Fraunhofer ISST

ISST REPORT

DIGITAL LIFE JOURNEY

FRAMEWORK FOR A SELF-DETERMINED LIFE OF CITIZENS IN AN INCREASINGLY DIGITIZED WORLD (BASIC RESEARCH PAPER)

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As the digitization of everyday life continues, we are perceiving many digital achievements as assisting us in our living and working environments. Most of these new digital services are based on data, or in more concrete terms, our personal data. Making a list of who processes which of our data for what purposes appears virtually impossible. Yet the question is: Would it be possible to describe the individual citizen in their entirety by combining all their data – the "digital me" so to speak? This report examines the basis for a self-determined life of every citizen. It represents a digital life journey showing how the individual can regain sovereignty over their data, and how society, technology, ethics, law, and economics have to work together.

ISST REPORT SERIES

White papers of the Fraunhofer Institute for Software and Systems Engineering ISST appear in the "ISST Report" series. This series of publications illuminates computer science trends and technologies, and examines innovative topics from the institute's research projects. Thus it offers insights into the current state of research on Data Ecosystems, which the institute significantly helps to shape.

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DAVID AND DAWID

ONE LIFE – TWO IDENTITIES?

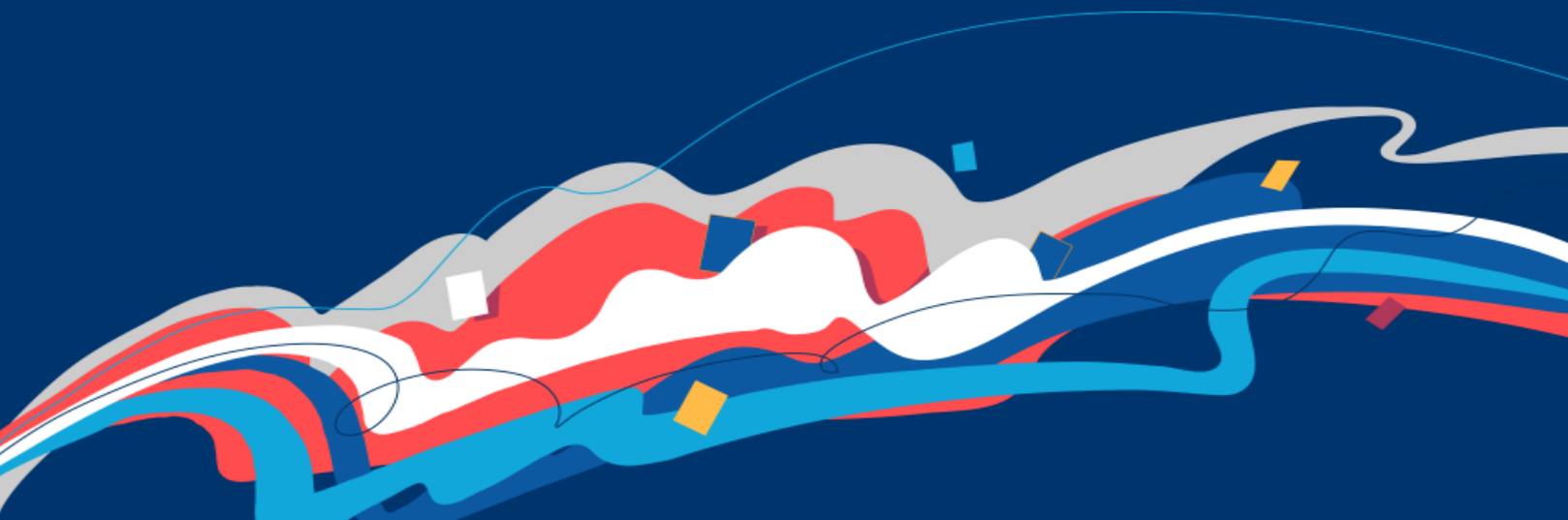
David *is in his 30s, a child of the 90s. His first experiences with the world wide web came through schoolmates. They were talking about the "SchülerVZ", a social network for students. Of course, David wanted to be part of this virtual network. From a technical perspective, access via the modem and establishing the dial-up connection took a few minutes. But then the first steps were quickly completed: He set up an account and created a profile. Shared music preferences and hobbies helped establish contact with people outside his own school as well. In the years that followed, things changed at a tearing pace: The slow modem was replaced by the much faster DSL. SchülerVZ was replaced by StudiVZ, and the age of large Internet corporations began. Google, Facebook, Twitter, and co. offered new possibilities for social participation in digital life. David's interest in these technologies continued and he chose to study computer sciences. The student digs – his first own home – were dutifully equipped with all the available technology. From remote-controlled lighting systems to intelligent heating control, everything was networked and could be controlled with the help of voice assistants. The first steps towards a smart home were taken. It is also handy that David's energy supplier records and delivers personalized digital meter readings. So David always has an immediate overview and can link this information to his smart home system. Meanwhile David does the bulk of his shopping on the Internet, especially with Amazon. Personalized suggestions help him always keep up to date. He rarely goes into a store, but is pleased that cash, cards, and co. have become a thing of the past. Meanwhile he can often use contactless payment with his smartphone. David usually takes his car when he does go shopping. Since he does not drive a great deal, the telematics rate offered by his car insurance company was particularly interesting for him. A telematics box records David's driving behavior and sends it to the insurance company, which uses this to calculate an individual discount. Meanwhile his health insurer also offers an app for earning a bonus by recording data about preventive measures. David notices that this thing with data seems to pay off. He starts to take notes on everything he is signed up for and what data he has stored there. With the knowledge gained through his studies of computer sciences, David builds a chatbot system that converges all his data with the help of artificial intelligence. But one morning, something unusual happens. Without David's help, the chatbot greets him with the words:*

»Hey David, it's me – ***Dawid*** *– your personal digital twin. You did not have a good night's sleep, but I went ahead and turned on the coffee machine.«*

1

INTRODUCTION

THE DIGITAL ME AND ITS DIGITAL LIFE JOURNEY IN THE DATA ECOSYSTEM



Some part of David's story reflects the life of nearly every one of us. According to the Federal Statistical Office, 87% of the population uses the Internet, 59% interacts online with their bank, and 56% are active in social networks (Federal Statistical Office, 2019). Surveys show, that 16% of Germans use smart home solutions, in particular the group of 35 to 44-year-olds. (Wagner, Gentner, Müller, Schlaak, Esser, Nugel, Busching, 2018). According to Bitkom, voice assistants are already being used by 13% of the population (Gentemann, Böhm, Esser, 2018) – more recent surveys by the Postbank in fact calculate 32% for 2019 (Postbank, 2019). Telematics rates are already being offered by eleven insurers, and about 4% of all drivers would be willing to switch to such a rate (kfz-betrieb.de, 2018). Currently they are being used by only about 1% of policyholders (Düsterhöft, Brandmayer, 2019).

As the digitization of everyday life continues, we are perceiving many digital achievements as assisting us in our living and working environments. Most of these new digital services are based on data, or in more concrete terms, our personal data. Making a list of who processes which of our data for what purposes appears virtually impossible. Yet the question is: Would it be possible to describe the individual citizen in their entirety individual citizen in their entirety by combining all their data – the »digital me« so to speak?

Clarke (1994) with the term »digital persona« already described the emergence of digital representations by converging data and data transactions available in the network. Here one has to differentiate between »informal digital personae«, meaning the person perceived by an external observer, and »formal digital personae«, meaning the person described by data in actuality (Clarke, 1994). 20 years later Clarke (2014) however stated that the concept has not produced a broad solution and application space to date. Aside from technology solutions, the social-political discourse is also lacking (Kerckhove, Almeida, 2013).

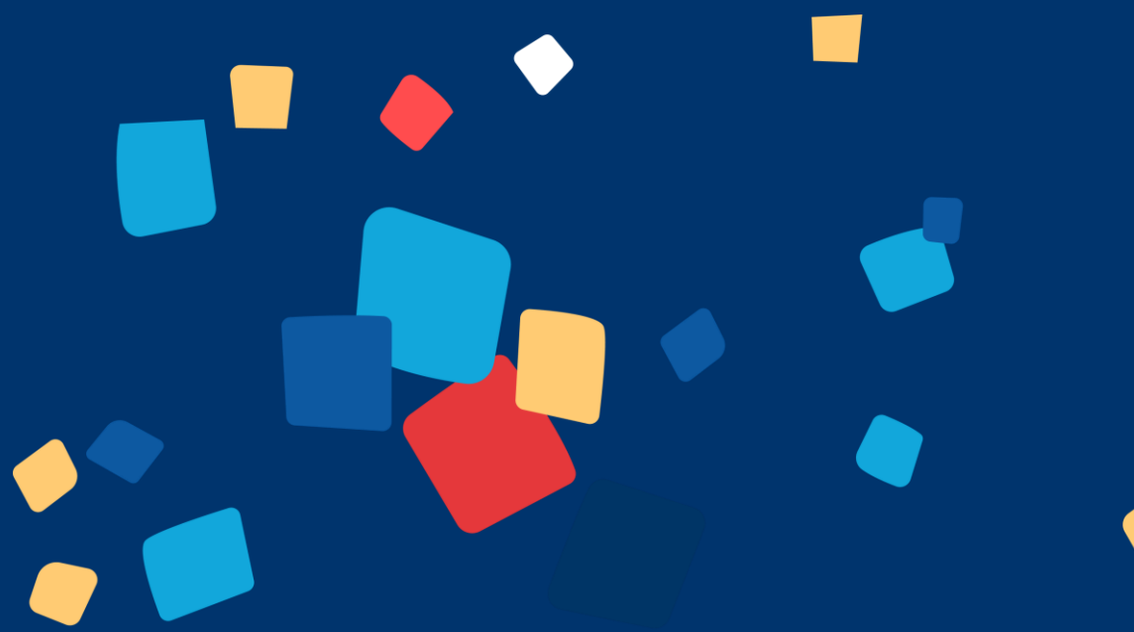
It becomes clear that the »digital me« in its »digital life journey« – from birth to death – is more than merely making a technology available. With the question »Who are virtual humans?«, Beard (Beard, 2001) points out the need to answer social, ethical, and legal questions. What if we were to transfer our entire life into a sort of digital memory, the way Bell and Gemmell (Bell, Gemmell, 2007) did over several decades based on the LifeBits project?

The objective of this position paper is to examine the »digital me« in its entirety on the »digital life journey«, to identity possible technology solutions, but also to describe what social, ethical, and economic effects can be expected due to the emergence of what are known as digital and data ecosystems (Otto, Cirullies, Holtkamp, Howar, Jürjens, Lis, Meister, Möller, 2019) .

2

BASIS

EXISTING CONCEPTS FOR A SELF-DETERMINED LIFE IN DIGITAL ECOSYSTEMS



The digital me and the digital life journey require a perspective that goes beyond mere technology solution variants. The Value of a Statistical Life (VSL) is an economic term that was quantified by Spengler (2004) at EUR 1.65 million. Klare (2010) however demonstrates that the understanding of value has to be broadened, as shown by the example of sentimental value (value based on the feelings of the owner or producer).

Thus, there are also social-ethical dimensions in regards to the digital me, and even the economic value is currently not quantifiable. The relevance of this issue and approach is revealed by the WIPO patent application from 2013 for intellectual property entitled "Systems and methods enabling consumers to control and monetize their personal data" (Puértolas-Montañés, 2015).

Summarizing just the works cited by Symons and Bass (2017) as well as Jentzsch (2017) in the area of the personal data economy results in a list of nearly 100 current projects and products worldwide. Fundamental concepts essential for the realization of a digital me from the perspective of the Fraunhofer Institute for Software and Systems Engineering ISST are described in the following.

2.1 PERSONAL DATA & PERSONAL INFORMATION

The digital life journey examines the data spaces emerging around the citizen, spaces that consist to a large extent of personal data. The term »personal information« is commonly used with the same meaning.

In the GDPR (Article 4(1), the European Commission defines this as follows: "Personal data is any information that relates to an identified or identifiable living individual. Different pieces of information, which collected together can lead to the identification of a particular person, also constitute personal data." (European Commission, 2019)

The World Economic Forum defines »personal data« as data and metadata, produced by persons and about persons, divided into »volunteered data« (data explicitly shared by a person), »observed data« (for example data about a person recorded by sensors), and »inferred data« (data about a person derived from the two other categories) (World Economic Forum, 2011).

In part due to the English term »personal data«, there is no differentiation from personal data. But when one considers the term »personal item«, it becomes apparent that »personal« designates something to which we fundamentally assign an (emotional) value, but that does not necessarily reveal anything about us as a person.

The term »personal data« will generally be used in this paper. In the course of the ethical examination and regulatory discussion however (digital heritage for example), the term »personal data« will be deliberately used as well for differentiation to express a sentimental value.

2.2 PERSONAL DATA STORAGE

The challenges associated with handling personal data have been incorporated in research for a long time already. An aspect of this is the storage of personal data and what is known as personal data storage (PDS). Montjoye et al. (2014) provide a good overview of PDS history and simultaneously present their approach of a metadata-based, open PDS system. Aside from this highly centralized view of handling personal data, there is on the other hand research focusing on federate architecture

approaches. Here the goal is to realize privacy, authentication, and authorization as well as data usage control beyond service provider limits.

The »digital.me« project subsidized by the EU was launched back in 2011, in particular to enable control of the digital self within social networks (Social Semantic Desktop) (Scerri, Gimenez, Herman, Bourimi, Thiel, 2011). »Di.Me« was intended to become a sort of »Single Point for Social Network«, but was unable to accomplish this, in part due to the market position of centrally operating platforms.

Sjöberg et al. (2017) with »Digital Me« present another system, which uses personal data storage to give the individual control over their own digital footprint. The EU-subsidized »DECODE« project (DEecentralised Citizen Owned Data Ecosystems) launched in 2017 can also be cited here: Going beyond storage, it intends to take the distribution structures into account as well (Symons, Bass, 2017).

Another interesting approach is the »MyData« concept originating from Finland, which exhibits analogies to the »International Data Space« in its basic structures (Poikola, Kuikkaniemi, Honko, 2015). »MyData« pursues three principles: 1. Each individual has sovereign control over their data at all times. 2. Data are machine readable and interoperable. 3. Data can be transferred between service providers via a decentralized infrastructure. »MyData« therefore implements the basic right of the individual to the self-determined control of their data with the help of a technical data management tool. Here the focus is less on the question of ownership and more on the possibility of control. Hakkila et al. (2016) illustrate what scenarios based on »MyData« could look like in healthcare.

In this paper, the term PDS is used to represents all subcategories such as personal data banks, personal data vaults, and personal information management systems.

2.3 DIGITAL TWIN

The concept of the digital twin emerged primarily from the industrial, industry 4.0 context. Deuter und Pethig (2019) provide an overview of concept formation and the interplay with the Reference Architecture Model Industry 4.0 (RAMI 4.0) according to IEC 62890. The hypothesis of the digital twin theory describes eight characteristics, showing that the digital twin can assume context-specific states and interact with an actor (Deuter, Pethig, 2019).

One must question to what extent this technical definition scope satisfies the biological concept of a twin, which does not constitute lifeless matter and has characteristics as well as abilities and skills. It also develops independently and is able to make decisions autonomously.

Bruynseels et al. (2018) pick up the digital twin concept from the perspective of healthcare and personalized medicine. Here it becomes clear that a digital twin cannot only encompass data but also behavior, for example through kinetic models.

2.4 DATA FLOW AND DATA USAGE CONTROL

Data can be used by the entity that collected them in accordance with the applicable laws and stored the data in their area of disposition. Full control over data flows appears factually impossible but

can be facilitated by ecosystems and data marketplaces. The »myneData« project intended to create such an ecosystem, identify privacy risks, and enable micropayment (Matzutt, Müllmann, Zeissig, Horst, Kasugai, Lidynia, Wieninger, Ziegeldorf, Gudergan, gen. Döhmann, Wehrle, Ziefle, 2017). But an ecosystem can only function with sufficient participation, as was more successfully demonstrated by the »Digit.me« industry example (see industrial approaches).

Wanting to control data flows, and therefore data usage as well, also means actively identifying for what purposes data are to be used and not used. Consent is a procedure familiar to us from the paper-based world, for example in the course of hospital care or the conclusion of a contract involving a request for information from the General Credit Protection Agency. It can be assumed that the volume of data usage requests will increase considerably in a data ecosystem. Ploug (2016) therefore proposes the concept of meta-consent using healthcare data as an example. Data are assigned to classes for this purpose, and the user can define for every class whether they want to be informed of data usage requests or whether a set of standard rules will apply.

Awareness is an elementary asset within the scope of consent to data usage (informed consent). Enabling control by the citizen does however also transfer responsibility to the citizen, and there is a need to critically question the extent to which the consequences are sufficiently understood.

2.5 SOVEREIGNTY

Sovereignty concepts were already defined back in the 1940s with consumer sovereignty (Hutt, 1940). Further developments address the empirical-descriptive (»How sovereign are consumers?«) and the prescriptive-normative levels (»How sovereign should consumers be?«) (Schwarzkopf, 2011). The consumer policy discourse and work of Mertz et al. (2016) results in four leading aspects: freedom of choice, self-determination, self-monitoring, and security.

Digital sovereignty intends to ensure the empowerment and freedom of decision of the citizen in a digital world. From the perspective of the Advisory Council for Consumer Affairs (SVRV), this requires technology, digital skills, and regulation. (Reisch, Büchel, Gigerenzer, Zander-Hayat, Joost, Micklitz, Oehler, Schlegel-Matthies, Wagner, 2017)

At times the »privacy paradox«, with a high level of security being demanded in one instance while data is made freely accessible in another, clearly shows that skill building in particular is needed in this regard (Engels, Grunewald, 2017).

2.6 ETHICS

The term data ethics describes fundamental issues of moral-social approaches in regards to data, algorithms, and courses of action associated with these (Floridi, Taddeo, 2016). Nevertheless, due to the focus on data, challenges in society as a whole are masked, as stated by Floridi (2018): Digital governance, digital ethics, and digital regulations are needed for an »onlife« – meaning the digital as well as the analog information sphere.

It seems evident that corporate social responsibility (CSR) requires digital responsibility, especially in the course of digitization.

This needs to support the existing CSR pillars but also has to examine new issues such as the loss of privacy (Thorun, Kettner, Merck, 2018).

The Advisory Council for Consumer Affairs (SVRV) examined the value of personal data from an ethical perspective and questioned whether trading data may be the better form of data protection (Palmetshofer, Semsrott, Alberts, 2017): Consumer centeredness has to be strengthened, transparency established, interoperability ensured, data storage must be centralized, and data contributions have to be enabled.

2.7 LAW – DATA OWNERSHIP AND POSSESSION

The currently lacking transferability of the terms »ownership« and »possession« to data and therefore the digital me constitutes a legal challenge. The legal protection of data can be evaluated based on various fields of law: physical property, intellectual property, data protection law, competition law protection, and criminal law protection.

A study conducted on behalf of the European Commission in 2016, and thus predating the General Data Protection Regulation (GDPR), states: »data ownership is not explicitly dealt with by any of the legal instruments at EU and national level« (Osborne Clarke LLP, 2016).

2.8 BUSINESS & ECONOMICS

To assign a value to data, it must be possible to determine a comparable and reproducible value according to accepted rules. Moody und Walsh (1999) address the challenges associated with determining the value of information and formulate seven principles. Analyses commissioned by the Advisory Council for Consumer Affairs (SVRV) show, based on various valuation approaches, that the dataset of a citizen can generate proceeds of up to EUR 440 per year (Palmetshofer, Semsrott, Alberts, 2017).

Aside from valuation, data trading and the relationship between the willingness to accept (WTA) and willingness to pay (WTP) are also relevant components (Acquisti, John, Loewenstein, 2013): Rather than investing an amount X in privacy, the citizen is more willing to give it up for that. The willingness to sell (WTS) was calculated at EUR 15 for contact data and EUR 19 for Facebook data (Benndorf, Normann, 2018). Not least, soft factors such as trust also play a crucial role for the willingness to share (WTS) (Schudy, Utikal, 2017).

2.9 INDUSTRIAL APPROACHES

New products and services have emerged in the industrial sector in recent years as well, especially after the GDPR came into force. Methods to prove the identity of a person beyond doubt as well as products for implementing personal data storage clearly take center stage here. Table 1 below lists examples of companies.

Table 1 List of industrial enterprises with technologies for sub-components of a digital life journey

Company	Description	URL
MyData Control Technologies (Germany)	Based on the IN2DUCE framework of Fraunhofer IESE, MYDATA offers a possible solution by masking and filtering data flows on the basis of defined data usage rules.	www.mydata-control.de
it's my data GmbH (Germany)	Enables citizens to enforce the GDPR. Data from various areas of life can be stored in the personal data store. Currently 120 companies can be queried, but generally are not yet technically connected.	www.itsmydata.de
Orbiter GmbH (Germany)	With idento.one, Orbiter implements a personal data bank similar to it's my data. Enforcing the rights of citizens under the GDPR is the objective.	www.orbiter.de www.idento.one
Verimi GmbH (Germany)	Enforcing absolutely certain identification and authorization in regards to companies and public authorities.	www.verimi.de
Hub of all Things (UK)	HAT operates in the sense of personal data storage and enables the secure administration of own data. External sources are connected with the help of data plugs.	www.hubofallthings.com
Meeco (UK)	Meeco is the "API of me" to realize the requirements of the GDPR and PSD2. It permits the collection, storage, and verification of data.	www.meeco.me
Jolocom (Germany)	Offers an API for implementing a decentrally organized identity. The Ethereum blockchain is used as the trust layer. A distinct, trustworthy identity can be assigned to anything using the open source protocol.	www.jolocom.io
Digi.me (UK, USA)	Digi.me administers personal data in the sense of personal data storage. Data producers and data consumers can connect with Digi.me and each other through an API to exchange data. The exchange of data takes place based on consent and is traceable.	www.digi.me

2.10 SUMMARY AND SCIENTIFIC CONNECTION

The current state of research offers partial results from many different scientific disciplines, but these do not yet complement and complete each other to date. A purely technological discussion does not appear productive, since the purely technological solution variants merely supply partial answers:

- Currently the examination of the digital me does not encompass any social, ethical, business, or also economic dimensions. Data ethics or also corporate social responsibility matters are therefore not taken into account.
- Personal data storage, such as the solution from it's my data, is a singular solution for the aggregation of all data and to enforce the rights under the GDPR. Whether a private enterprise company with no public/social mandate and no legal basis including obligations should possess such data needs to be critically examined.
- Enforcing rules, for example regarding data usage, only succeeds in closed, controllable environments and presumes the cooperation of companies.
- Preventing the secondary use of data is not technically possible at this time. Data as intangible goods can be easily duplicated.

For this reason, the remainder of this report will examine the dimensions of a framework that is required for an integrated view of a self-determined life for citizens in an increasingly digitized world.

3

DIGITAL LIFE JOURNEY

FRAMEWORK FOR A SELF-DETERMINED LIFE IN AN INCREASINGLY DIGITIZED WORLD

Figure 1 Ensuring data sovereignty throughout the life cycle.

The scientific discussion in section 2 clearly illustrates that an examination of the digital me and its digital life journey requires multiple perspectives. Science has created solutions to address some issues for the secure handling of personal data. From the perspective of Fraunhofer ISST, an integrated approach is lacking for the creation of an environment that permits the sovereign movement of the digital me in a future data ecosystem.

The goal of Fraunhofer ISST's digital life journey is to define a framework that describes the journey of a digital me throughout its life with all its characteristics in the digital ecosystem. »Life« is a systemic term, made up of units that interact with each other in order to support and/or maintain each other (Sadava, Hillis, Heller, 2019). From a biological perspective »lif« is closely linked to the definition of an animate being. Typical characteristics of an animate being are (Plaxco, Groß, 2012, Sadava, Hillis, Heller, 2019): 1. individuality and form, 2. metabolism, 3. movement and response to stimuli, 4. growth and development, 5. reproduction and heredity, 6. evolution.

It appears evident that the status quo of our digital life today with its heterogeneous data distribution must be factually perceived as lifeless matter. But what behavior can be expected when data are increasingly converged into a larger whole? To what extent can symbiotic or also parasitic developments between people and the digital me emerge?

The digital life journey outlines the path for a sovereign handling of own data from our birth to our death (see Figure 1). Beyond the actual physical birth, data assigned to us prior to that also have to be taken into account. Here the increasing prevalence of genetic screening is an example. Defined approaches are also required for the handling of data when we cannot make those decisions, temporarily or also permanently, due to cognitive and/or motor impairments (such as coma) or after death. Here the focus is on the digital legacy or digital inheritance, what we receive and what we pass on.

3.1 THE THREE EVOLUTIONARY STAGES OF THE DIGITAL LIFE JOURNEY

From digital shadow to digital twin – the digital life journey describes three evolutionary stages in the digitization of an individual citizen.

3.1.1 DIGITAL SHADOW

The individual finds themselves in a technological world. Smartphones, wearables, and co. are part of this transformation of analog data into their digital form of representation. Everything around us is a sensor and captures data that describe us. These are stored in provider-specific data silos that can be interacted with, for example using provider-specific apps. Thus, we can access, visualize, or change the data of a service provider.

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	DIGITAL SHADOW	DIGITAL ME	PERSONAL DIGITAL TWIN
1. Individuality and form	Diffuse topology with possibly low or difficult to trace homology to the data owner.	No individuality with simultaneously high homology to the data owner.	High individuality possible with simultaneously high homology to the data owner.
2. Metabolism	Uncontrolled supply of data.	Supply of data in terms of type and scope controlled by the citizen.	Supply of data in terms of type and scope by the citizen or rules and algorithms.
3. Movement and response to stimuli	Intransparent movement of data.	Traceable movement triggered by the citizen.	Traceable, autonomous movement possible.
4. Growth and development	Diffuse growth, dispersion, and development without control by the citizen.	Determined and controlled by the citizen.	Independent growth and development in coordination with the citizen possible.
5. Reproduction and heredity	Dissemination of data without traceability and control.	Controlled and traceable dissemination of data.	Capacity for traceable and autonomous dissemination of data.
6. Evolution	Further development requires the formation of an ecosystem.	Active raising to the next evolutionary level by the citizen.	Further development of the digital twin in coordination with the citizen is possible.

Table 2 Transferability of the characteristics of animate beings to the concepts of the digital shadow, digital me, and digital twin.

For example, activity data are recorded by a fitness tracker and other data such as sleep behavior are calculated from that in the background. The smart home system also records activity data that allow conclusions to be drawn about our circadian rhythm. But what possibilities for control does the citizen have?

Unfortunately, *one cannot yet speak of an ecosystem here* since the decision whether and to what extent we gain access to our data is made solely by the respective provider. Thus, a provider's data are part of a shadow of ourselves, which only becomes visible subject to the conditions of the respective provider. Making the entirety of our shadow visible would require all providers to work together. This is also an essential requirement from the perspective of an ecosystem, which is not yet given today in the age of the platform economy. Thus, the digital shadow is not necessarily also a digital footprint, which is defined by traceability and confirmability.

Table 2 clearly illustrates the diffuse, virtually tumorous growth of the digital shadow. The type and extent of the shadow are frequently not known and therefore indeterminable. At no point does the citizen have influence over their digital shadow.

The objective: The digital life journey establishes a framework for the evolution of the digital shadow to the digital me, thereby strengthening the data sovereignty of the individual citizen.

3.1.2 DIGITAL ME

The digital me creates, for the first time, an integrated image of the data that are available for a citizen. An essential prerequisite is the existence of an ecosystem that *transcends service provider limits.* Everything captured by sensors in the digital life of a citizen becomes transparent and controllable.

For example, we receive an inquiry when another service provider wants to use our mobility data. It describes the type and scope of use. This results in the characteristics of the digital me described in Table 2, assuring the citizen of a higher level of control in contrast to the digital shadow. The citizen determines what data are included in the digital me and by whom they may be used. There is no function here for automating behaviors in the system.

The objective: The digital life journey establishes user-centered technology to enforce the methods of the digital shadow.

It creates the framework for enforcing self-monitoring, self-determination, security, and freedom of choice with the help of methods.

3.1.3 PERSONAL DIGITAL TWIN

The personal digital twin as the evolutionary further development of the digital me needs to be more than a mere representation of data in a (dynamic) information model. In addition to section 3.1.2, the digital twin must be enabled to *interact autonomously with an ecosystem*. Thus it has the ability to learn and practice skills.

For example, the personal digital twin automatically responds to data usage inquiries from service providers. Recording new data that defines the personal digital twin can also be supported with the help of automation.

Such a dynamic system will have to be based on artificial intelligence methods in order to gather facts with the help of machine learning, derive skills from them, and identify situations relevant for decision making with the help of data mining, complex event processing, and similar technologies.

That is why Table 2 goes considerably beyond control by the citizen. The personal digital twin has a significantly higher degree of autonomy, it is more than a data-based copy. Nevertheless, it is part of its »genetics« to act in the interest of its twin in the real world – the citizen.

The objective: The digital life journey forces interaction with overall issues of a digital society (including digital rights and the like), and facilitates a controversial discourse about the virtual person.

3.2 THE DIGITAL LIFE JOURNEY FRAMEWORK

The digital life journey framework describes the technical and non-technical levels required for the realization of a digitally assisted society from the perspective of citizens and companies. Here the focus is on the sovereign control of data usage by the citizen. Likewise, companies are to be given the opportunity to realize data-driven value creation. Only then can an integrated digital ecosystem emerge.

3.2.1 PERSONAL DATA STORAGE

Personal data storage is primarily a technical solution variant for the realization of a digital me. Relevant approaches have already been described in section 2.2. However, the integrated interplay of digital entities within the framework of a digital ecosystem is essential.

Such an ecosystem of producers and consumers as well as dynamics for the generation, transfer, and storage of data and information also encompasses social/normative requirements. These need to be considered in the rules and standards of personal data storage for the digital me.

What a solution variant of the digital me based on the International Data Space may look like is described in section 4.

3.2.2 DIGITAL RIGHTS & REGULATION

As already described in chapter 2, the data law question in respect to data as a non-tangible asset is currently not stringently regulated. From the perspective of the digital life journey however, clear regulation is required in the interest of both the citizen and companies.

»We are living 4.0« is how Funk (2017) starts off her book »Das Erbe im Netz«, illuminating the legal situation and digital inheritance in practice. The author states that there are no explicit legal provisions, and that a complex interplay of inheritance law, basic rights, and data protection must be taken into account.

Best practices, such as those offered by the Federation of German Consumer Organizations (Verbraucherzentrale Bundesverband e.V.), constitute initial approaches that help enforce rights based on the GDPR (Verbraucherzentrale Bundesverband, 2018). Assistance with how to handle the digital inheritance is offered as well (Verbraucherzentrale Bundesverband, 2019).

3.2.3 DIGITAL BUSINESS MODELS

Back in 2011, the World Economic Forum in its whitepaper »Personal Data: The Emergence of a New Asset Class« described the relevance of personal data for the economy. Personal data represent a post-industrial opportunity for a new economy. However, the risks and legal framework outweigh the expected economic effects. (World Economic Forum, 2011)

The relevance of the citizen's consent to the processing of own data was discussed in section 2.5. Jentzsch (2017) points out the resulting economic potential: The individual with their data becomes part of a business or also economic utilization potential.

The digital life journey sees the need for a structured approach to establishing business models in digital, data-based ecosystems, as identified for example by »Das Geschäftsmodell-Toolbook für digitale Ökosysteme« (Engelhardt, Petzolt, 2019). Digital platforms require a different understanding of the value of goods, services, or data. An individual player is weak – networking is one of the most important requirements.

To work out business models, the value of the underlying product or service needs to be established. In regards to data this is not just the monetary value (market value and inherent value) but also the potential social value or even the sentimental value. There is still a considerable deficit here in the existing approaches from the perspective of the digital life journey, also in the interplay with ethical implications.

3.2.4 DIGITAL LIFE LITERACY

Dealing with the entities of digital ecosystems requires new skills, such as the knowledge of what defines the secure handling of data, or also that data have inherent value.

Usually the term »digital literacy« is aimed at technical skills, but this is inadequate from the perspective of Buckingham (2015). Beyond using a computer or the right way to search for information, skills are also required to evaluate this and put it into a context. The genesis of the term refers to computer literacy as well as information literacy, thereby leading to a one-dimensional interpretation (Lankshear, Knobel, 2008).

From the perspective of the digital life journey, all aspects to link digital and real life are lacking along with an understanding of the implications of a digital lifestyle. Digital life literacy makes it clear that self-determination in dealing with continuously ongoing digitization can only be given if the individual is enabled to put the implications into an overall social context.

3.2.5 DIGITAL ETHICS

The handling of personal data is not only a legal but also an ethical issue. This is illustrated by the requirement to take common welfare into account, which results from the GDPR and was implemented in Section 22 of the Federal Data Protection Act (BDSG). The community must not be harmed by withholding data.

Section 2.6 already made it clear that the interplay of digital governance, digital ethics, and digital regulation is required. The digital life journey also sees this need and recommends structured approaches, such as those established by the British government in the area of data ethics with the Data Ethics Framework and the Data Ethics Workbook (Department for Digital, Culture Media & Sport, 2018).

We are in the midst of a transformation that requires us to question how our non-digital values and non-digital behaviors should continue to be brought to bear in a digital ecosystem.

3.2.6 CORPORATE DIGITAL RESPONSIBILITY

As described in section 2.6, digitization also changes the requirements for corporate social responsibility (CSR). It is apparent that digitization has not yet been incorporated into the compliance directives of many companies (Hildebrandt, Landhäußer, 2017).

Governance structures for society as a whole are based on the assumption that individual entities have sole control in their ecosystem and take rules of conduct accepted by both sides into account in doing so. New, digital ecosystems will prompt us to deliberate our European values of dignity, autonomy, freedom, solidarity, equality, democracy, justice, and trust in view of the new possibilities. (Burgess, Floridi, Pols, van den Hoven, 2018)

The digital life journey reveals the need to break down silo thinking, and to subordinate both those in control and those who are controlled to a shared, superordinate view of the world. This appears necessary when one examines the effects that are amplified by digitization, such as »nudging« for example. The goal of nudging is to selectively and predictably influence a person's behavior, but without restricting the freedom of the person being influenced through prohibitions or incentives (Sunstein, 2014, Weinmann, Schneider, vom Brocke, 2016).

This results in a need to reassign as well as expand responsibilities in order to enable a self-determined life for the digital me.

3.2.7 DIGITAL, DIGITAL BUSINESS AND DATA ECOSYSTEM

Sovereign control over one's own data presumes an ecosystem that brings the entities (citizens, companies, government organizations, and so on) of a digitizing society together. Such an ecosystem is also called a digital ecosystem, and was defined as follows by Hadzic et al. (2007) : »*A digital ecosystem is the dynamic and synergetic complex of digital communities consisting of interconnected, interrelated and interdependent digital species situated in a digital environment that interact as a functional unit and are linked together through actions, information and transaction flows.*«

Thus, a digital ecosystem is a technical view of a self-organizing, technical infrastructure with the goal of creating an environment and a network of digitally-oriented entities.

Complementary market mechanisms also have to be included here from the perspective of the digital life journey.

In reference to the term »business ecosystem« coined by Moore (1993), this means establishing what are known as digital business ecosystems in accordance with the efforts of the European Commission (Nachira, 2002). Producers, suppliers, buyers, and so on must be brought together under consideration of the socioeconomic environment as well as the regulatory framework – also in regards to digital products and digitally supported services.

The data ecosystems of the individual entities are part of a digital ecosystem. Fraunhofer ISST (Otto, Cirullies, Holtkamp, Howar, Jürjens, Lis, Meister, Möller, 2019) defines a data ecosystem as follows: »*If a business ecosystem requires contributions of data, i.e. data is a central business ecosystem resource, this ecosystem is called 'data ecosystem'*.«

The application of digital ecosystems, for example to healthcare, shows: Health information can be prepared, stored, used, managed, analyzed, and shared through a digital ecosystem. (Hadzic, Chang, 2010, Hadzic, Dillon, 2008)

Figure 2 Digital life journey framework

DIGITAL LIFE JOURNEY

A FRAMEWORK FOR SOVEREIGN DIGITAL LIFE

DIGITAL BUSINESS MODELS

DIGITAL SOVEREIGNTY

DIGITAL LITERACY

DIGITAL RIGHTS & REGULATION

DIGITAL ETHICS

DIGITAL GOVERNANCE

CORPORATE DIGITAL RESPONSIBILITY

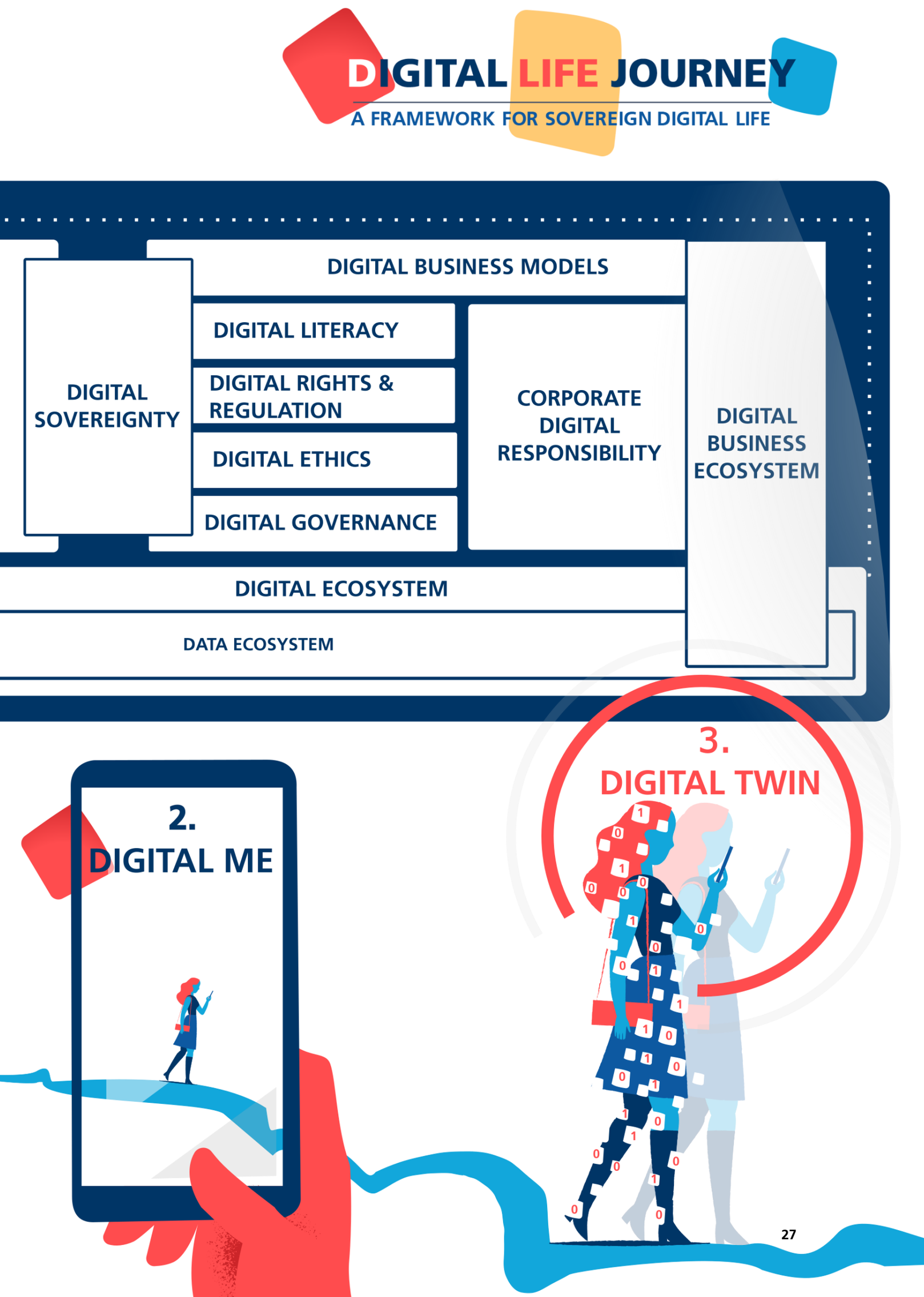
DIGITAL BUSINESS ECOSYSTEM

DIGITAL ECOSYSTEM

DATA ECOSYSTEM

2. DIGITAL ME

3. DIGITAL TWIN



4

DIGITAL ME

SOLUTION VARIANTS BASED ON THE INTERNATIONAL DATA SPACE

The digital life journey in the preceding section clearly shows that digital transformation does not mean solely the introduction of new technologies, but demands new methods and approaches to dealing with digitization in society.

Nudging as an example makes it clear how the individual citizen can be exploited through »participation effects« far removed from prohibitions – and accordingly within the limits of the law. The aggregation of data in particular bears the risk of confronting us with unwanted situations.

Avoiding such effects means making the individual sovereign in a digitizing society. As the DLJ framework shows, new skills have to be developed (digital literacy), but tools to control the citizen's digital me need to be provided as well. The Advisory Council for Consumer Affairs (SVRV) (Reisch, Büchel, Gigerenzer, Zander-Hayat, Joost, Micklitz, Oehler, Schlegel-Matthies, Wagner, 2017) already expressed the need for a dashboard to establish transparency for one's own data back in 2017. The GDPR and the PSP II (Payment Services Directive) promote transparency and access to one's own data.

Thus, it appears opportune to establish access variants for the digital me, utilizing legal innovation for one's own benefit and connecting to established infrastructures such as the International Data Space.

4.1 The "DIGITAL ME"

As described in section 3.1.2, the digital me is a representation of the individual in the form of data and is controlled by them.

Controlling means:

- Seeing: The individual sees what data about them are stored where.
- Storing and erasing: Data can be actively added or also erased by the user.
- Deciding: Data usage can be influenced by the user by actively involving them in the decision.
- Tracing: The use of data is traceable by the citizen.

Since the concepts will be based to a large extent on the International Data Space, it is briefly introduced in the following. A listing of key requirements from the perspective of the digital me follows.

4.1.1 THE INTERNATIONAL DATA SPACE

The International Data Space (IDS) is an initiative with the objective of creating a secure data space that enables the sovereign management of their data assets for companies of all sizes in various sectors. To perpetuate the activities, the initiative is institutionalized in the form of a registered association, the International Data Spaces Association, encompassing about 100 companies from various sectors.

The Reference Architecture Model, meanwhile available in version 3.0, describes the structure of a virtual data space (see Figure 3) and also governance models going beyond that (Otto, Steinbuß, Teuscher, Lohmann, 2019). While the data space is not tied to any sector, it currently operates primarily on a B2B basis without taking the citizen into account.

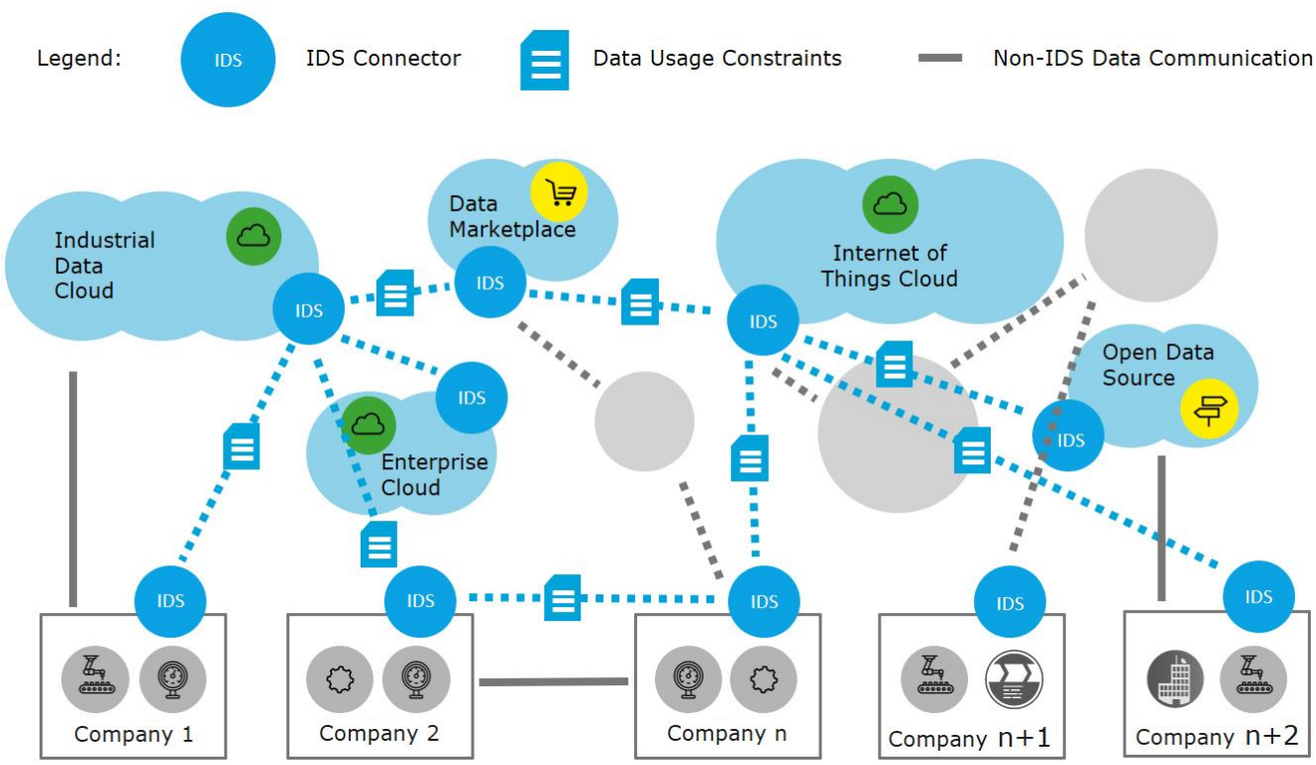


Figure 3 Cross-sector exchange of data via the IDS.

4.1.2 REQUIREMENTS OF THE DIGITAL ME

Numerous approaches and standards such as DIN 66272 assist with the identification of relevant classes of requirements. Creating a digital me for a digital ecosystem should take the following requirements into account as a minimum (supported by (World Economic Forum, 2011)):

- Reliability: The digital me deals with personal data in particular. Reliability is a key characteristic to establish trust.
- Security: Trust also means being able to rely on a high level of security. Here security refers to both technical and organizational security.
- Interoperability: The existing silos owned by the respective service providers have to be broken down. Only then can a platform economy emerge and sovereign control by the citizen be enabled. This also presumes technical interoperability of the systems.
- Transparency and traceability: Currently there is a lack of transparency regarding who uses which data for what purpose. The digital me has to establish this transparency and support the traceability of data usage within data-driven value chains.
- Simplicity and user friendliness: The system has to integrate seamlessly with the digital shadow

in order to support the evolutionary step to the digital me. Complex data approvals have to be avoided as discussed in section 2.4 in reference to the meta-consent process. All functions must be self-explanatory.

- Added value: Systems are only used if added value for the respective user is discernible. The digital me has to be used in a resilient ecosystem with relevant service providers from the outset. Mechanisms also have to be established to potentially permit monetary participation by the citizen.

4.2 SOLUTION ARCHITECTURE

Figure 4 shows a solution variant for healthcare. Health encompasses all areas of life and it seems evident that situations related to healthcare can be better understood if a large volume of situation-related data is available. These data do not necessarily have to originate from healthcare, but can for example be recorded by a smart home system.

Here the International Data Space helps transmit data across sectors using a trusted communication channel. DaWID (see project summary below) is one of the first projects exploring this interface.

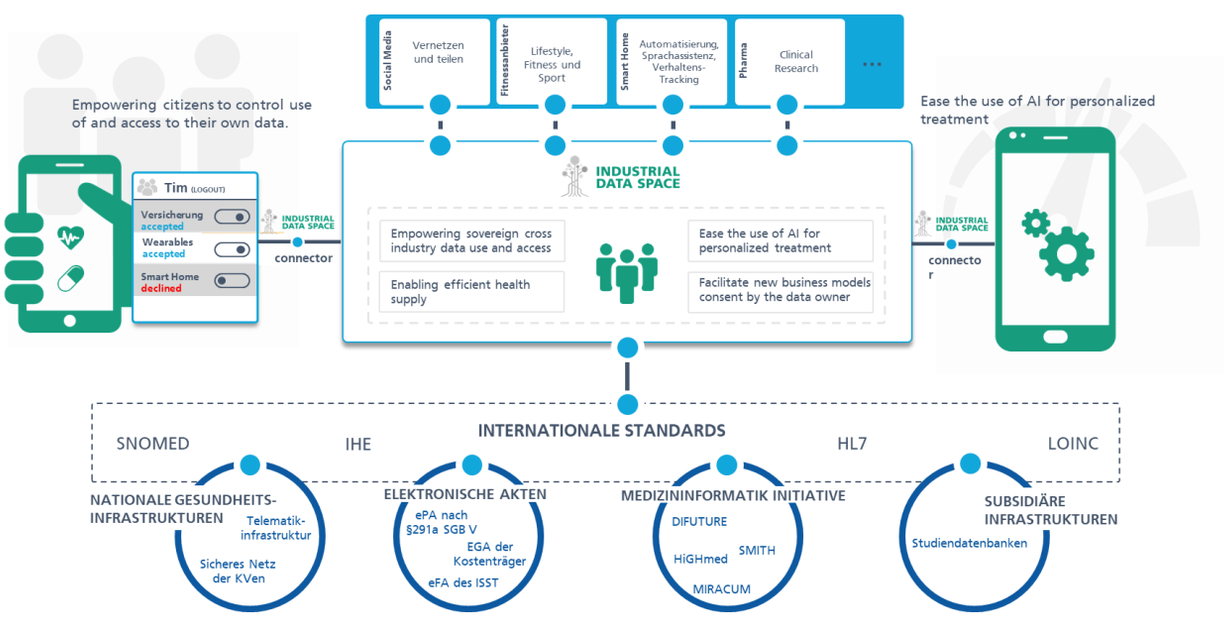


Figure 4 A solution variant based on the International Data Space for using the digital me within the framework of maintaining and restoring health.

5

CONCLUSION

It has been shown that there is a great need to restore the citizen's sovereignty over the use of their data. With the digital life journey described in this report, Fraunhofer ISST illustrates the technical as well as regulatory and social frameworks that are required to realize this. It also describes what partial solutions are already available today, and in what areas there is a need for further research.

Fraunhofer ISST is going to elaborate the digital life journey jointly with additional industry and political partners, and will present a prototype implementation of the concept in 2020. Furthermore, the activities will be bundled in the form of a »Digital Life Journey« initiative headed by Fraunhofer ISST.

PROJECT SUMMARY

DaWID

BACK-GROUND

The objective of DaWID (data-centered value creation platform for interactive-assisted service systems), a project subsidized by the Federal Ministry of Education and Research (BMBF), is to grant citizens sovereignty over their data. Here the interdisciplinary team not only represents technical but also data ethics and economic expertise. The results are intended to encourage the implementation of platform economy concepts and to assign a clear role to citizens within data-driven value chains.

ISST ASSIGNMEI

In phase I, Fraunhofer ISST is responsible for working out a concept for researching methods to enforce data usage rules based on the International Data Space. Fraunhofer IMW, KIT, idigiT, and Deutsche Telekom have been engaged as network partners. Economic implications of data usage are being illuminated by Fraunhofer IMW, and idigiT is working out ethical constrains for data usage. KIT is ensuring the trusted processing of data along data processing chains.

PARTNERS

Fraunhofer ISST

GEFÖRDERT VOM Bundesministerium für Bildung und Forschung

Network partners:

KIT Karlsruher Institut für Technologie 1825 1956 2009

universität Institute for Digital Transformation in Healthcare

Fraunhofer IMW

"DaWID gives the citizen control over their data processing within the framework of the International Data Space."

6

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