premium version also displays the exact geographic location of all matching real-estate offerings on a map, the full description by the landlord as well as a direct link to the original real-estate website where the advertisement is taken from and the landlord to be contacted. This full and hassle-free access to property data, which is essential when searching for a new living location, offers a clear added value to the free Smart Spot version. In summary, both the comprehensive user preference input as well as the full access to the complete set of recommendation results form the basis for a large revenue stream from premium service subscriptions.

A second, minor revenue source comes from premium service payments made by landlords or roommates searching for a suitable future tenant who fits their specific personal preferences. Considering the time-consuming hassle of selecting and conducting interviews with a vast number of applicants for flat-sharing or renting, roommates and landlords can benefit from an easy and quick pre-selection process for future tenants, automatically conducted on the Smart Spot platform. For this purpose, they can complement their free flatshare postings with specific preferences. For example, hobbies, skills or workplace of their future roommates. Smart Spot can then, based on the entries and social network profiles of flat-searching users, automatically search for and mark the applications of suitable roommates. In return for using this time-saving matching service, landlords and roommates are charged a small subscription-based premium.

A third revenue stream is generated by selling data about personal preferences and displaying matching product or service advertisements on Smart Spot's website. In order not to alienate users, these ads are placed in a non-invasive manner, near the page margins. Initially, the revenue from advertising is expected to be non-substantial. Growing popularity and a growing user base however can considerably push revenues in the future.

11.2.9 Costs

Smart Spot exhibits a primarily value-driven cost structure since it targets less price-sensitive customers whom it delivers a highly personalized service offering to. Focus on value creation emphasizes labor costs for employing highly skilled developers, key account managers and customer support personnel as well as data acquisition costs (e.g. paid to social network for accessing users' personal data) as main cost initiators. Bearing in mind the high importance of a quick and large customer base acquisition, marketing costs for Social Media Marketing (SMM) and Search Engine Optimization (SEO) are an additional key cost driver, especially at the beginning of operations. These fixed and partly variable (data acquisition, SEO) operating expenses are complemented by primarily fixed capital expenditures for the necessary IT infrastructure and some further operating costs for IT maintenance. However, with a rising number of users, Smart Spot's IT-based solution is bound to experience strong economies of scale and, given a favorable user adoption of the premium service, will quickly become profitable.

11.3 Scenario robustness check

In order to better assess the robustness of the Smart Spot business model in future Smart Cities, the business model is mapped against the four scenarios described in the scenario report. Within each scenario the respective strengths and weaknesses of Smart Spot are derived and a general evaluation of the success probability is presented.

11.3.1 Data as an individually controlled public good

This scenario describes a future where citizens have total control over their own data and a single data supplier aggregates all available data in Smart Cities. A single data supplier implies a high level of standardization of data formats and interfaces. This facilitates the integration of various data sources, which is a critical part of the envisioned service offering of Smart Spot.

On the other hand, having only one data supplier and citizens having total private control over their own data can result in less availability and diversity of business-model-critical data. First, users might not want to share their data. Second, there might be insufficient competitive motivation for data suppliers to gather and offer actually available user data. This, in turn, would negatively influence the quality of living recommendations made by Smart Spot. In economic terms, a monopoly on data supply also drives high data acquisition costs, significantly affecting Smart Spot's cost structure. Total control over private data and the extensive reliance on users' private data within the described business idea also limits the revenue streams. It seems rather unlikely that users would allow personal data usage for on-site advertising. Additionally, high societal sensitization for privacy issues reduces the number of potential users willing to input personal information, narrowing thereby major revenue streams. These two factors pose the greatest threat to business profitability.

However, with continuing urbanization and high demographic migration rates, the strong value proposition of Smart Spot remains highly relevant and ensures demand even in this scenario. With business model adaptations towards the introduction and adherence to strong data protection guidelines, a sufficient customer base and revenues might still be achievable. Therefore, Smart Spot can still be classified as moderately robust in this scenario.

11.3.2 The big brother

The Big Brother scenario is characterized by the existence of only one data supplier and absolute lack of private control over one's own data.

This constellation implies easy integration of various data sources within the Smart Spot recommendation system thanks to high-level standardization, which is driven by the single data supplier. Since the business model relies on a high level of personal data accessibility, no control over one's own data greatly facilitates the realization of Smart Spot. The lack of privacy concerns keeps the demand for this solution strong and most probably negates drawbacks from high data acquisition fees associated with the existing data supply monopoly. Another threat arises from the monopolistic position of the data supplier as a competitor.

All in all, Smart Spot seems to be a highly promising business idea within the Big Brother scenario.

11.3.3 The smaller brothers

A high number of specialized data providers as well as no individual control over own data constitute the main characteristics of this scenario.

Smart Spot business model can benefit from low data acquisition costs, driven by the intense competition on the data supply market. Moreover, the abundance and high competition among data providers, coupled with lack of private control over own data, ensures high diversity and quality of available data, which is essential for the described business model. Given the low relevance of privacy issues, customer acceptance and adoption of the service is expected to be extremely high. Hence, non-central revenue streams, which depend on a high customer base, such as advertising can also gain importance. Business profitability therefore looks highly promising.

On the other hand, a potentially critical issue remains the low data standardization, which is expected due to the vast number of specialized data providers competing on the market. However, if overcome, these challenges would serve as a high entry barrier for potential future competitors. Still, lack of market transparency over the most complete and qualitatively best data sets amid a sea of suppliers can increase search and transaction costs. Since successful data integration and analysis is central for the success of Smart Spot, the ability to cope with these problems is crucial.

Given that the technical issue around standardization is sufficiently resolved, the positive effects on business model profitability in this scenario are expected to clearly outweigh any economic disadvantages. This contributes to the evaluation of Smart Spot as a highly robust business model within this scenario.

11.3.4 The data stock exchange

This scenario describes a future with an infinite number of data suppliers and total individual control over private data.

Limited sharing of personal data and strong privacy concerns in this scenario make the realization of Smart Spot's personal data-dependent business model riskier. Achieving a broad customer base becomes more unlikely than in the scenarios with no individual control over own data. This certainly negatively affects advertising revenue streams, as well as the amount of available personal data and hence the quality of recommendations. The service quality is further limited by standardization issues due to the great number of data providers active on the market.

Nevertheless, through the introduction of special data privacy policies and considering the strong value proposition of Smart Spot for Smart Cities, a business offering with a somewhat robust customer demand can still be devised. A high number of data suppliers can keep data acquisition costs low and ensure that diverse set of data types are provided. To sum it up, these factors alleviate the negative effects and contribute to a generally ambiguous evaluation of the idea's robustness in this scenario.

11.4 Conclusion

Urbanization is a key driver that creates a market for innovative solutions that address the problem of scarce living space in future Smart Cities. The increasing digitization of cities in general and the housing market specifically suggest the usage of data to solve this problem.

Smart Spot takes these developments into account and uses a large amount of available data to improve the situation on the real estate market. Additionally, it helps to improve other severe challenges like congestion and pollution by avoiding traffic and suggesting living spaces that require less traveling. Smart Spot is an application that emphasizes the importance of citizens in a Smart City.

Although the exact shape of Smart Cities in the future is not yet clear, especially regarding control of personal data and the number of data suppliers on the market, Smart Spot has a high potential, as it is robust in all of the possible scenarios. Privacy rights are of minor importance as the strong value proposition will convince customers to share personal data on, then preferences even when they have full control of their data. A high number of data suppliers does not only come with disadvantages like a lacking standardization, but also brings along certain advantages, for example more specific data and possibly of higher quality.

Additionally, the basic idea of using a large amount of information to make customized recommendations for paying customers will have a large potential in the future and can be transferred to various applications.

Instead of only suggesting neighborhoods in a city, the same concept could be used to compare cities and neighborhoods in all parts of the world. The algorithm and core competencies for this solution would be similar to the ones needed for Smart Spot, but they will provide suggestions about better living spaces not limited to one particular city. Such service could help its clients to find a better place to move to, provide suggestions about a next place to visit on holidays, or where to build a summer house.

Another application could be general recommendations regarding the organization of free time activities. Personal information like personal and friends' availability, preferences and current location can be matched with real time offers from restaurants and shops as well as with environmental data like weather and pollution to make customized real time suggestions for daily or weekly activities.

Finally, such an application could be used for job recommendations. Similar algorithms which take into account educational, personal and professional information of interested applicants could be matched with company and job position data regarding salary, aggregated employees' mood, and analysts' prospects for the respective company. This way, the expensive, intransparent and effortful tasks of headhunters could be replaced with a smart and efficient recommendation system.

A system matching personal preferences and lifestyles with environmental and other data to make personalized suggestions not only solves the accommodation search problem, but can also be successfully applied to other areas.

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12 Chapter 12

Intercity Data Marketplace

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Executive Summary

Intercity Data Marketplace (IDM) provides a platform for the exchange of data between cities that have commonalities in certain areas, e.g. public transportation networks, utilities or population structure. It also provides value added services consisting of reports and benchmarking services. IDM enables cities to conduct feasibility studies in order to better forecast costs and hedge risks of large public Smart City projects. Target groups are cities with already established Smart City technologies and cities planning to become smart as well as governments, non-governmental organizations and private organization that want to use benchmarking services to support their decision making on the allocation of resources, such as subsidies.. The business model works best in a world with low privacy regulations and one central supplier of data in a city ("The big brother" scenario). As the number of data suppliers is the most decisive driver for the feasibility of IDM, scenarios where many suppliers and high privacy regulations exist, endanger the success of the business model.

12.1 Introduction

Data marketplaces play an important role within a city to facilitate innovation. But there are potentials in the usage of data that go beyond the borders of a Smart City. A Smart City uses the data generated from sensor networks to derive concrete actions for the improvement of different aspects in the city. An additional use case for data generated in city A, is the usage of this data in city B. In case of two cities with similar characteristics in certain areas, e.g. the setup of public transportation networks, population or climate conditions, data can be used not only in the city where it has been generated. When city A decided to restructure its public transportation network based on the analysis of data that was generated by sensor networks, e.g. tracking of patterns in the movement of passengers, city B might adapt these actions for their own infrastructure project if they have a very similar setup of public transportation. Another possibility is the conduction of feasibility studies based on the experiences in city A in order to better hedge risks and plan costs linked to investments in infrastructure. The idea of IDM is that of a trader model plus value added services. The sale of data to cities is one source of revenue. Based on the degree of vertical integration of a market place operator, data is offered raw, filtered or analyzed. Cities can use raw data to conduct their own analyses and derive consequences for the improvement of their city or pay more for the access to analyzed data with linked prescriptions. Value-added services, e.g. reports about different areas of Smart Cities or data individually tailored to the the specific needs of a city as well as benchmarking services complement the portfolio of IDM. Key performance indicators (KPIs) enable the comparison of cities. Governments and private institutions can then derive consequences for the allocation of resources to theses cities, e.g. the allocation subsidies.

As this idea deals with a model of a data marketplace itself, the number of data suppliers in the scenario robustness check is interpreted as the number of sources that provide data marketplaces with data. This interpretation is of particluar importance for the understanding of the scenario robustness check.

12.2 Business idea

IDM is a data marketplace for the exchange of data between cities that have similar areas and characteristics, e.g. population, size, transportation networks or climate conditions. A non-smart city planning to introduce Smart City technologies can make use of provided data by a Smart City and learns from cities with successfully established smart technologies. IDM is clustered into two main pillars: Data Trading and Value Added Services. IDM acquires data and resells it on their provided platform. According to the degree of vertical integration, IDM can refine this data by analyzing it and deriving insights and recommendations for potential buyers. By that, margins can be increased due to the willingness of customers to pay more for data with higher informative value. Therefore three different forms of data can be distinguished: Raw, filtered and analyzed data.

Raw data is acquired and directly sold on the marketplace. Buyers of raw data profit from the aggregation of raw data from different sources on a data marketplace.

Filtered data is data presorted according to different factors such as time horizon, data formats, size or sources. Buyers of filtered data can identify required data faster and more precisely.

Analyzed data can increase revenue streams due to its higher informative value. This data can be presented in form of recommendations or even prescriptions to support cities in their process of data based decision making.

Additional services based on existing knowledge enable IDM to differentiate from competition, to create entry barriers for followers and to offer more value to its customers. There are three add-on services offered by IDM:

Regular reports on certain city KPIs or countries provide other cities with regular updates on developments and projects in the field of smart cities. To provide these reports, resources for the analysis and publishing have to be developed.

Besides regular reports, cities are able to order customized reports on demand that addresses the specific issues a city wants to tackle. These reports are made by an expert team of IDM and are realized within individually set up projects in cooperation with the customer city.

Rankings based on KPIs combined with benchmarking services compare cities and create transparency on different areas. Based on the variety of data that is collected, a framework with KPIs for certain areas of a city can be developed, e.g. in public transportation, utilities or public safety. Cities can then be compared by external parties such as governments, non-governmental associations or private companies to support decisions on ranked cities, such as the allocating of resources, e.g. subsidies or the decision on manufacturing sites.

IDM can start as a simple broker model, which requires low investment and allows to conduct first tests of demand. This strategy helps to avoid sunk cost and develop an appropriate pricing model. After a proof-of-concept the model can be further developed into a trader model with value added services, as described above. By doing so, higher entry barriers for possible followers are created and IDM is strengthened by additional services.

Benefits

The underlying business model is highly scalable due to data being a digital good. High switching costs generated by setting new standard formats and offering additional services create lock-in effects for customers. The early building of strong networks within political authorities helps to gain competitive advantage.

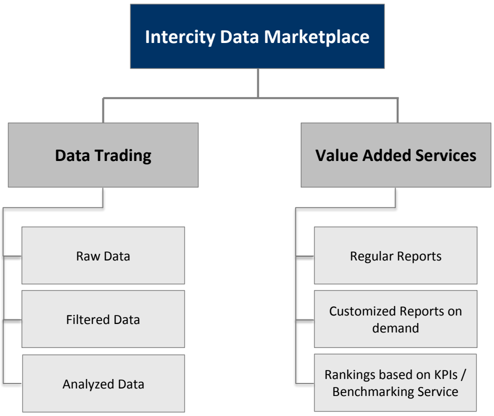

Figure 12.1: Incoming and outgoing financial flows

Political institutions can use provided rankings to motivate cities to facilitate investments in smart technologies. They then can gather and provide more data and become data sellers to IDM. These cities can take the role of reference models and test areas for the impact of smart technologies in cities. Thus, support from public authorities stimulates the development of a market and contributes to the attractivenes of the underlying business model.

Challenges

Two cities have to be comparable in certain aspects to make use of data generated in one of the cities. This challenge limits the transfer of knowledge between cities as well as the international exchange of data, since cities on different continents differ to a higher extent. Different data formats from various sensor networks implicate costs for the standardization of data. This restriction can limit the usage of different sensor networks or can cause a decrease in margins. As data often contains information about citizen or private institutions, property rights on related data have to be clarified. By introducing shared revenue models to let property owners benefit from the sale of data, margins are lowered. Conflicts regarding property rights of data between cities ordering the installation of sensor networks and sensor network companies that install and maintains these networks have to be clarified. Being a trader, IDM has to have access to strong financial resources to be able to aquire enough data for offering a sufficiently large database, so that buyers can choose the data according to their individual requirements and for IDM to offer relevant reports and valid rankings. As IDM customers are cities run by public authorities, creating a strong political network that is able to influence market regulations is another challenge. Without these networks it will be hard for IDM to stay in the market.

12.2.1 Value proposition

A multi-sided business model like IDM basically has two customer segments: the buyers and the sellers of data.

Values for buyers and sellers
IDM has an innovative business model and so this business can satisfy customer needs, which no other player in the market addresses so far: the accessibility of data and the professional exchange of data. On the one hand, IDM also offers a possibility for cities to sell the data they gather and to get their data analyzed professionally. On the other hand, IDM provides access to detailed, complete and exclusive data sets on entire projects. Thus, interested cities profit from the experience of more advanced cities.

Additional values for sellers
Smart Cities can partly amortize their large expenses for the infrastructure by offering their raw data for sale. Data sales may become a stable source of income, so cities might be more interested in generating data.

Additional values for buyers
Cost reductions are possible on the buyer side. Non-smart cities and smaller cities with a more limited budget can learn from the "smartest". This way, they can benefit from the experiences of first movers, gain valuable insights while avoiding costly beginner's mistakes on large projects.

One big value for the buyers of data will simply be convenience. They will not need to handle big data streams themselves and care about complex analytics. IDM will analyze and process the raw data for them, offering easy to read reports.

For buyers, such as other cities or the government, the possibility to order customized reports tailored to certain needs is a great advantage. This way, they can get professional advise based on analyzed data sets for very special projects or problems. Businesses are probably more interested in consumer data, while cities might be motivated to know details about the construction phase of a new concert hall another Smart City has experience in. For the government it will be valuable to get instant insights on e.g. the CO_2 level, water and energy consumption data or transportation data of various cities.

In addition, buyers can forecast costs and possible obstacles of complex projects in a more precise way, reducing risks. IDM will be able to develop certain KPIs in different categories like mobility, population, CO_2 or energy consumption and create a benchmark. By selling data based on these KPIs, Smart Cities become more transparent concerning their technological and ecological progress. The benchmarking of the different cities are of great value especially for governments, which can use the results as a basis for political decisions, like the financial support a city receives. It makes cities not only more transparent but also comparable.

12.2.2 Customer segments

IDM addresses different customer segments. One important customer segment is the segment of Smart Cities and non-smart cities willing to 'smarten up'. Especially at the beginning, IDM aims at acting mainly as a data broker for raw data between cities, simply matching supply and demand. Later on, IDM plans on buying and reselling raw, filtered and partly analyzed data sets. This means that the customer needs to have the capability to process the data streams, which is why Smart Cities are the main focus for this service.

As the business of IDM develops, value added services will be offered, such as rankings and benchmarking services, regular reports as well as customized reports on demand.

With certain KPIs, IDM aims to develop an algorithm for a benchmarking system to compare cities. Possible customers on a macro level are governments, but also public institutions, which will be able to use these rankings to assign federal subsidies according to the rankings of the cities and to get a detailed picture on the progress of certain cities. Rankings and benchmarking services will also be an interesting source for environmental associations or e.g. the EU. On a micro level, rankings might influence the decision of corporations for moving the headquarter to a different, smarter city, because of its superior infrastructure. Thus, also companies are a possible customer for the rankings.

Apart from benchmarking services, IDM offers to analyze and process data in order to generate reports on various KPIs. This addresses predominantly other cities that do not have the capability to analyze raw data themselves. These cities can benefit from the knowledge of more experienced cities, especially when planning a new and complex project, e.g. setting up a new public transport system. Also, for certain industries the reports provide valuable insights. Utility providers will be interested in the latest figures and statistics on energy consumption, while manufacturers of trains for subways and railway companies will want to know more about the utilization of public transport and details on the traffic situation. Of course, the reports are also an excellent source of information for governments, insurances, research institutes and environmental associations, which may base their political decisions on the reports.

12.2.3 Channels

IDM aims at reaching its customer segments and communicate the values of its services through various channels. Since the services which IDM offers are based on sensitive data, trustworthiness and responsible handling of information are thus important requirements for a functioning customer relationship. Partner websites cannot guarantee the safety and security standards that IDM wants to offer. This is why IDM relies on direct and owned distribution channels, e.g. an in-house salesforce, an aftersales team and an own website.

A strong expert salesforce is especially important concerning the key account management, as cities are the sources of data, which is the heart of the business model of IDM. It is essential to be in close contact with the sellers of data to negotiate fair prices, discuss the offer and values as well as listen to their needs. Potential buyers of data, reports and rankings are contacted regularly by the salesforce, who are also the contact persons for discussing demands for report customization. Some qualified people are needed to deal with politicians, as they are an important customer segment.

A trained aftersales team is available in case of questions or concerns. They handle complaints and react in a customer friendly way.

On a website with an integrated webshop the data and services will be offered. There, customers can order reports – digitally or physically – make requests and access raw, filtered or analyzed data sets. As already mentioned, the security of the website is an important asset, as it reflects the reliability and trustworthiness of the business and thus raises the willingness to buy and sell data.

12.2.4 Customer relationships

As an enterprise working across geographical boundaries, IDM addresses very diverse customer segments. Depending upon the customer segment, the enterprise needs to carefully devise customer relationship policies in order to acquire new customers and retain the existing ones while boosting sales. The customer relationship will mostly be based on personal relationship and assistance, but will also include some automated services.

In order to acquire new customers, IDM will present itself on conferences. On such events IDM intends to seize the attention of high profile personnel and to build a long lasting relationship with customers. A network of distinguished people – diplomats from cities and intergovernmental organizations, scientists from research institutes and executives from companies – will help IDM attract more customers.

A company that trades data between cities and involves such influential clients is bound to meet some expectations. IDM therefore wishes to provide exceptional service to the existing customers. The company plans to employ automated services for swift response and personal assistance with a team of experts for any additional needs. The automated services will be available 24/7 to all customers via online platform, mobile applications and auto telephone services. For the issues that need more time and attention, a dedicated team of experts will be available on request. In order to boost sales, IDM will employ highly qualified sales agents that offer products tailored to individual customers.

12.2.5 Key resources

In the case of IDM there are several key resources that the company relies on.

First and foremost, data is a key resource. Without data from cities, the whole business model does not work. It is not only the quantity but also the quality of data that is important to attract customers and to be able to offer high quality reports and benchmarks. Hence, maintaining a good relationship to Smart Cities is crucial. This is why a large and skilled salesforce can be also considered a key resource.

With politicians, big corporations and cities being the main customers, a good network to people in key positions is an important resource. Especially in terms of politics it would be a great advantage to get key politicians on board, that provide the required network for IDM. This can be a pivotal factor for the success of IDM and raise insurmountable barriers to entry.

Apart from acquiring data, the analysis of data is of equal importance. The tools which are used by IDM have to be state of the art and be able to handle different data formats effectively and in a timely manner. Experts will be required to aggregate data efficiently.

For the benchmarking service IDM needs a KPI structure and an algorithm behind. Both the KPI structure and the algorithm are key resources and a strong competitive advantage as they are confidential and thus difficult to copy. These key resources should be able to react flexibly to changes and new requirements, offer stable results and meet the high expectations of key customers like governments.

12.2.6 Key activities

In order to establish itself as an intercity data trader and a superior benchmarking platform, IDM has to perform three major activities. IDM, as its key activities, maintains a platform for cities to exchange data and provides benchmarking and ranking services for cities. Besides the basic tasks required to carry out the business idea, the company also needs to maintain the network of influential people and lobbyists.

First of all, the marketplace needs to acquire data from several cities and from various sectors within the city. The acquired data should be properly aggregated, analyzed and processed according to customer needs. IDM seeks to deliver data that can immediately be used by customers. Such a vision necessitates the marketplace to aggregate the data from multiple cities and across multiple sectors and then process them into one single package. The marketplace also needs to combine the acquired data and generate a new set of relevant data.

Furthermore, to provide a benchmarking platform, the marketplace needs to include data analytics in its key activities. IDM needs to develop KPI metrics which, when combined with the acquired data, can be used to create data reports and bechmarks of cities. The final step is to distribute the data to the customers.

12.2.7 Key partners

IDM needs to create a strong network of suppliers and partners. One key partner type are those that generate data: cities, corporations and governments. As a data trader, IDM needs to have a trustworthy partner relationship with its data suppliers. Cities and governments play a key role as cities generate data and governments regulate the ownership and transaction of the data. In order to get the relevant set of data from these cities, it is very important to build strong relationships that ensure the supply of data. Furthermore, cities and governments are both suppliers and clients.

Another key partner type are data analytics companies. These companies can assist on data analytic solutions for very huge and complex projects that are beyond IDM's capability and require specialists from the field. The partners can share resources and mutually benefit from each other.

A further outlook could be to establish a strategic partnership with data marketplaces within cities, to facilitate the operations of data collection and data distribution.

12.2.8 Revenues

There are four sources of revenue for IDM:

1. The sale of data to cities: prices depend on the degree of analysis, whether filtered or analyzed data is sold.

2. Fees for the the access to data reports: continuous access to regularly updated reports on specific areas of Smart Cities is offered.

3. Additional fees for customized reports: reports are tailored to the specific needs of a city and allow for higher prices.

4. Fees for the access to regularly updated benchmarking services: this is build the fourth source of revenue.

While sales of data and the sale of customized reports are one-time customer payments, recurring revenues from subscription fee models allow for continuous cash flows.

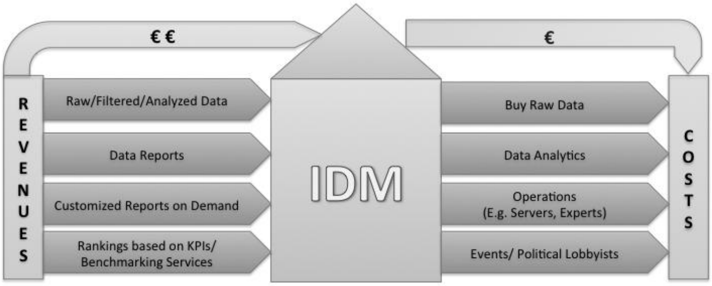

Figure 12.2: Incoming and outgoing financial flows

12.2.9 Costs

Dealing with high profile customers and intergovernmental organizations, IDM needs to ensure the best quality of its products and services. The company mainly focuses on a premium value and tries to minimize the costs without compromises in the quality.

Data has become a commodity and with rising dependency on data, it will presumably become a very expensive resource. As a company that trades data, the cost of buying relevant data is the driving factor for the company's costs. To comply with its value-driven vision, the company needs to gather as much diverse data as it can to produce and deliver the best results. Buying raw data and transforming it into an appealing service again requires a huge portion of the company's costs. Data analytics, outsourced or in-house, will also be very expensive. IDM needs to invest in infrastructure – servers, office areas, inter/intra-networking and experts.

A data marketplace that operates beyond national and international boundaries needs to invest a significant amount in political lobbyists. Apart from good valued products and services, it needs to consistently influence cities, governments, scientific institutes and companies. To do so, it needs to organize extravagant events that attract the most distinguished people and highly influential customers from all sectors. Assigning dedicated key account managers to these clients and delivering tailored products on request will also account for a notable amount of the company's costs.

12.3 Scenario robustness check

The success of the IDM business idea depends on many different factors and characteristics of possible scenarios in the future. Since each of the scenarios is equally plausible, the robustness of the IDM against all scenarios and their different key driver characteristics need to be examined. The four extremes that were analyzed are high versus low control over private data and one versus infinite data suppliers. In the case of IDM the evaluated system is the city itself. For example in the case of only one data supplier it may be the government and if there are infinite data suppliers the data may come directly from individuals or organizations such as public transportation or energy companies.

12.3.1 Data as an individually controlled public good

The scenario “Data as an individually controlled public good” is characterized by a single data supplier and full control of citizens over their private data.

One of the biggest challenges for IDM is standardization. In order to automize the combination and analysis of data, a high degree of standardization is needed. In a system where only one single data source exists, this is obviously fulfilled. Another key factor is the aggregation of data. It is essential to have broad access to all kinds of data, which of course needs to be collected from somewhere. One advantage of a single data source is that the data only needs to be collected from a single source rather than looking for data among endless sources. However, as this scenario is characterized by full control over private data, most gathered data within a city is anonymized data. This makes data less valuable and citizens have to be given high incentives in order to share private data with IDM. In this scenario, the price of data is determined by the one data marketplace. However, as described in the scenario, this is a special case because it is regulated by law. Nevertheless, it needs to be mentioned that a monopoly normally can charge any price on data and thus makes IDM highly dependent from the one single data marketplace.

12.3.2 The big brother

This scenario is characterized by a high standardization of data formats, which enables the bundling of data from various sources as well as a cheaper operation of sensor networks and interfaces. As in this scenario there is only one central supplier of data within a city, there are fewer players on the supply side which could lead to higher purchasing prices for data. Moreover, this development provides easier access to data and increases transparency on existing data suppliers. Due to low privacy regulations data contains more personalized information.Public authorities are willing to foster the pervasion of smart technologies. Data companies and market players in the field of IT play an important role in global economies. The ability to analyze large amounts of data is crucial for old industries to optimize their business and generate growth. Public private partnerships enable large IT companies to better collect and use data as there are much less privacy regulations. A marketplace can benefit from this initiatives but has to be aware of the influence by public authorities that hinders flexibility. As governments allow to collect more personalized data about citizens, data marketplaces highly benefit. The support of data gathering by the public sector and the wide availability of sensor networks allow the gathering of large data amounts, especially in public space within a city.

12.3.3 The smaller brothers

The smaller brothers is a scenario where infinite number of data suppliers exist and individuals have no control of their private data. In such a scenario Intercity Data Marketplace is believed to have moderate success.

Intercity Data Marketplace's operations mostly depend on the trade of data between cities. Intercity data trade puts the people's privacy in jeopardy. However, if privacy is of little concern as in the scenario, such issues will not hinder the functionality of Intercity Data Marketplace. Access to citizen's personal data and the permission to distribute rather advances the company's services.

While the lack of privacy is advantageous for IDM, this is counterbalanced by the presence of an infinite number of suppliers within the city. The sources for most data for IDM are the marketplaces within the city. Thus with a presence of an infinite number of suppliers, data collection can be a very inefficient process. This is the case particularly because the data is distributed among various suppliers and it requires a lot of time and effort to locate the appropriate supplier for the required data. The high distribution of data leads to less transparency on available sources and on data quality. In addtion there are issues of standardization: Multiple suppliers bring in multiple standards to the market. After the complex data collection process, IDM needs to put in a significant amount of effort to standardize the data formats for aggregating data.

IDM can be refined and adapted to this scenario. Howevern, it will foster most if the data source information is freely available and the data marketplaces within the city agree to maintain one common standard.

12.3.4 The data stock exchange

The scenario of „the data stock exchange“ is characterized by people having high control over their personal data and by an infinite number of data suppliers. For IDM these are not very favorable conditions. With high privacy, IDM is hardly able to buy anything but anonymous data, with a lower analytical value than that of personalized data. Data linked to personal characteristics is hard to get. Strong incentives have to be set to convince people to give it away. Data streams might only represent people who agree to contribute their data, so the need for completeness of data cannot be fulfilled anymore, which decreases the attractiveness of IDM.

If a large number of suppliers exist, IDM would have to negotiate with a lot of different people and authorities in a city, each owning fragments of data streams. The personnel expenses of IDM for these negotiations would be so costly, that the business model might not work. Although prices for data sets would be lower due to the high competition of suppliers, the effort to aggregate the different sets of data would be too high.

Concluding, IDM will certainly face strong challenges in this scenario. Compared to the other three extreme scenarios that were examined, IDM is believed to work worst in “the data stock exchange” scenario.

12.4 Conclusion

In 2013, Smart City is still just another sensational topic that citizens and governments all around the world are excited about, and is slowly transforming into reality. As cities become smarter they also tend to work in close co-operation with each other. While it is common knowledge that data is a key resource for smarter cities, little is known about the future of sharing data between the cities. IDM strives to fill this gap and establish a platform that will enable the cities to exchange their data and prosper together. Along with a data trading platform, IDM will provide the cities with benchmarking and ranking services.

IDM has a clear advantage of being the first one in the market but also needs to face the challenges of setting the initial data standards and regulating the data protection acts across boundaries. The strategic business model, as described above, suggests the proliferating prospect of the business idea in the future years of Smart Cities.

The business idea was put under thorough examination for robustness in the four presented scenarios. From the robustness check it is evident that the idea is feasible in all, but in ’The data stock exchange’ scenario. The examined scenarios are extreme cases. IDM will flourish best if the economy heads towards ’The Big Brother’ scenario.

If adjusted to each scenario’s requirements, IDM will provide advanced solutions to the future demand of data exchange market between cities.

13

Chapter 13

Tourisipate

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Executive summary

In 2012, international tourist arrivals surpassed 1 billion (1,035 billion) for the first time, making tourism a more important market that still holds great potential Organization [435]. The growing importance of personalized tourist experiences for generating revenue is a key element of the business idea that is described in this chapter. Tourisipate aims to bring tourists or business travelers and companies together by providing highly personalized touristic mobile services. In practice, Tourisipate is a two-sided platform delivering tourist information and ad content of physical shops on the mobile devices of city explorers. Hence, Tourisipate addresses application users and advertisement providers. While it offers personalized tourist experience to the app users, the ad providers profit from an increase in marketing efficiency. The predominant distribution channel is web sales, followed by an own sales force and word-of mouth marketing, which are also of high importance. The whole service is highly automated with the exception of a highly trained quest consultants who can be hired by customers. Advanced algorithms and real-time collected data together with a wide user base, IT employees and the team of dedicated quest consultants form the most important resources of the business model. To ensure success of the application, collaboration with telecommunication providers and official tourism info points need to be established. Tourisipate generates revenues through a three-level pricing model consisting of a basic display charge, a pay-per-click charge and a pay-per-visit charge. Further

revenues are generated by premium accounts that allow businesses to create quests, buy pre-built quests and hire quest consultants. Tourisipate's expenses are composed of the maintenance and support of the mobile application and IT infrastructure as well as human resources. The robustness check with the scenarios described in the scenario report indicates that Tourisipate is highly robust. Tourisipate has a unique approach, matching the need for information and adventure of city explorers with the need to expand the customer basis of businesses.

13.1 Introduction

Tourism is a huge industry and has a high annual growth rate. In 2012, the number of cross-border travelers passed the mark of one billion from 996m the year before [437, p. 1]. Furthermore, in 2011, international tourism and travel receipts summed up to 740bn EUR [436, p. 1]. According to statistics, international tourism generates 30 percent of worldwide service exports [436, p. 1]. Given these numbers, it is worth having a closer look at the tourism and travel industry, as there is still a lot of potential for innovative business ideas such as Tourisipate.

The way we use mobile phones has influenced the way we travel. In 2007, Steve Jobs, the CEO of Apple, revealed the first iPhone, which initiated a revolution in the mobile phone market [434]. The introduction of the concept of apps and the drop in prices for mobile internet paved the way for comprehensive and easy access to updated information related to traveling. Recent surveys among travelers have revealed that the number of people using mobile internet while traveling is increasing [438].

Over the last years, a lot of new smartphone services related to tourism and traveling have entered the market. To begin with, there are map applications provided by big search engine operators, e.g. Google Maps, Bing Maps, Yahoo Maps, and some which are based on the open maps of the OpenStreetMap project. All of them are also available on mobile platforms. Typically, they can display maps, search results on the map as well as basic information about map database entries and offer more or less advanced navigation. These applications use the mobile phone's built-in positioning hardware to determine the current location on the map. [431]

Location-based social networks are another kind of mobile applications experiencing notable growth. The most prominent may be Foursquare. Its concept relies on the ability of mobile phones to determine the current position. Users of Foursquare can check in to places and earn badges based on the number of check-ins. Furthermore, they can become the virtual mayors of places in cities, if they hold the highest number of check-ins. Besides that, Foursquare offers information about places and stores which can be rated, shared and recommended. [429]

Concerning tourist information and trip planning, there are several well-established services on the mobile app market, e.g. TripAdvisor and tripwolf. In general, they provide information about trip and shopping possibilities all over the world. The users can rate them and write individual reviews. On top of that, these services offer simple tools to assemble individual lists and to write travel blogs which can be shared with people in the user's network. [440]

The field of personalized advertisement also is considerably profitable as a lot of internet companies base a big part of their business model on it, e.g. Google, Facebook and Microsoft Bing [432]. Users benefit from free services, provided that they create a user profile for the respective service. Profile information and actions on the website are typically used to display ads which are most likely to be interesting for the user. The prevailing payment model is pay-per-click, which means that Google and Co. earn money with every click on an ad. [430]

In recent years, applications fostering spontaneous get-togethers have gained popularity. The service Spontacts, for example, provides easy access to a leisure time community. The goal is to have a platform for an easy organization of spontaneous activities. As the whole community is allowed to join, users will get to know new people. [439]

The mobile application Tourisipate presented in the following sections combines certain components and aspects of all previously mentioned applications. To differentiate itself from the other services a social component is added, which makes people interact by solving quests. Furthermore, Tourisipate uses existing map services instead of creating a new one. It incorporates the location-based check-in concept of Foursquare and tourist information from services such as TripAdvisor, but instead of just creating a new rating and review platform it includes information that is already available. The most distinctive feature of Tourisipate is that it takes the concepts of personalized advertisement and spontaneous get-togethers and combines them within a game.

13.2 Business idea

Tourisipate is a unique business idea that provides a platform for city explorers and businesses to interact. Its main element is a mobile app that allows travelers and locals to navigate through a city while taking part in games. In fact, apart from offering basic visitor information, Tourisipate allows tourists to interact with each other through the app, obtain tips on special offers and complete quests offered by participating companies. Businesses of all sizes can create ad content, which is displayed to a selected group of users based on their profile information and their location within the city. Furthermore, users have the choice of completing solo quests or joining group quests. This structure also applies to special offers.

As depicted in figure13.1, tourist information is at the core of the Tourisipate services. Presenting real-time informative tips on a map, Tourisipate serves as a virtual city guide showing attractions in the users' vicinity. The next layer consists of real-time special offers published by local shops on the user's travel itinerary. With the free account, companies are provided with the necessary tools to build ads. The Tourisipate app charges participating companies once the user clicks on the ad. The success of an ad is measured by the number of clicks and the number of visits to the store.

Quests provide another layer of the Tourisipate services. They are a gamification feature of the application and their creation is available for business customers with premium accounts. In exchange for a one-time fee, premium

Figure 13.1: Tourisipate service layers

account holders can design special missions for app users. Mid- and large-sized businesses can also pay quests for support by quest consultants. Quests incentivize participants to get involved in an activity that is challenging and exciting to them. In return, participants generate value for the sponsoring company that "owns" the quest as it is branded by the company and may result in increased sales when app users need to visit the store.

App users are rewarded for quest completions with additional discounts or free products by the company as well as cumulative TourisiPoints within the Tourisipate app. The number of points directly correlates with the user's involvement in the Tourisipate activities. While all activities are rewarded with TourisiPoints, the points gathered in group activities are given a higher value in order to encourage the building of a tight community of Tourisipate users.

The following use cases demonstrate the usage of Tourisipate from the perspective of two city explorers: a business traveler and a leisure traveler.

Use case: Tourist information and offers

Alice is in Munich for several business meetings. At the main train station, she scans a QR code that she received from another tourist. The QR code leads her to information on the Tourisipate app, which she downloads, but she has had no time to try it out. Her business meetings last the whole day. In the evening, Alice feels rather lonely and remembers the Tourisipate app. She opens it, quickly creates a profile to join the community and proceeds to a map of the neighborhood. On the map, a pop-up announces that the boutique around the corner is open for the whole night. When she checks the details of the offer she notices a special offer for a free drink at the store. Alice is thrilled – shopping and a cocktail is exactly what she needs to relax after this long day. She heads for the boutique where she meets other Tourisipate community members.

Use case: Group quests

Eva is wandering around Prague and receives a quest challenge on her Tourisipate app. There is a group planning to do a flash mob on Wenceslas Square and they need one more person to complete their team. She meets them on the way to the H&M store that raised the challenge. The cashier gives them H&M branded T-shirts and they choose their song: Thriller. One of them will set up the music and film while the others dance. They start a bit shyly, but in a matter of seconds dozens of people join them. The event is a success and the video they upload to the Tourisipate community website gives them 100 TourisiPoints each. Apart from this reward, they can also keep the T-shirts. Afterwards, the group heads out to a Tourisipate–recommended restaurant nearby that offers a group discount.

13.2.1 Value proposition

Tourisipate addresses two types of customer segments: app users and advertisement providers.

To earn revenue, Tourisipate needs ad providers. They are offered the information necessary to better target their customers. With the application constantly running in the background, notifications of special offers and quests that pop up directly on users' phones lead to a greater exposure, which in turn leads to additional revenue for the ad providers. The creation of the ad content is greatly facilitated by the existence of a web platform and the support of consultants and offers great convenience in generating ads. In the future, simple analytics will be added: an ad effectiveness report based on geolocation and purchasing patterns of the app users.

Regarding app users, Tourisipate offers a personalized tourist experience. The convenience of using this app for accessing information about the city for free is a primary advantage. As the user passes by, tips about the touristic attractions nearby pop up on the smartphone. If users want to, they can also access detailed information by browsing the app. In addition to that, users have access to personalized discount offers that may not be available to regular customers. Also they can become part of a community. Quests not only offer TourisiPoints important within the Tourisipate community, but also physical rewards for their completion.

13.2.2 Customer segments

As mentioned above, customers of Tourisipate can be divided into two major segments – app users and ad providers. App users actively use the Tourisipate application on their mobile devices when walking around the city. This segment can be further divided into three groups: tourists, business travelers and city inhabitants.

Tourists form the prevailing part of app users and are essential for the success of the whole business model. They come to explore the city and to spend money on accommodation, food and other products and services. Therefore, they are interested in getting city-related information and can be tempted by the discounts they can get when using Tourisipate. Some tourists, such as back-packers, will also benefit from the possibility to meet other people and to get to know them by accomplishing quests.

Most business travelers can be characterized as people who work during the day and spend the evening by themselves. Tourisipate can help them get together with other people for an evening drink or, possibly, a drinking game at a bar. Of course, in their free time, they can also benefit from the city information and discounts or even join groups of tourists in the city on diverse quests. This group of app users is important for the business model because, unlike typical tourists, they often come back to the same city. If they have a positive experience with the app, they are quite likely to use it again on their next business trips and in their home cities.

The last group of app users are locals. This group of users will be predominantly interested in the possibility to meet new people and in the discounts that are offered. Also, they are quite likely to travel to some other cities or countries in the future and may use the app then as well.

The second major customer segment consists of the ad providers – companies that advertise and offer discounts and quests on Tourisipate. Among them, there are big chains, such as H&M or McDonald's, and little local stores and restaurants. They pay fees for placing their offers on Tourisipate based on the type and extent of services they are using.

13.2.3 Channels

Channels differ by customer segments. The predominant channel for app users is web sales. Advertisement for Tourisipate can be found in social media and on websites with tourism-related content. If potential app users decide to learn more about Tourisipate, they can find a detailed description of the app on an app store or ask members of the social media community. The app can be obtained for free on an app store or on the Tourisipate website. Word-of-mouth marketing is also very important. If users are satisfied with the app, they are likely to recommend it to their friends and other people with whom they may talk about their traveling experience. By sharing positive experience on their social media profiles, additional advertising is made. Leaflets and posters are placed at tourist info points in cities. Since the app is functional in multiple cities, app users are likely to use it more often. They can even become local app users after returning to their home city.

The choice of a channel type for addressing ad providers depends on their size and attractiveness for Tourisipate. Restaurants and stores located in only one city are addressed mainly by web sales and word-of-mouth marketing. They can find all information about Tourisipate and also register for a free account on the internet. Top-selling ad providers, such as stores or fast-food chains that are present in multiple cities and countries, need to be addressed individually. For this reason, Tourisipate has a dedicated sales force formed by highly trained employees and freelancers that proactively offer the services to these potential ad providers. The internal sales force also regularly visits trade fairs on the tourism sector in order to build effective networks. Moreover, large ad providers are also more likely to take advantage of Tourisipate consultants who provide them with continuous personal assistance. The effectiveness of Tourisipate as a marketing channel for ad providers can be seen in the ad effectiveness report which is sent to interested ad providers on a monthly basis. It contains statistics on the number of displayed offers, clicks and visits made by Tourisipate app users and also on the participation in and completion of quests.

To raise awareness among both app users and ad providers, advertising campaigns in cities, on social media and possibly on TV and radio will be launched. Apart from advertisements on social media networks and at tourist information points, these campaigns will have a rather one-time character. Their purpose is to create a basic awareness about the product and to attract early adopters.

13.2.4 Customer relationships

Maintaining good customer relationships with both customer segments is vital for the success of Tourisipate. The app itself is highly automated and so no direct contact of the representatives of Tourisipate with app users is needed when they explore the city. App users can describe their experience with the app, ask questions and make suggestions for improvement in a social media community. They also have the possibility to upload videos about the quests and share related content. App users collect TourisiPoints for the completion of every quest, which determines their position in the community. Depending on the number of TourisiPoints, app users may qualify for additional discounts and quests or even become community leaders with whom Tourisipate will collaborate on the future development of the app. Apart from further in-app benefits, community leaders can be financially rewarded for their cooperation.

Ad providers with free accounts are served by a web interface, a highly automated platform, suitable for making simple discount offers. If they decide to pay for a premium account, they receive additional tools which can be used to prepare quests and more elaborated offers. They can even choose to buy pre-defined quests that can be easily adapted to their needs. The previously described service for ad providers is rather automated with little interaction with the employees of Tourisipate. If ad providers need to create more elaborate quests or do not want to spend time preparing them, they can pay fee for getting personal assistance by one of Tourisipate's consultants. Together with these consultants, ad providers can create content specifically tailored to their needs, which is at the same time more appealing to app users.

13.2.5 Key resources

The key resources of Tourisipate are intellectual resources, a broad user base and employees. The intellectual resources include algorithms that select the most interesting offers for app users based on their personal data and location. The app does not only work with static data entered after the first log-in but it also dynamically collects data about the behavior of every app user and analyzes it. By doing so, it can predict the behavior of other users with common denominators, such as common interests or preferred type of quests. This makes the targeting of offers even more precise. Therefore, the data collected in real-time is another key resource.

A broad user base is another vital part of Toursipate's success, as it builds a community. The community feature of Tourisipate is crucial, because it prevents app users from switching to a competitor's product. It is also important to take into consideration the feedback from the community, because only by doing that the real needs of app users can be understood.

Another crucial part are IT employees and quest consultants. The IT department needs to be composed of specialists because frequent failures or bugs would significantly damage the image of Tourisipate. The consultants need to be highly skilled in communication and technically savvy to be able to create even complicated quests, based on the wishes of ad providers. Moreover, it is essential that they know the city they are working in because only then they can provide a sufficient level of expertise. Ideally, consultants are locals that have been living in the city for multiple years.

13.2.6 Key activities

The primary touch point with app users is the Tourisipate smartphone application: A cross-platform mobile app has to be developed and maintained. This is a continuous process, as new features can be added throughout the product life cycle. Once the app is in place, the next key activity is to create a community of users. This activity is important because the business concept of Tourisipate relies on community involvement.

Before reaching out to business customers, a web platform, linked to the mobile application, needs to be developed. Its purpose is to enable businesses to create ads and quest content in a user friendly, straightforward manner. Furthermore, this will ensure the content complies with the format and content policies devised by Tourisipate. Once the platform is in place, the sales force will start proposing the Tourisipate service to mid- and large-sized companies. Finally, another key activity is providing assistance with quest design. A specialized team of quest consultants will help businesses create customized quests.

13.2.7 Key partners

In order to be able to use Tourisipate, app users need to have free internet access at all times. Currently, only a few cities are covered with free internet access. This can be a serious problem for the Toursipate app as it displays location-based offers and provides real-time guidance for quests. For this reason, partnerships with telecommunication companies that provide free 3G or 4G internet connection should be formed. Once cities become fully covered with free internet, these partnerships might not be needed anymore.

Another group of key partners are the official tourism info points in cities. Their collaboration is needed, especially for the propagation of the mobile application among tourists. The cooperation can include the possibility to place leaflets and posters at their offices or the active promotion of the app to tourists. They can also help managing the city-related content of the application. In return for this help, information about tourists, their location and popular places can be shared with them.

13.2.8 Revenues

Tourisipate generates revenues by displaying personalized ads and offering complementary services. These are paid for by companies which want their ads to be displayed. As described in section 13.2 the Tourisipate application consists of three consecutive layers of features. The revenue streams are illustrated in figures 13.1 and 13.2.

City-related information only, does not generate any revenue, since app users can use this application feature for free. In the special offers and ads layer, a three-level pricing model is applied. The first level consists of the basic display charge. Ad providers are charged it for every ad they show in the Tourisipate app. This ensures a basic income which does not depend on the actual acceptance of the ad by the users.

Every time an app user clicks on an ad which has popped up on his mobile phone screen, the advertisement provider is charged a fee. This accounts for most of the variable revenues.

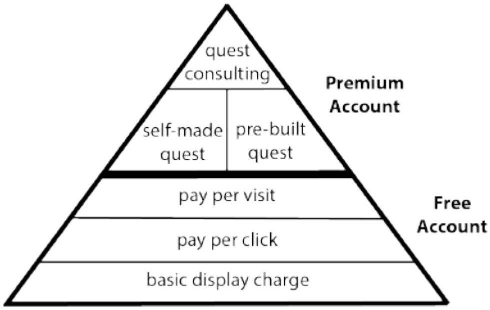

Figure 13.2: Revenue streams of Tourisipate

The fact that geolocation is recorded all the time enables to verify if a user who clicks on an ad actually visits the respective store. Provided that he does, an additional pay-per-visit fee is charged. Moreover, mobile payment is spreading [433]. Thus, it is worth considering to charge an additional commission on purchases once respective data can be retrieved from payment apps.

Regarding the quests, advertisement providers are able to choose from several additional complementary services: A premium account providing design tools, pre-designed quest templates or even a quest consultant. With a premium account based on a monthly subscription fee the customer can use these online tools to design quests for the tourists. To support the process of designing the quests, pre-designed templates can be purchased on the web platform. As users get emotionally involved in the quest, the probability of buying an ad provider's product or service increases.

If the tools provided through the online platform are not sufficient to meet the demand of ad providers, they can order a professional consultant. They are dedicated to assist the ad provider during the quest design process and to act as a mediator between the customer and the technical department at Tourisipate. Big companies are the most promising customers of this additional service as they need to reach a high number of people and are most likely to pay for assistance.

Overall, the business model of Tourisipate is based on several revenue streams. The basic charge for the display of advertisements and the premium subscription are the most promising sources of income.

13.2.9 Costs

Tourisipate is a purely internet-based service and highly relies on the mobile application and the technology behind it. The mobile application as a core component has to be maintained. Due to the rapid development progress in mobile operating systems, updates have to be released continuously and reported technical issues have to be handled immediately. To do so, Tourisipate relies on software developers, server administrators and technical service personnel. These account for a considerable share of Tourisipate's costs.

All the technology mentioned above has to be maintained to keep Tourisipate running. The electricity bill and constant investments in up-to-date hardware and hosting are also considerable parts of the costs.

Even an internet-based business like Tourisipate needs a sales force to acquire large customers. Their task is to contact big companies and chains to gain them as service customers. Their salaries, together with the salaries of employees of the IT department, are an important cost factor.

One of the incentives to use the Tourisipate mobile application is the provision of free internet access at the destination, at least at the beginning. To provide this service Tourisipate signs contracts with mobile network providers.

13.3 Scenario robustness check

In this section, the robustness of the Tourisipate business model will be assessed for the four scenarios developed within this Trend Report.

13.3.1 Data as an individually controlled public good

This scenario is characterized by a high level of privacy and the existence of only one monopolistic data supplier. In such an environment, app users are free to choose what data they are willing to share with Tourisipate. If they decide to share none or only a minimal amount of data, the business model might face serious problems. In such a case, the app would no longer be able to provide tailored offers and the added value for ad providers might be drastically reduced. To overcome this difficulty, missing data on app users could be bought on the data marketplace, if available. However, this would cause additional costs.

The existence of only one data supplier means that the price of city-related information pulled from the data marketplace can be relatively high. It can lead to the necessity for Tourisipate to create this content. Moreover, if Tourisipate decides to sell the app users' personal data to a third party, it will be able to sell it only to the data supplier. Thanks to its monopolistic status, it can offer an unreasonably low price for it.

Altogether, the success of Tourisipate in this scenario depends on the willingness of people to share their personal information and on the prices of data on the data marketplace. The possibility to earn money by selling the collected data is also relatively limited. For all these reasons, this scenario is highly unfavorable for Tourisipate.

13.3.2 The big brother

The Big Brother scenario paints the picture of a world where privacy boundaries have slowly eroded. In the year 2030, there is one monopolistic data supplier that holds all information. Even though the collection of data can be decentralized, the fact that there is only one player who buys the data leads to low prices paid by the monopolistic player, e.g. to Tourisipate. Nevertheless, the price at which data is sold is quite high, unless regulated by the state. Another relevant aspect is the high level of standardization: because one player controls all information, data formats are standardized across all platforms. This is advantageous for the developers of data consuming applications as they do not need to support multiple data formats.

In the case of Tourisipate, part of the necessary application data is implicitly created by its users. The user profiles, mobility patterns and spending patterns can be retrieved from the usage of the software. Furthermore, since each of the businesses that collaborate with Tourisipate see a benefit using it, their information does not need to be purchased. Data that needs to be bought from the monopolistic data supplier is cartographic data and tourist information about the cities in which Tourisipate operates. Even though this cost can be high, given the static nature of this information, it is a one–time investment. Without the obstacle of privacy laws, the increasing employment of sensors can enable more and more types of data to be added to the user profiles. The management team of Tourisipate has to decide if further personalization of the application is worth buying expensive user data from the data supplier.

All in all, the Big Brother scenario presents a relatively good environment for Tourisipate. On the one hand, the initial investment in city maps and tourist information can prove to be a high market entry barrier. But the fact that the mobile application has no restrictions in implicitly collecting the necessary user information is very advantageous. Rich user profiles are the source of experience personalization which is in turn essential for the success of Tourisipate.

13.3.3 The smaller brothers

The smaller brothers scenario describes a world in which individuals have no control over their private data and each individual can sell data. The consequences are twofold. First, data has become a widely available resource that is used for all kinds of purposes. Second, the availability of data makes the competition within the sector fierce, which in turn keeps data prices low. A problem that comes with multiple data suppliers is the issue of data standardization. The various formats require data analysts that dedicate their time to making the different formats compatible with each other.

The effects on Tourisipate of this scenario are as follows: First, personal data from users can be freely used once given to Tourisipate. This data will probably not cost anything as the users provide it for using the Tourisipate services. Tourisipate could further capitalize on personal data by selling it to third parties.

The smaller brother scenario is probably the best environment for Tourisipate because of no acquisition costs for personal data and no privacy restrictions to use the data. It is expected that Tourisipate users will want to give their data in exchange for customized special offers and quest services.

13.3.4 The data stock exchange

In this scenario, every person has total control over their own data and the number of data suppliers is virtually infinite. The core features of Tourisipate rely on the availablity of one's own and other's location data and the personal user profiles. Since every single data package collected by Tourisipate requires explicit permission, it depends on the users' willingness to share their data in order to fully benefit from the value propositions. Provided that users recognize and appreciate the offered value proposition, they are more likely to grant the necessary permissions.

Tourisipate does not rely on the sale of data, which means that the business does not depend on the market price for data. Furthermore, as Tourisipate only uses the data directly collected from the user, users do not have to be convinced of granting sale permissions. However, Tourisipate uses external data to enrich the application. Publicly and easily available data, such as store locations and maps, will most likely be very cheap if not for free, because the high number of data suppliers will keep the price low. For personal data the exact opposite might be the case. The possibility to exactly set access permissions will lead to a scarceness of personal data and hence will keep the prices high. Consequently, the amount of available content depends on data prices and the financial means of Tourisipate.

On top of that, the high number of data suppliers and the shattered distribution of data will probably make aggregation and purchase of data more complicated. Information may even remain incomplete.

Whether Tourisipate works in this scenario is questionable. The core challenge to be faced is to convince potential users that Tourisipate creates some additional value for them. Only then they are likely to grant Tourisipate access to their personal data.

13.4 Conclusion

By the year 2030, tourism will have grown much farther, holding great potential. It is expected that tourists will continue to use mobile services to improve the quality and convenience of their tourism experience.

The general business idea behind personalized content is the increase in sales thanks to a better matching of products and services to personal information such as interests and preferences. Tourists are generally very willing to spend money and actively search for offers. By displaying special offers that are within the vicinity of the tourists and personalized to their interests, Tourisipate is in a great position.

The development of quests adds a social and a gamified component to the tourism experience. By completing quests and thus promoting the business, tourists are able to earn special offers and TourisiPoints. Furthermore, given the nature of the Tourisipate app, the boundary between the online and the offline world is blurred.

All in all, Tourisipate takes a personalized and socially gamified approach into the tourism industry. It enhances the tourist experience of city explorers. Thanks to its unique approach, Tourisipate is robust in most of the scenarios.

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