

DIGITAL IDENTITIES IN THE PEER-TO-PEER SHAREECONOMY ESTABLISHING TRUST IN ONLINE NETWORKS

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Establishing Trust in Online Networks

Abstract

With the digitization of our society an increasing amount of services such as social interaction, banking, shopping, administrative services etc. are shifted towards the web and enabled through computer based technologies. For one, with the growing number of accounts and need for security, identity management is becoming more complicated for users. For the other, the insurance of the correct identity and handling of the same is becoming more difficult for the provider and identity middleware. These developments require user-friendly and trustworthy identity management which are not yet in place. This research paper examines a new solution to identity management which meets the demands of both security as well as ease of use and addresses the core functionality: trust. To do so it examines the relatively new field of shareconomy in which numerous actors share a service or a commodity by including status quo case studies and user surveys. The main outcome is that new identity should bundle diverse identification methods, supply extended authorization services, ensure trust between the actors and provide facilitated access points to products and services in the web.

Annotation: This work has been created with hindsight to a project collaboration of Fraunhofer Institute FOKUS and Bundesdruckerei GmbH.

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List of Abbreviations

AD	Active directory
API	Application programming interface
BYOD	Bring-your-own-device
CA	Certificate authority
ICT	Information communication technology
IDM	Identity management
IDaaS	Identity-as-a-service
PEP	Policy enforcement point
PDP	Policy decision point
SMB	Small and medium businesses
SSL	Secure sockets layer
SSO	Single-sign-on
TaaS	Trust-as-a-service
TSP	Trusted service platform
TTP	Trusted third party

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1. Introduction

Today, a vast number of services such as social interaction, banking, shopping, administrative services etc. are shifted towards the web and enabled through computer based technologies. Especially in business, information communication technologies (ICT) and the internet are no longer replaceable. An individual user today already counts 10 to 200 online accounts ranging from email, social networks, online banking, trading platforms, booking platforms etc. (Löer, 2013). For one, with the growing number of accounts and need for security, identity management is becoming more complicated for users. For the other, the insurance of the correct identity and handling of the same is becoming more difficult for the provider and identity middleware (Al-Khouri, 2013, Gartner, 2012). These developments have consequently led to the need for user-friendly and trustworthy identity management¹. To be able to shift administrative and business processes into the web, it is critically important to ensure that secure identities only submit the information relevant for a specific task. Identity services are a necessity in all products and services accessible via the internet, be it business products and services, government products and services or other (Hart & Skevington, 1997).

The growth of services, platforms and access variations in the web is enormous. In this process a vast number of user accounts are and will be created which are all due to a trusted identification management. This development is accelerated by the relatively new field of shareconomy in which numerous actors share a service or a commodity. Shareconomy describes a trend which shifts using services and products from single ownership to sharing (this is valid for commodities, knowledge and other resources). The underlying benefit of shareconomy is the increased value of a product or service due to reuse of excess capacity in contrast to single ownership. Users (individuals as well as businesses) typically utilize a growing number of shareconomy services and are requested to create new accounts each time, resulting in a high number of username and passwords combinations which are increasingly hard to remember, chosen repetitively and therefore weak (Windley, 2005).

Additionally, in this environment, reliability has to be ensured between anonymous individuals which share each other's assets. From the user as well as from the provider perspective, an uncomplicated and secure approach to identity management which increases ease of use, trust and ultimately also the user base is desirable. Whilst there are several simple or secure methods on the market, a combination of both rarely exists. Therefore, a holistic and trusted conceptualization of full identity management including different levels of security and an increased ease of use is needed. This concept can be described as an identity service bus² or identity broker and is here referred to as trusted service platform (TSP). An identity solution should guarantee secure identities in their specific context and integrate all former authentication methods, supply extended authorization services (conditioned access) and therefore provide facilitated access points to products and services in the web. This research paper describes the underlying concepts of identity management, the boundaries of the examined field of shareconomy, and on this basis the prerequisites and requirements of such an identity service bus.

¹ Identities and identity management are solely related to the interaction in digital systems and do not refer to other academic fields which examine ethnological, cultural and psychological identities.

² An identity service bus describes a software architecture model which facilitates the interaction and communication between mutually interacting software applications.

1.1. Research scope and questions

Although the issue of trust and a respective identity solution which facilitates reliability of stakeholders can be adapted to nearly all informative, business and public interactions on the web, the scope of the research paper only allows the examination of one field. Due to the significance and the nature of a vast number of users, the author has chosen to limit the research field to shareconomy. Particularly in an environment composed of a multitude of mostly unknown users who are sharing the same resources, security and trust between the user groups are core requirements (see chapter 3.3.). Although shareconomy can also take place in offline environments (e.g. sharing neighborhood goods via personal agreement), only services which can be provided or given access to via the internet (such as car sharing, flat sharing and other prominent examples) and consequently have the potential to reach a much larger (online) customer base will be looked at.

This research paper will not focus on the detailed steps of development of the platform or the specific technical realization but instead examine the needs, functionalities and application of the envisioned area shareconomy from a needs perspective. Legal and regulatory issues play a significant role in identity management and shareconomy but can only be mentioned marginally due to scope restraints.

Several research questions have been identified which will be answered throughout this research paper:

- 1) How can identity management lead to trusted structures and contribute to a functioning transaction environment in online services?
- 2) What level of importance is assigned to trust in the field of shareconomy?
- 3) What is the status quo regarding identity management solutions in the shareconomy?
- 4) What should the general functionalities of a TSP in this environment cover?

The overall aim of this research paper is to demonstrate a viable approach as well as challenges of an identity solution in the field of shareconomy which can contribute to building trust and cultivating the digital identity within.

This research has been conducted with hindsight to a project collaboration of Fraunhofer FOKUS and Bundesdruckerei GmbH³ and serves as an envisioned consideration of new application fields of a trusted service platform. Within the project, the partners explore the application field of eGovernment - the facilitation of communication, interaction and transactions within public administration and with its stakeholders, citizens and businesses.

1.2. Methodology and structure

In order to sharpen validity from different angles, the research is composed of a mixture of secondary and primary research which adapts various components of the Yin and Eisenhardt⁴ approach (1989).⁴ The research fields identity management and shareconomy will be examined and brought together into a holistic concept for exploring the concept of a TSP in shareconomy. Whilst there is more information available in the rather new field of identity management where research goes back about 10-15 years,

³ Bundesdruckerei GmbH is Germany's most important provider of full ID-management solutions. The company develops and provides solutions and services for the secure identification in both the analog and digital world. Bundesdruckerei GmbH offers trust service center and eID services for national and international clients in the private as well as public marketplace.

⁴ Eisenhardt (1989) proposed a directed case study approach with a priori constructs resulting from studying prior literature (theory rather than past empirical observation) in contrast to Glaser's grounded theory approach without taking prior literature into consideration. Yin followed a deductive approach, building theory from prior literature which is then validated with case studies (1994).

shareconomy has yet to find its place in academic literature. A definition and the boundaries of shareconomy cannot be detected in openly available academic sources. For that reason, this research paper also includes a classification of shareconomy as well as carefully defined boundaries to related areas.

A qualitative, broader level cross-case analysis⁵ (N=16) will be conducted by carefully looking at the current identity management (IDM) methods which are implemented by shareconomy platform providers in order to provide practical insights into the status quo and prevalent practices regarding trust assurance through IDM. These practical insights give evidence for the needs and requirements of a TSP. In addition, primary research in the form of a user survey will be conducted. The user survey shall test the theory (deductive research approach), give additional information about the needs and requirements regarding identity management in the shareconomy and form the basis for understanding the value that the platform could generate to the end users. Combined qualitative and quantitative data allows for a synergistic view of evidence, fosters divergent grounding of theory and contributes to a wider picture (Eisenhardt, 1989:533).

The structure of the research paper is as follows:

Chapter two will give an introduction to identity management, including a definition, underlying concepts, challenges and its contribution to trust.

Chapter three will lay the foundations for a mutual understanding of shareconomy, explain its terms, challenges and the need for trust within this environment.

Chapter four provides a user survey regarding user's needs in the IDM context and an analysis of current identity management solutions within shareconomy platforms taking into account theoretical foundations from chapters two and three. Based on the conducted survey and analysis, general further requirements of an identity service bus will be displayed.

A comprehensive overview about the research topic and main findings will be given in chapter five. Supplementary areas of interest and research which have been come to light in the course of the work will be pointed out to encourage further investigations on the topic. To conclude, a short outlook on shareconomy will be given.

In order to increase comprehensiveness, the terms shareconomy/sharing economy/share economy, user/service provider/resource provider, TSP/identity service bus/identity broker which are mentioned repeatedly and used interchangeably within this work will be clarified in the appendix, p. 35. It is recommendable to refer to this section, whenever these terms seem not to be clear.

⁵Cross-case or multi-case analysis requires multiple sampling which adds to the validity and generalization of findings (Miles & Huberman, 1994).

2. Introduction to digital identity management

With the introduction and diffusion of the world wide web in the mid-90s, the capacity to access and store information, conducting transactions and using the internet in all various forms was revolutionary (OECD, 2011:8). Since then, the opportunities of the web are gradually becoming more personal. Whereas in the beginning, the web mainly served for providing information, it now identifies who we are on a contextual basis we are in order to deliver all kinds of personalized services, ranging from targeted information and marketing to social interactions and e-commerce. The internet has become an integral part of our everyday interactions and eventually transformed our society to the essential module of today's internet economy (OECD, 2008a:4). As of 2012, every fourth person is connected to the web (Internet World Stats, 2012). Increasing numbers of people are transferring parts of their life to the digital space in order to consume information, services and products and exchange with different known and unknown stakeholders. Personal contact in the traditional economy is replaced by automated services in our service-oriented economy. In these systems, actors expect a certain behavior from others as well as the protection of own data and the own identity.

Identities are equally significant in the digital as in the physical world. Just as we present ourselves in a different way to different persons in different contexts and therefore create a multitude of partial identities, we also create and represent a vast number of digital identities. Every time a new account is created for the use of a web-service, a new digital identity is generated. In different roles, different identities or pseudonyms like email accounts, chat names, eBay trade name, social network names etc. are used. Digital identities vary from physical identities particularly across two points:

- 1) Trust between transaction partners (e.g. in selling goods and services) is built through physical appearance in the physical world. Trustworthiness of actors has to be ensured in digital environments by suitable information communication technologies.

- 2) Whereas a sales transaction can be done anonymously in a physical store (cash payment), an online marketplace always requests some credentials such as payment details, name or delivery address or just stores the IP address.

Mechanisms have to be put in place to replace the management of identities of the physical world: this is referred to as digital identity management (Windley, 2005:3; Steinbrecher et al., 2010:1). The next paragraph introduces the most important definitions and concepts of IDM which will be relevant to and deployed in this research paper.

2.1. Definition and concepts

Definition and functions

The core function of identity management is establishing and managing the roles and access privileges of individual network users. It is the link which enables remote interactions between an organization (service provider) and the individual (service user) (OECD, 2008b:8). Identity management and access management act as a framework for business processes in order to facilitate the management of digital identities. According to ISO standard 29115, a digital identity is a set of attributes (name, address, hair color, status, occupation etc.) related to an entity (person or object). In many transactions, only a subset of attributes

related to a digital identity is presented in different situations and roles, which is referred to as partial identities (Pfitzmann & Hansen, 2008). Thus, identity management can be defined as the assignment of digital identities including their attributes and credentials regarding the creation, usage, maintenance and revocation of the same. According to the ISO/IEC JTC 1/SC 27 Work group 5⁶ framework for IDM (DIN, 2013:1), identity management encompasses:

- the field of application (intra-organizational, inter-organizational/federal),
- the authentication process or verification of an entity (one time access, role-based access control, single-sign-on),
- the choice and integration of authentication methods from soft token to physical tokens,
- the management of information which is linked to an entity in the relevant context (attributes),
- the authorization process to access resources based on certain certificates, roles, rights or attributes and
- the handling of identities and their attributes.

An IDM solution has to target all steps of the identity lifecycle and built an adequate set of technologies which ideally enable and support cryptography, directories, digital rights management, identity federation⁷, interoperability standards (Windley, 2005:6) and eventually ensures information security and secure identities. The identity lifecycle is composed of the provisioning and consequently creation of an identity to start the relationship and the handling of this identity with its roles and attributes including authentication and authorization, the management of the identity (updates, changes, history), its compliance to rules and regulatory defined in the system and the revocation process (deletion of the identity) which ends the relationship in the network:

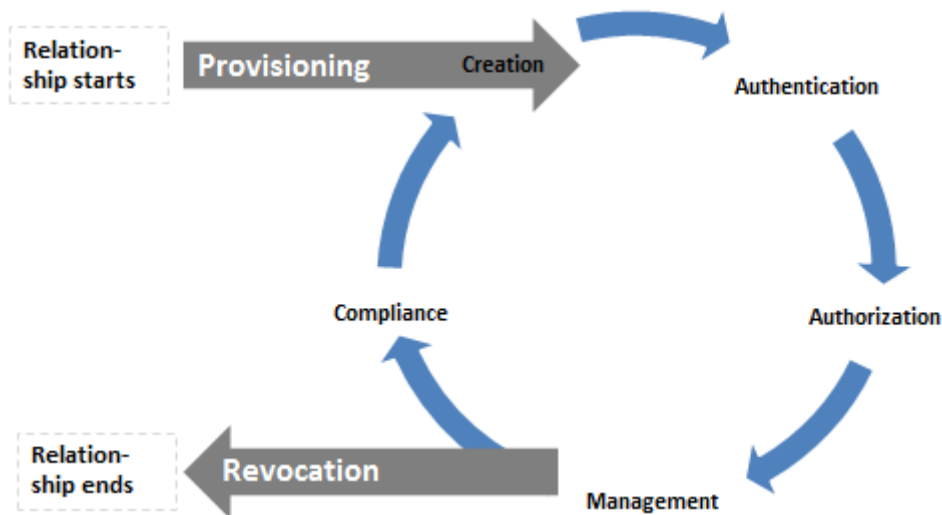


Figure 1: Identity lifecycle, own illustration based on Mangiuc, 2012: 487 ff.

⁶ The SC27 is responsible for the development of standards for the protection of information and ICT in mandate from the International Organization of Standardization and the International Electrotechnical Commission. Its work group 5 is dealing with identity management and privacy technologies.

⁷ Identity federation is an agreement among multiple web providers which lets subscribers use the same identification data to obtain access to the networks of all partners in the group (Windley, 2005:118ff.).

Terms and concepts

Authentication

Authentication refers to ensuring that an entity is what it claims to be before accessing systems or applications. There is a wide range of authentication methods ranging from basic and insecure methods such as username/password to secure methods such as two-factor-authentication or electronic cards. They can generally be classified into three types: something you know (passwords, PINs or answers to security questions), something you have (physical tokens or digital certificates⁸) or something you are (biometric attributes such as fingerprints or face recognition) (Windley, 2005, Stollar, 2009:45).

Authorization

Authorization refers to applying the correct access levels which an entity possesses. After a successful authentication to the system, the functions which the entity is allowed to manage are being identified and the entity is granted suitable rights, privileges, or permission. The decision is based on a set of data which the identity carries composed of identity data (roles or attributes), contextual data (location, time, type of device, level of authentication) or other external data (third party information) (Vidwans & Wessler, 2013:5). Decisions are made by policy engines; gatekeeper components carry out the enforcement (see Figure 2). In the normal case, standardized user profiles will be created which have preinstalled right issuance. In a more complex environment, role and rights management is by no means trivial and requires an adequate management, execution and controlling process.

Identity management system

Whereas Figure 1 shows the process from the identity point of view, the identity management system refers to the identity management process towards a platform operator as illustrated in Figure 2. In order to start the identification process and gain access to a resource or task or perform a transaction, an entity has to provide its credentials along with the request or claim. Credentials can be digital certificates, or certain access combination (badges, passwords, user names, keys) which prove that the identity belongs to them and the entity has the right to use it. Credentials are used for providing trust between the subjects and usually are chosen according to the required risk (high risk requires secure authentication credentials, e.g. two-factor authentication) (1).

Credentials that are provided to the policy enforcement point (or security authority) will be authenticated/validated optionally by using a separate authentication server (2). After successful authentication, an access request is sent to an optional separate policy decision point which retrieves the security policy for the according request (3&4).

The policy decision point (PDP) uses the policy and asserted identity to determine entitlements (guarantee of access based on rights) and permissions (actions that the entity is allowed to perform) from the identity store which holds information about the asserted identity (5). The information is redirected to the policy enforcement point (PEP) (6) which finally allows or denies access to the entity (7).

⁸ Digital certificates are an attachment to an electronic message within a PKI and serve the purpose of security. Digital certificates are issued by a trusted certificate authority (CA) and include identity information about the requestor and a copy of his public key as well as a digital signature from the CA (Windley, 2005:41).

The process can be mapped as follows:

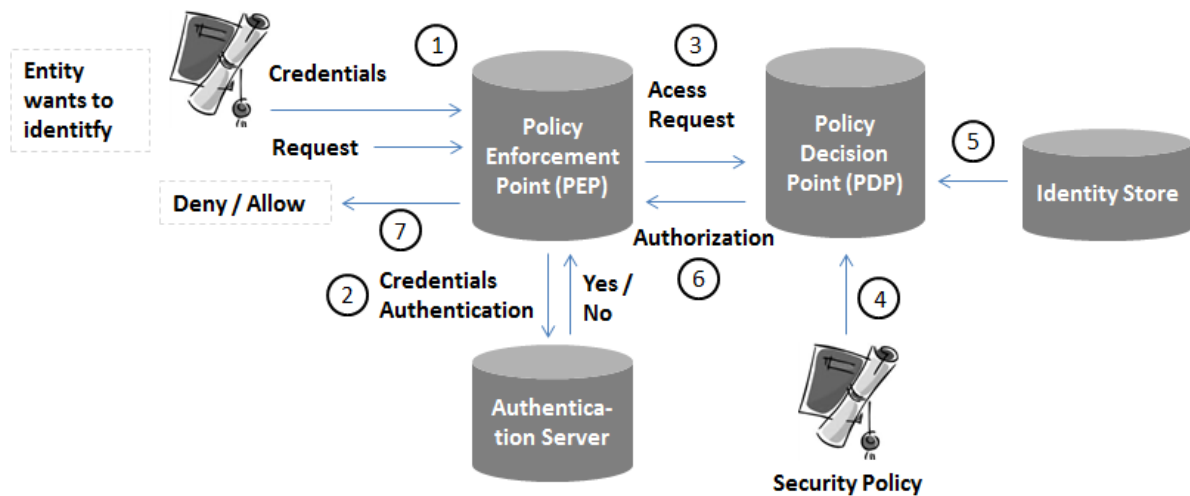


Figure 2: Identity Management System, own illustration according to Windley, 2011:10

The most important functions of IDM are authentication and authorization. Nevertheless, IDM solutions can execute a multitude of additional functions within these areas as shown later on. Since digital identity management is an ever growing but fairly new topic, it is facing several challenges as explained in the following subchapter.

2.2. Challenges in digital identity management

Today, 75-80% of German citizens have doubts regarding security when executing transactions in the web (Welzel et al., 2012:7, Reuters Deutschland, 2014:1). The fear of data theft has risen tremendously from 4% in 2012 to 61% in 2013 according to the eGovernment Monitor (Initiative D21 & Ipima, 2013:17). This development can partly be ascribed to Edward Snowden and the uncovering of the NSA affairs including PRISM and TEMPORA, which continue to reveal incriminating news and increase distrust in human-built technical systems and their purposes. Other events of severe hacking can be seen in recent times: By the end of 2013 it came to light that over the past years 16 million German email accounts had been hacked and all information (especially private data such as credit card details, password to other accounts etc.) could be accessed by the attackers (The Guardian, 2014). Additionally, in 2013, 21 million people in Germany have been victim to data fraud and data theft (Reuters Deutschland, 2014:1). Other concerns regarding security of data in the web relate to insecure transmission (67%) and the concept of the “vitreous citizens” whose data and behavior are collected to create rayed and monitored humans (62%) (Initiative D21 & Ipima, 2013:16).

Following the tremendous growth of online services and web-based systems which all require the identification of entities, following challenges in IDM can be identified (Carter, 2007:9):

- The high number of created accounts with soft tokens such as for example username/password weaken the concept, since either weak passwords (e.g. words which can be automatically generated by the application of dictionaries that run through a system) are chosen or strong passwords are used in numerous accounts (Stollar, 2009:44). Thus, hacking an account becomes easier or more worthwhile.

- Digital identities are easier to falsify or steal than physical identities, where an identity proof via in-person biometric proof can be conducted. On the web, identities can be stolen by hacking or other means and misused.
- Consequently, security concerns and issues of identity fraud and theft are increasing since more and more services are transferred into the digital world and thus access points and usage points for fraud are increasing.
- (Personal) information is less secure because the motivation of hacking and transmitting data is increasing as data becomes more valuable. Fear of online surveillance and data collection as well as the transmittal of identity information to other unauthorized parties is diminishing confidence in services in the web.
- There is a lack of individual user empowerment and control. Users often do not have a say or are not transparently informed about which information has been collected, transmitted, stored and linked.

The result of these challenges is inhibited confidence, impaired trust and decline of digital transactions. To counter these concerns and rebuild trust in online services and transactions which need data to operate, trustworthy technologies have to be put in place. The aim of IDM should be to ensure trustworthy, identity related and rules compliant processes which are implementable in a standardized and organization independent manner (if (is), 2012:1). Trust enabling services have to be established between all actors to serve as important drivers for digital services (Cofta, 2011:247).

2.3. Identity management as a trust provider

Trust has always played a fundamental role in human societies regarding social interactions and relationships between individuals and groups in organizations, communities, institutions and even whole economies. Research in social sciences such as sociology, psychology, economics and political science has vastly analyzed the field of trust. Although this research provides a multi-dimensional family of trust concepts due to its eclectic nature, the value of trust is acknowledged in every field (Corritore, 2003:738). It reduces uncertainty and enables people to manage risky or ambiguous situations (Deutsch, 1962; Mayer et al., 1995). Today, trust has also been recognized in computer science as ICT structures have to take over the former trustworthiness of personal contacts. It is fundamental for building up and managing public key infrastructures, peer-to-peer networks, large-scale e-commerce applications, web-services, the semantic web, or interactive online communities (FIDIS, 2009:11).

Trust can be defined as "the firm belief or confidence in the honesty, integrity, justice, reliability, etc., of a person, company, etc. In security engineering, a trusted system is a system that is relied upon to a specified extent to enforce a specified security policy." (EuroSmart, 2012:1) Corritore et al. revealed another perspective by stating that trust is "an attitude [...] that one's vulnerabilities will not be exploited." (2003:740)

Since IDM handles identity data/attributes and enables online transactions using them, it is the core for establishing a trusted environment (Davies et al., 2002). Secure identities are the most important building block of trust.

Identity management has to build trusted services which ensure integrity, non-repudiation and confidentiality (Windley, 2013:33). These three concepts are of particular importance to ensure information security within the network of identities. Integrity – the correctness of information – is crucial in order to know

that information (credentials, messages, transactions) is authentic and protected from unauthorized or unintentional alteration, modification, or deletion. Non-repudiation provides evidence of messages or transactions and ensures that an action cannot be denied by any actor. Thus, it ensures accountability.

Confidentiality ensures that information is stored and transmitted securely and only authorized entities are able to have access and read the information which is being transmitted (PICOS, 2008:57). Cryptography⁹ methods are most common techniques to address confidentiality and enable additional means (e.g. digital certificates) in order to ensure integrity and non-repudiation. According to Stoller, authentication enables ensuring the criteria of trust (integrity, non-repudiation and confidentiality) and can therefore be seen as a key pillar of an information protection strategy (2009).

Due to the increasing concerns regarding identity in terms of loss of privacy and fear of abuse, new interoperable services, procedures and infrastructures must be developed to ensure individual sovereignty, control of digital identities and on reliance on business partners to achieve maximum benefit and safety. A new level of trust can be provided by the integration of electronic identity cards in business process chains for a secure authentication.

The significance of trust in identity management systems is increasingly reflected in academic and applied research. Identity management and trusted services are widely discussed fields from the beginning of this century. The most relevant research projects within the Sixth and Seventh Research Framework Programme of the European Union (2002-2006 and 2007-2013) will be outlined briefly:

- Prime and PrimeLife¹⁰ (Privacy and Identity Management in Europe for Life) are succeeding projects concerning core privacy and trust issues addressing the challenges of protecting the user in the growing digital environment. Core topics are collaborative trust scenarios and virtual communities with the aim of establishing life-long privacy.
- TAS3¹¹ (Trusted Architecture for Securely Shared Services) developed an architecture which provides trusted services to manage personal information. It includes dynamic user-centric management and an end-to-end secure transmission of personal information and user-controlled attributes.
- TURBINE¹² (Trusted Revocable Biometric Identities) develops privacy enhancing authentication technologies based on biometric information. It provides secure, automatic user identification using electronic fingerprint authentication and protection of biometrics data through cryptography.
- ABC4 Trust¹³ (Attribute-based Credentials for Trust) aims at moving forward towards the federation and interchangeability of technologies supporting trustworthy and ensuring privacy preserving attribute-based credentials. The core idea is blanking attributes which are not used in a particular context to improve data security and anonymity.
- PICOS¹⁴ (Privacy in Community Services) focuses on secure electronic services for communities regarding data protection and identity management. It develops secure environments to share personal data with authorized parties and allows users to have a transparent insight in which personal data is being transmitted.

⁹ According to Windley, cryptography can be defined as the science of making the cost of discovery of hidden information greater than the value of information itself. (2005:34)

¹⁰ www.primelife.eu

¹¹ www.tas3.eu

¹² www.turbine-project.org

¹³ www.abc4trust.eu

¹⁴ www.picos-project.eu

- SWIFT¹⁵ develops an overall access control framework which integrates a variety of different operators and solves identity fragmentation. It builds federation to the network while addressing usability and privacy concerns and leverages identity technology as a key to integrate service and transport infrastructures for the benefit of users and the providers.
- GINI SA (Global Identity Networking of Individuals - Support Action) project¹⁶ addresses the subject of personal identity management and works towards solutions which help the user to address their own identity space. The aim is to develop solutions for individuals to be able to manage their own identity data and provide it in an open and flexible manner.

In summary, research projects concentrate on:

- protecting user identities in digital environments,
- secure environments to share and control personal data,
- user-controlled management,
- privacy enhancing authentication technologies,
- overall access control frameworks and
- integrated research on identity and identification technologies.

Although there is extensive research available regarding data scarcity, data protection and secure identification (methods which are eventually aiming at ensuring trust in digital environments) the results have rarely been applied in business environments. Most common marketplaces, networks and platforms only partly address the concepts which have been developed. Whereas identity fraud or identity theft (topics that IDM service providers can be held accountable for) are mostly integrated, the focus on user-centered solutions has not yet been a major concern (Crompton, 2010:293).

Solutions have to shift from solely acting in the interest of the organization to as well following the interest of the user and thus create mutual trust. Factors relevant to trust are accountability (transparent information handling and organizational responsibility), control (more control for individuals over how their information is collected, stored and distributed) and an overall fair risk allocation (information about risk concerning distributed data and the own identity) (Crompton, 2010:294).

However, in most web-based services and networks, users are not aware of how their personal data is analyzed and which data is being transmitted to other parties nor can they control the distribution of their own data. Within smaller networks, identity theft is mostly prevented because benefits of stealing an identity outweigh its effort. At the same time, companies are interested in the collection of valuable (personal) data since it offers an additional revenue source and increasingly becomes the central part of business models (Gartner & Fischer, 2013; Ashford, 2011). Identity and data protection as well as ease of use are of high interest to service users. As businesses have to act more and more customer oriented¹⁷, an approximation towards user and data protection can hopefully be expected in future.

The next chapter displays why shareeconomy is a vital application field to identity management solutions and lays the foundation for a mutual understanding of the term shareeconomy as it is defined in this work.

¹⁵ www.ist-swift.eu

¹⁶ <http://www.gini-sa.eu>

¹⁷ Reflecting the general trend of increased consumer power, customer centered products and service businesses.

3. An emerging field in the economy: shareconomy

Shareconomy is a growing field which offers large potential and is defined by a wide range of rather small actors. According to a study by AirBnB (2012:4ff.), the growth of the shareconomy in Germany is based particularly on the following factors: sustainable expectations towards products and manufacturers, easy access and exchange via the internet, a social environment where alternative ownership gains importance, positive review of shareconomy in public debates and a relatively high rate of social innovations. Shareconomy offers potential to create new business models and hence new revenue sources for both individual entrepreneurs and big companies¹⁸.

In this environment, the pooling of identity mechanisms and the availability of interoperability frameworks, leading to the integration of other services can drastically reduce the cost for shareconomy platform providers. By integrating existing and holistic solutions, such as the identity solution which is being approached here, platform providers could focus on their core business – building up a user friendly and easy platform for the exchange of resources. IDM frameworks which are created for a multitude of customers usually create a higher level of identity assurance since they can rely on more complex structures due to the worth of scale and scope effects.

By ensuring a trustworthiness environment and the possibility to build a federated environment, new services could develop which possibly may not have otherwise due to a too little user base and too little security. This in turn stimulates the rate of innovation (OECD, 2011:33). Especially in the uprising field of shareconomy with its nature of many unknown users who share own valuable resources for certain time spans, a holistic solution in IDM should be developed. As of now, there are several decentralized shareconomy initiatives and respective identification methods around on the German market. These could be efficiently bundled under the establishment of a TSP.

In recent years, an increasing number of companies adopt flexible, on demand availability as a business model which shifts single ownership to sharing. A current pattern change is fortifying this development: Individual belongings gradually lose their value as objects and services become more important than tools. For example, cars are nowadays often regarded as a means or delivery method for providing transportation rather than a product or status symbol (Chesbrough, 2011:35). 83% of German internet users are well-disposed towards sharing, thus shareconomy offers huge potential (BITKOM, 2013c:1). Whereas there are many different but only a few larger endeavors to be seen around the world, shareconomy is a field which is not yet familiar to everybody nor which has been elaborated upon in academic science. Therefore, a brief introduction to the underlying principles of shareconomy including its definition will be given.

3.1. Definition and significance

The idea of shareconomy is not new to peoples' minds. Since the beginning of mankind, humans have always shared all kinds of resources. In fact, not being willing to share is ultimately the reason for wars, as humanity fight over resources such as territory, power, raw materials, valuables etc. Shareconomy promotes concepts such as community, shared access to resources and reputation (GDI, 2013). Shareconomy

¹⁸ Some critics state that shareconomy has the potential to even transform formerly cost free and natural services into monetized ones (FAZ, 2013).

today originates from macro-economic factors such as consumption and market weariness where people start distrusting the marketers of our generations and open up towards innovative, collaborative and sustainable consumption models (f/21 Initiative, 2013). According to Rachel Botsman, a pioneer in shareconomy literature, the 20th century “hyper consumption” changed towards the 21st century “collaborative consumption” model (2010).¹⁹ The web and its technologies enable shareconomy at unprecedented levels of efficiency and scale (BITKOM, 2013a:1, AirBnB, 2012:1).

Many sources do not differentiate between shareconomy and collaborative consumption. In this research, shareconomy is regarded as a part of collaborative consumption, which refers to wider systems boundaries of organized sharing, bartering, lending, trading, renting, gifting, and swapping (Botsman & Rogers, 2010).²⁰

Shareconomy defined

Shareconomy evolves where overcapacity of goods and services are present (Green, 2012:2). Drivers of shareconomy are trust and reliability between the actors, the growing significance of community, an idling cycle of assets, the opportunity to derive value and the attainment of a critical mass to make the system work efficiently. It addresses Anderson’s long tail concept²¹: Especially in the internet business, firms can offer a higher number of niche products instead of only core products to generate more revenue.

The author’s definition of shareconomy is as follows:

Shareconomy is the creation of new business models within a marketplace to use excess capacity of resources (tangible and intangible) through on-demand sharing instead of transferring ownership. It matches own under-utilized assets with potential users through middlemen (shareconomy platforms). Shareconomy lowers the asset’s total cost of ownership and creates additional value.

Shareconomy satisfies the economic principle of coincidence of wants, which is a category of transaction costs that usually impose severe limitations on economies which are lacking money and are thus dominated by barter or other in-kind transactions (Jevons, 1875). Shareconomy provides networks to immediately stimulate these needs and thus creates a so-called “double coincidence of wants” (win-win-situation). Transaction costs of resources are widely minimized since running costs like car insurance and maintenance are now partly distributed via rental fees to other resource users and access to platforms is on-demand. This is what Chesbrough (2011:38) calls the utilization differential: With the more effective utilization of an asset, fixed costs can be reduced, profitability increased and a higher return on investment achieved.²² The common revenue model of shareconomy is to skim parts of the additional generated value flow into the operating costs of the intermediary shareconomy platform supplemented by ads contribution.

¹⁹ Rachel Botsman is the author of one of the first books of co-consumption (What’s Mine is Yours: The Rise of Collaborative Consumption) and therefore a pioneer in this field. She is being criticized by embellishing the shareconomy movement and believing oversimplified in the world improving power of co-consumption.

²⁰ Other areas of collaborative consumption are redistribution markets (referring to the swap and movement, thus the change of ownership of assets from not needed locations to needed ones instead of diminishment) and collaborative lifestyles (referring particularly to neighborhoods which profit from exchanging assets on a non-business level).

²¹ Long tail refers to a business model where a large number of little demand products generate more revenue than a few best sellers. Whereas in conventional models offering niche products would be too capital intensive, the internet enables the encounter of needs and demands on a virtual level which reduces regional or informational limitations.

²² There are many cost-inefficient assets which show a very low utilization rate from individual property to company assets such as jets, copy machines, land etc. which could all be used in shareconomy business model in future.

As a marketplace, shareconomy can be classified as a sub-area of e-commerce. According to Mohapatra, "e-commerce is usually associated with buying and selling over the Internet, or conducting any transaction involving the transfer of ownership or rights to use goods or services through a computer mediated network." (2013:73) Shareconomy describes the process of buying or conducting a transaction (the use of a resource, not the transfer of ownership) through the internet. In contrast to many e-commerce platforms, the shareconomy platform itself is not a party within the marketplace contracts. The fulfillment of the contract concluded via the online platform is solely between the users. Thus, the middlemen's role to facilitate trust between the user groups is particularly important to make his business model work.

The potential of shareconomy is revealed through ICT infrastructures which are able connect a larger user base on-demand (Sundararajan, 2013). Technology has reduced transaction costs, leading to cheaper and easier sharing of resources which through greater access is possible on a much larger scale (The Economist, 2013:1). Through the availability of an increased amount of data about people and things physical assets can be disaggregated and consumed as services. ICT allows efficient collaboration without geographic or time-based borders and thus helps to increase economic and innovative capacities by pooling explicit capabilities. ICT drives shareconomy by offering flexible and on-demand access through the increasing smartphone diffusion, social networks and instant functions such as online payment. Another development which accelerates the growth of shareconomy even further is the digitization of products and services. Music, books, consultation and also product drafts can be distributed and accessed online through ICT.

Since mostly peer-to-peer sharing initiatives can be seen in Germany²³, the case study focusses on examples from this area instead of brand-driven or business sharing. The term peer-to-peer as opposed to client-server originates from computer science where in networks each PC could act and react. Figuratively, each participant in shareconomy is a peer, because he can use products and services offer them alike. Instead of renting through traditional car rental agencies such as Hertz or hotel booking company like Expedia, consumers can use a peer-to-peer marketplace which offers more products, more flexibility and often a better price (Sundararajan, 2012, Wu et al., 2012). BMW's prominent DriveNow for example cannot be assigned to peer-to-peer shareconomy since there is no peer network in place (BMW is the only supplier, resource users cannot become resource suppliers). Although it inherits many characteristics of a shareconomy business model (flexible, available on time, use of excess capacity, for a limited time span) it cannot clearly be distinguished from traditional renting companies such as Hertz and co. (Voight, 2013). A new business opportunity for BMW would be not only catering their own car share with their web-based infrastructure but providing this infrastructure as software-as-a-service to other suppliers who could offer their cars on this ready-made platform (forward integration).

Other examples of shareconomy can be anything which refers to sharing assets with overcapacity from car share, flat share, sharing of digital accounts, sharing of other physical assets such as machines, sports equipment or even sharing of tasks and knowledge. In many cases, familiar social networking shifts towards service networking using online network to realize tasks in real life in the new people powered marketplaces (Botsman, 2010).

²³ According to a study conducted by Altimeter, 2/3 of shareconomy initiatives or start-ups in the U.S. market engage in peer-to-peer sharing as opposed to business or brand-driven sharing (like BMW's DriveNow, Netflix offering media-streaming subscriptions, and Salesforce providing its software-as-a-service) (2013:8).

Economic significance of shareconomy

The affinity towards shareconomy can be found in a few older academic sources. Already in the end of the 20th century, Jeremy Rifkin (2000), American economist and journalist, stated that the idea of ownership and acquisition of assets will slowly be replaced by the acquisition of user rights of these assets. It is a big topic of interest in different fields. The most prominent one is the annual ICT business fair CeBIT, the biggest and most important ICT business exhibition worldwide (Technologie und Management Journal, 2013). CeBIT 2013 featured the topic shareconomy as their main slogan and bundled all presented topics, solutions, products under this umbrella. CeBIT regards shareconomy as an uprising economic field which will grow significantly in the next years mainly driven by the development and infrastructures in ICT. Cloud computing, account sharing, identity management, mobile devices, location services and other innovations will contribute to the sharing of digital assets, physical goods and more (BITKOM, 2013a:1). However, a clear classification of what shareconomy is and isn't has not been delivered by CeBIT participants. CeBIT embraces everything from sharing information, documents, software and alike which does not differentiate the area sufficiently.

Some studies already analyze the motivation and impacts of shareconomy, such as f/21 Initiative (2013) BITKOM (2013a,b,c) and Gottlieb Duttweiler Institute (GDI, 2013). Studies generally agree on the large potential and significance of shareconomy. The economic potential of shareconomy is based on the idle capacity of resources and the willingness of sharing. For instance, utility rates of cars and companies' central processing units are estimated to be as low as 5 % and 10 % respectively (Salesforce, 2013), illustrating high potentials of growth which can generate significant value.

According to a Forbes research study, \$3.5 billion revenue was estimated worldwide in 2013 for individuals taking part in shareconomy services. Growth rates are expected to be 25% (Forbes, 2013:60). AirBnB, one of the largest players in shareconomy reached a market value of \$1 billion valuation in 2011 (Wu et al., 2012:2). Shareconomy has the potential to not only fulfill individual's needs but also develop towards a disruptive economic force driven by sociological change and information communication technologies. Still, the development and diffusion of shareconomy has just taken off. In Germany, 12% of the population takes part in collaborative consumption activities via the internet (AirBnB, 2012:2), 3% are using car sharing and 2% flat sharing (BITKOM, 2013b:9).

Shareconomy as a services business model

Services are becoming increasingly important and products as such are losing significance. Peter Drucker already stated in 1974 (p.57): "What the customer buys and considers value is never a product. It is always utility – that is what the product does for him." This trend is mutually conditional to the raise of shareconomy. Business platforms shift their value to offering the best possible services, user experience and user exchange. The business model can be either demand-driven, supply-driven or both. Oftentimes, the user directly participates on business platforms (through surveys, commentaries, blogs, ratings, competitions etc.).

This shift modifies Porter's original value chain model to a services value chain model, which can be applied to shareconomy as shown in Figure 3:

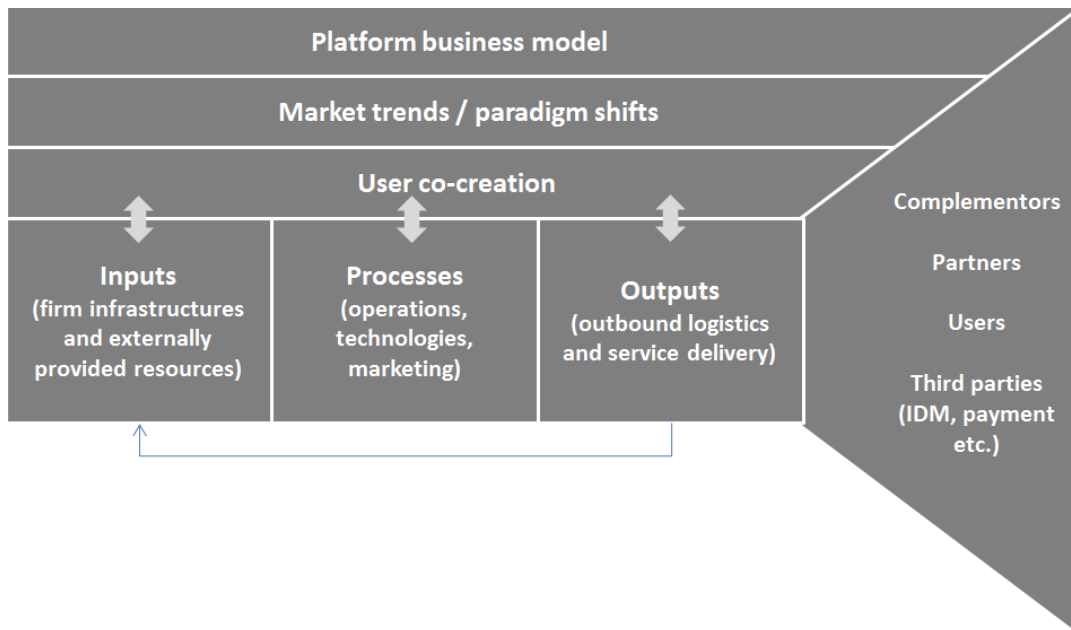


Figure 3: Shareeconomy value chain, own illustration according to Chesbrough, 2011:35

Shareeconomy enables a stronger focus on services business rather than products business in general, thus providing required and customer-tailored activities instead of standardized and inflexible products (Chesbrough, 2011, p. 201). Primary tasks are becoming less defined since core products and services are provided from the outside and the core function of the platform is an intermediary one. Here, processes have to be developed which contribute to a competitive advantage and superior position compared to the competitors in the market. Since the platforms heavily rely on user and provider integration, the primary functions are not merely interacting with former internal support functions such as firm infrastructure, human resources, and procurement but external influences such as market trends or paradigm shifts and co-creation.

Resource users and providers overlap and are both customers and content creators. It is not a closed model with fix margins, but complementors, partners and third parties who influence and change the value chain significantly. Finally, an integral value of shareeconomy is that products or services are not being sold once but incorporated back into the value chain as they are shared for a limited time period. The platform business model provides interaction and thus creates new value of which parts flow back into financing the platforms.

The services business model also inherits potential improvements regarding the needs of the client. With an altered front-end, certain wants of the client could be individually stored and displayed. Platform front-ends as well as product or services characteristics could be targeted directly at the client. A digital key to a shared car for example could automatically apply the prior user preferences such as favorite radio station, preferred temperature and seat position (Chesbrough, 2011:36). These automatic adjustments are not in place yet but are technically already implementable and might become realistic in future in many shareeconomy areas.

Shareeconomy as an innovation

According to Hauschildt, innovations are qualitatively new products or processes which differentiate observably from the former situation (2004:7). The newness of an innovation is the connection of functions and means which have never been combined beforehand. Innovations are the result of ideas which have

been turned into an invention. Only when the invention is realized in a business manner, it can be called innovation and then begins the diffusion process, where it is adopted, copied or neglected (Ili, 2010:22).

Shareconomy can be traditionally classified as an incremental process innovation. The products or services themselves are not considerably new, but the approach of distribution on the market differs from normal rental solutions and increases product and services usage rates. In this regard, a more suitable point of view is the business model innovation, which has come up in the past few years. Here, neither products nor services are invented all over again, but their usage rate and according business model can be regarded as something new which satisfies a yet unfulfilled need (Ili, 2010:24). This applies to shareconomy, which uses existing products or services, opens them up for multiple usages and sharing instead of single ownerships and therefore generates savings for the resource user and revenue for the resource provider as well as the middlemen.

Shareconomy will define and change traditional business models of long-in-place companies which have to adapt to the needs of their customers (Botsman & Rogers, 2010). Company's direct product and services distribution now request lower time-to-market and just-in-time characteristics. Few examples already show the integration of community involvement into corporations' business models. Swisscom, a major telecommunications provider in Switzerland with an operating income of CHF 2.43 billion in 2012 (Swisscom, 2012:2), has integrated a neighborhood support into their traditional services and support model (The Wall Street Journal, 2013). Instead of enduring hotlines and appointments for home support, they created a web platform where communities can help each other fixing their telecommunications problems. Another measure to handle the disruption of traditional e-commerce activities is the engagement in mergers and acquisitions (M&As). A trend of online scale leaders buying in or financing shareconomy platforms to avoid cannibalization can be seen. Examples from the U.S are Enterprise Car Rental acquiring the peer-to-peer ride sharer Zimride in July 2013, ride share Uber raising an additional \$258m from Google Ventures and TPG in August 2013 and HomeAway acquiring the home share Travelmob in 2013 (Olson & Connor, 2013:47). Literature regarding how traditional firms and respective business models will and have to adapt in order to cope with the fast changing environment has not yet been published.

3.2. Challenges in shareconomy

As in many business models which are based on the utilization of new infrastructures (here referring to the digital infrastructure which acts as the resource intermediary), shareconomy also faces the hen/egg dilemma. Shareconomy platforms will struggle to reach the critical mass of users and resource suppliers which make the system work on-demand through network effects and flexible supply. The fast development of ICT infrastructures are one of the core requirements of the raise of shareconomy. Without virtual networks connecting suppliers, platforms and users, shareconomy could not have the economic power to break through because the link to different stakeholders would be absent. Thus, shareconomy platforms increasingly face the problem of a too little user base.

An integral challenge of shareconomy is preventing the misuse of shared resources. When sharing a personal asset with an unknown user, mechanisms have to be put in place which limit personal risks by in the best case providing confidence that the user will not misuse the asset (e.g. destroy a flat or car) or in the worst case tracking back the liable user in order to press charges. People much rather engage in misuse when they are not identified and charges are of high effort to track back to them. Platforms which are handling valuable assets such as property or cars are currently addressing damage with the arrangement of insurance contracts. This is a way of ensuring the supplier that he will get a replacement for his valuables (which are often not replaceable by monetary means) but does not inhibit misuse in the first place.

Another challenge which should be elaborated upon but is not subject of this study is the installation of necessary regulations and policies within the new supply paradigm shareconomy (Sundararajan, 2012). While shareconomy platforms are disrupting traditional businesses by cannibalizing their user or customer base, it is a recent trend that large firms sue platforms for doing so. AirBnB and other large shareconomy portals are currently facing legal charges from competitors regarding taxation of commercialized personal assets on a larger scale which raises the need for adequate laws.

One of the answers to the main challenges in shareconomy is providing trust between actors to reduce the entry barrier. Therefore, an essential part of the ICT infrastructure which is being developed for marketplaces and other platforms online is the identity management infrastructure. Without adequate authentication and authorization, access to numerous services and trust between different actors would not be possible. The significance and levels of trust which are important to that regard will be explained in the next paragraph.

3.3. The need for trust and security

“The sharing economy is itself a play in a much grander fundamental shift from an infrastructure that protects people from each other to an infrastructure that helps people trust each other.” (Green, 2012:3)

In online marketplaces, trust is considered as one of the most important criteria contributing to the success of transactions regarding products and services (Windley, 2005:1). Confidence-building measures in distributed applications and services environments are required for economic success. According to Botsman, trust can even be considered as the currency of the new economy (2012). Whereas trust was previously only limited to security and privacy aspects, it is nowadays considered as an extended, multidimensional and complex construct which addresses both cognitive and emotional determinants (Corritore, 2003:743). A recent study conducted in the name of the European Commission finds that “the biggest challenge from a client’s perspective [...] is the lack of trust in online activities and transactions. Compa-

nies in the sharing economy are therefore trying to come up with measures to boost confidence like peer-to-peer rating systems and ID checks.” (2013:2)

In traditional sharing models, people would lend items mostly to familiar people in which case trust is established through a common feature (same neighborhood, same friends, same school etc.). As recent developments show²⁴, the potential and value of shareconomy is capitalized when sharing in unknown networks as the user base is much larger. This incorporates anonymous individuals, user groups, companies and public actors. On this scale, mechanisms have to be installed which replace the natural trust and reliability of personal networks towards anonymous networks which do not share mutual experiences. In shareconomy, platforms (websites) and their functionalities act as the objects of trust. From the user perspective “the website” and the institution operating it is responsible for trust between users, trust in technology and trust into cooperating parties. Factors such as ease of use, information content accuracy (also typography), design features and trust marks of approved organizations like Norton Verisign or PayPal for payment and general reputation or branding have been largely identified for contributing to trusting a webpage as such (Corritore, 2003; Fogg et al., 2001; Milne & Boza, 1999). Since shareconomy websites are rather new and have mostly not established deeply trusted relationships, external ICT components could assist. Trusted third parties, such as insurances and banks are already providing a variety of means to enable confidence in transactions (Hart, 1997:1). Similar solutions or trust marks are mostly not to be found in shareconomy.

In order to ensure credibility, security and privacy for involved actors, IDM should provide a user identity which in case of misuse allows back-tracking to the real person, identity protection mechanisms corresponding to the level of risk accorded to each specific transaction (risks of sharing books is substantially lower than sharing a car, therefore authentication methods have to reflect the level of risk) and follow legal privacy protection requirements (OECD, 2011:16). According to Deutsch (1962), risk describes the likelihood of an undesired outcome and is a significant factor of trust. Decreased risk concerns can be attained by giving users more control (Corritore, 2003:752). Minimization of risk results into increased trust.

Shareconomy increases the available information about every user on the web. Information about personal assets and sharing behavior are now being tracked by ICT, stored and analyzed by companies. Security and anonymity, the linkability or unjust disclosure of this data has to be strictly prevented to ensure trust.

To create trust between multiple parties, identities have to be authentic and trustworthy (Fromm et al., 2013:5) and service providers have to enable adequate data protection mechanisms. Digital services have to replace former personal trust qualities such as personal and functional relationships, group identification and reputation in order to ensure good collaboration and exchange of information and goods (PICOS, 2008:50). Technology has to ensure a working environment without errors to increase efficiency and ease of use. The need for trust in shareconomy can be related to the fields of personal trust (regarding personal information), inter-community trust (trusting other actors), trustworthy content (availability and accuracy of information) and trust in technology (trustworthiness and ease of use of infrastructures) (PICOS, 2008:50). Electronic processes are characterized by the separation of product, service provider and user. Trust enables a stable co-operation, closes information gaps and reduces uncertainties. Trust requires reliability concerning the user party, the service provider party and the identity provider and technology which enables the co-operation and illustrates the link between the two (Welzel et al., 2012:4).

²⁴ For example, since its start in 2008, AirBnB reached 15.8 million bookings 2012 and a 120% increase in branded searches within one year (Wu et al., 2012:3).

In summary, the different areas of trust, partly already identified in section 2.3. and relevant to shareconomy can be displayed as follows²⁵:

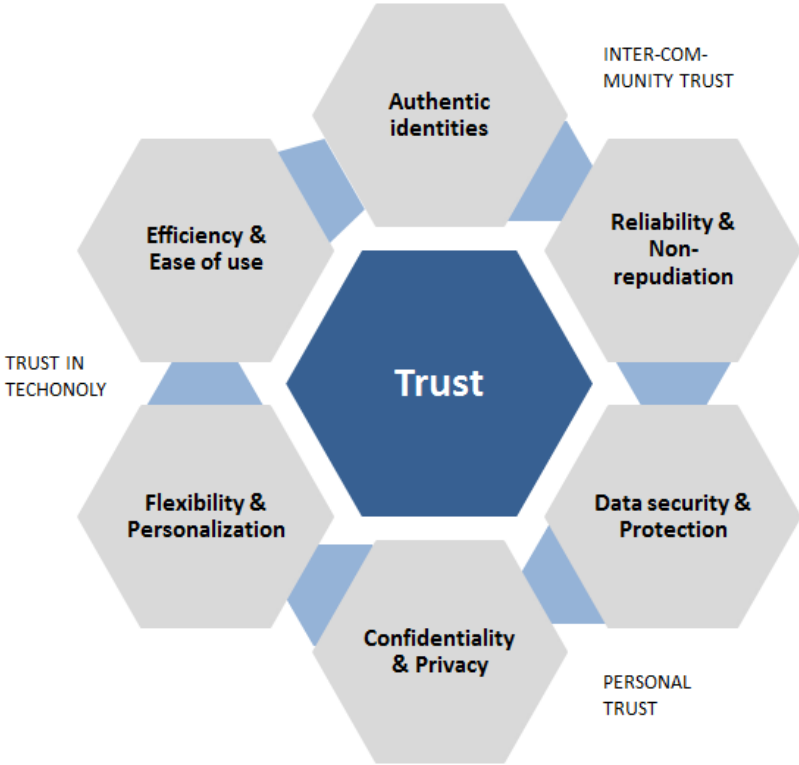


Figure 4: The dimensions of trust in shareconomy

Unavailable trust assurance methods could act as a barrier in shareconomy businesses. Even if some sharing models still require the personal exchange of the asset (e.g. when renting out personally owned cars, the key and the car will usually still be transmitted in person), it helps significantly to partly automate processes beforehand. Uninstalled trust mechanisms lead to misuse of resources as well as nonessential capacities which are deployed for transaction partners not fulfilling their part of the deal (e.g. not showing up as a ride supplier at Mitfahrgelegenheit). Being aware of traceability increases trust and reduces cases of misuse. The next paragraph shows how trust and IDM is already addressed in shareconomy nowadays.

²⁵ The trust dimensions are neither mutual exclusive nor collectively exhaustive but partly overlap and influence each other.

4. Identity management in the German shareconomy landscape

In this part, the practical research outcomes of the research will be presented. First, user expectations and needs are being defined through the analysis of the self-conducted user survey and a study conducted on the U.S. market. Second, the author has studied the status quo of identity management in shareconomy in order to analyze to which extent the requirements towards trust, security and ease of use are already established. User expectations and current methods will be explained and further needs of IDM uncovered.

4.1. User motivation based on user surveys

The growth of shareconomy platforms in Germany has been lower than expected in relation to the growth on other markets, e.g. North America. Whereas lots of U.S. platforms have reached a substantial number of transactions and users, only a small number such as AirBnB have achieved a critical mass of users in Germany. Some firms have already left the market or currently are in a state of liquidation (e.g. Gnibble). In addition to a non-working revenue and break-even model, the attraction of a minor pool of participants is the main reason for failure. Nevertheless, an increasing number of start-ups engage in shareconomy which leads to market growth.

A study conducted by Carbonview Research (2012) with a sample size of 383 participants in the U.S. has shown that the main barriers to participating on shareconomy platforms are misuse of resources (30%), no trust to others in the network (23%) and compromised privacy (14%). These results can be transferred to the German market as buying behavior according to the underlying characteristics of Western marketplaces is relatively equal. Furthermore, with the German uncertainty avoidance, which is substantially higher than in the U.S., an even greater impact can be expected²⁶.

In order to gain more detailed insights regarding opinions towards security and trust on the German market, an online survey was conducted in the course of the research.

User online survey

Since shareconomy services are not yet well known to the entire German population, the online survey was limited to a narrower target group which simultaneously presents potential users of shareconomy. Generally, online surveys are a questionable mean regarding the presentation of a whole population group, since the online nature of the survey already rather targets web affine persons (McKinsey, 2004:4). Since web affine persons are the shareconomy's main target group the representativeness of the sample group is not negatively affected. The survey was distributed via social networks and per email to 235 persons ranging in age from 18-45, representing the core target group of shareconomy (AirBnB, 2012). 98 persons participated in the online survey. There is no consensus in literature about the appropriate number of participants in surveys. The assumption of a suitable sample size ranges between 20 and 200 people, whilst depending on the nature of the research questions, a theoretical saturation occurs starting at a

²⁶ Hofstede's concept of uncertainty avoidance (UA) dimension expresses the degree to which a person in society feels uncomfortable with a sense of uncertainty and ambiguity (2001). Hence, societies with a high UA are less likely to engage into actions which reflect a higher uncertainty. Applied to shareconomy, Germans would only engage in these services once they are surer that no expected outcome such as misuse of their resources or reduced quality when using resources of others is involved.

certain number of participating persons which leads to no significant additional insight per added participant (Winter, 2000). A sample group of 100 participants usually reflects the margin of error of 10% (Sciencebuddies, 2006:1).

The questionnaire contained different types of questions including two-way questions (limit answers to a pair of alternative responses yes and no) with optional open commentary fields to explain the answers, multiple-choice questions to select the most applicable answer and ranking scale questions to reflect upon the significance of different impacts. Questions were not always limited to the field of shareconomy but also addressed a wider understanding of IDM.

Survey participants were asked how many digital identities such as email logins, travel portals, social network sites etc. they possess. The average amount of digital identities which persons have to handle is approximately 10 to 15, more detailed results are displayed in Figure 6. Of these persons, the majority (45%) loses their account or access details once per month, 22% even more often (see Figure 5).

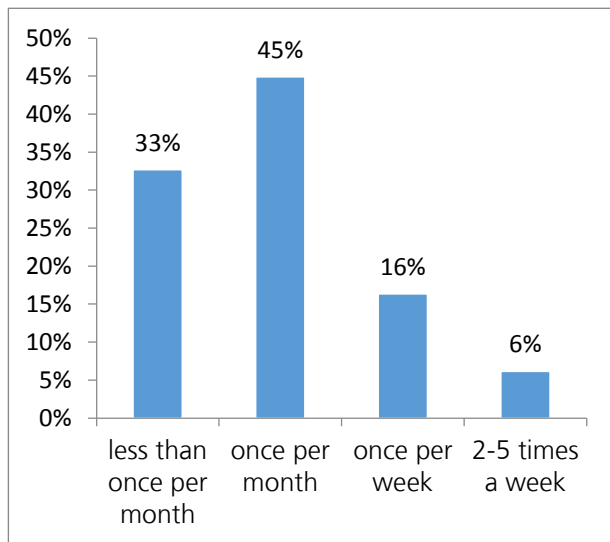


Figure 5: Amount of lost account details

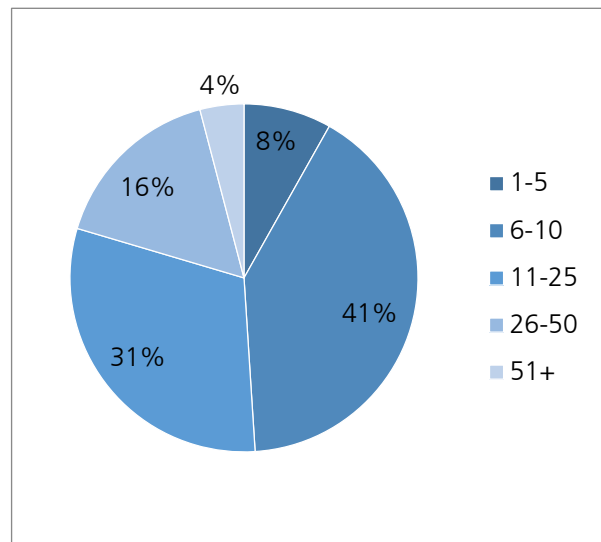


Figure 6: Amount of digital identities

As a result, 70% of the respondents would like to use fewer accounts in order to prevent account loss and increase usability as long as security and data protection are ensured. 64% were in favor of using Single-Sign-On (SSO)²⁷ likewise under the condition that data privacy is being guaranteed. The most important factor for respondents was the control over their personal information in digital accounts: 94% favored solutions which provide self-managed systems with own decisions about which data is provided to the system, which data can be transferred and which data can be stored.

Furthermore, 82% of respondents preferred a more secure identification and authentication via two-factor authorization (e.g. SMS TAN) or electronic cards such as the German Identity Card. This applies especially to the fields of online banking (85%), e-commerce (68%) and online booking (45%). Particularly in peer-to-peer shareconomy services, a more secure identification is important for 74% of respondents. As much as 60% claim that this would be a driver for them personally to use shareconomy services (either as resource provider or user).

²⁷ SSO provides access to different services with a single authentication and authorization in one session. Ease of use is improved because users can access various services in the network without creating different accounts, having to remember several passwords or executing multiple authentication processes (Vidvans & Wessler, 2013:4).

At the end of the survey, respondents were asked to estimate the potential of IDM solutions to improve four areas transparency, security, user control and ease of use on a scale from 0=very low or none to 4=very high. The main potential has been allocated to security improvements through a new identity solution, followed closely by ease of use (in terms of federation/reduction of accounts), user control and transparency of transferred data and terms of use/data policies. Detailed scores can be seen in Figure 7:

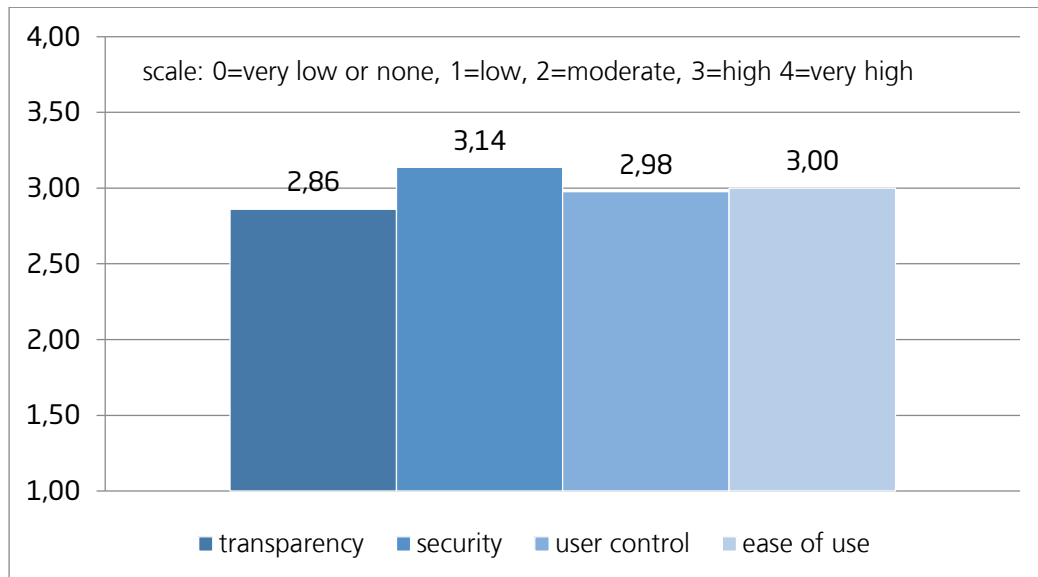


Figure 7: Average potential of IDM improvements per area

This is in line with current IDM research projects as identified in 2.3. and can thus be seen as a general trend in identity management. User interests should play a vital role the functionalities of a TSP since they are core to the success of the shareconomy platform.

In summary, personal risk management and trust concerns in online environments are gaining importance. An increased value for users can be achieved by providing more secure identification and a larger choice and bundling of ID methods and own handling of rights and roles. Although transparency and security enhancing methods are largely in favor of users, they will only be accepted if the user interface is composed in a user-friendly and easy manner. Thus, special attention has to be paid not only to the back-end functionalities but particularly to the front-end design in order to reach a necessary adoption. To which extent user expectations and wants are already applied in reality will be shown in a case analysis in the next paragraph.

4.2. Status quo of identity management solutions

This cross-case analysis gives an overview of current identity and trust ensuring methods in the German shareconomy by looking at 16 shareconomy platforms with diverse characteristics. The platforms have been chosen because they reflect different platform sizes from few to many users as well as different areas of shareconomy and are therefore suitable to present the general situation in this field.

The platforms were evaluated according to the following characteristics and corresponding purposes:

- their type, name, legal status and web reference: to give information about the company and the shared resource,
- numbers of participants: to reflect upon the size and diffusion level,

- current login methods: to evaluate their security level,
- IDM and trust relation: to analyze current techniques regarding the levels of trust as identified before, namely inter-community trust (trusting other actors) and trustworthy content (availability and accuracy of information),
- data security and anonymity: to look at current techniques regarding personal trust (regarding personal information) and trust in technology (trustworthiness of infrastructures),
- payment/revenue models: gives information about the business model of the platform and will be used when analyzing possible business models for the TSP.

Information for the analysis stem from the respective websites including identification methods, platform description, terms of use and data policies. Supplementary sources have provided information regarding the number of participants as well as the payment models²⁸. For an improved readability, the full analysis can be found in the appendix (see p. 37). Main findings according to the evaluated criteria will be summarized here. Presented results partly already address functions which are not yet provided by the platform.

Current login methods and attributes

All platforms provide a direct sign-up/registration on the platform with username/password, hence this soft token method does not provide much security against hacking an account. Nevertheless, in shareconomy it is not very likely that accounts are exposed to this threat (as opposed to bank accounts), it is more important that the user is who he claims to be and trustworthy. The user has to create an account for each single service and accumulates these. A bundling of accounts would improve the user-friendliness of services within shareconomy.

Most platforms (10 out of 16) also provide the possibility to login via existing accounts on the social network Facebook via the Facebook API. Only the goods sharing service Gribble allows the login via Twitter and Gmail. Consequently, it can be expected that shareconomy platforms are generally open to SSO and federation. Due to the limited financial resources, most platforms have decided to reduce the possibilities to one additional login possibility, although a wide choice of identification methods increases user comfort and hence acceptance of the service. On the one hand, providing federation to Facebook increases the ease of use for the user. On the other hand, it offers Facebook (Twitter and Gmail respectively) the opportunity to collect the user's behavior data which is usually not in the user's interest. A more confidential federation solution which reduces the number of person's partial identities and simultaneously provides privacy would be desirable. Two-factor authentication as well as authentication via stronger methods like electronic cards within the login process is yet to be found.

A large number of platforms ask for personal data (attributes) such as name, address, telephone number and birthdate and if applicable driver's license number and date of issue in the registration process. However, a proof of data in most cases only occurs via an email confirmation link. Thus, identification of users is hardly ensured when pursuing transactions but would be favorable within the shareconomy community. This poses the question on data collection – why is the bulk of personal data required if it does not fulfill a certain purpose or claim (e.g. control)? Why do book, goods and clothes sharing platforms like Leihdirein-Buch, frents and CommonVintage require birthdates? Data transparency and minimization, the policies of visibility of processes and gathering the least amount of personal data, should play a larger role in shareconomy's identity management.

²⁸ Websites and supplementary sources are indicated directly within the list in the appendix, p. 67.

IDM and trust

Trust has been recognized by shareconomy platforms as one of the enablers of their business models. Most platforms integrate a separate section on trust on their websites. In order to achieve credibility, platforms have to provide trust systems. Nevertheless, although they provide certain trust insurance methods, all platforms claim that they cannot ensure the correctness of an identity in order to avoid legal charges²⁹.

The most prominent example to ensure trust between participants and facilitate decisions is a reputation or rating system, as it is best known from traditional marketplaces such as Ebay. A reputation system provides a mechanism for the evaluation of trustworthiness when actors lack personal history or past experience with each other (Dieberger et al., 2000; Resnick et al., 2000). It allows participants within a community to rate one another and to rely on already conducted transactions and the according user experiences when making a decision (a concept referred to as derived trust³⁰). Collected opinions are typically passed as ratings to a reputation center which uses specific algorithms to dynamically compute the reputation scores (Almeroth et al., 2010). Thus, reputation systems are a typical mean to facilitate trust (Resnick et al., 2000). In this analysis, 15 out of 16 platforms (except parking spot share Ampido) use ratings, peer reviews (favorites) or status systems (the more successful transactions, the higher the status), where users can evaluate each other according to the reliability and the quality of shared assets. Ratings are a supplementary attribute of a person's identity. Since reputation systems are currently installed by each platform individually, users have to create a new reputation on each platform. This could harm the ease of use and also willingness to engage in new sharing endeavors where reputation has to be built up from scratch. As reputation systems are the main pillars for establishing trust and implemented in nearly all platforms, a federation or pooling of reputation systems seems to be a viable approach which goes hand in hand with the establishment of identity federation.

A one-time verification of the user is carried out by few platforms in the form of content proof (e.g. explicit recognition of participants on pictures or address verification via google maps), SMS verification (one-time password sent to mobile phone), credit card verification (verifies identity with credit company) and ID verification (until now hard copy or scan of ID card). As the content proof only gives information about if a person is recognizable or if a specific address exists, it reduces false information but is not a proof and hence can be considered as the lowest verification method. In contrast, ID verification explicitly identifies a person and verifies other credentials or attributes such as address and birthdate and thus is a very strong measure for verification and eventually trust. As of now, only one service (CarZapp) provides a mandatory ID verification for users, AirBnB relies on ID verification or connection to social networks, Couchsurfing applies credit card verification and Leihdireinbuch, Leihdirwas and Blablacar use SMS verification and/or content proof. 10 out of 16 platforms have no verification in place. Thus, an increasing implementation of methods which could efficiently ensure a person's identity would be recommendable.

Currently, estimating the risk level or reliability of users often lies in the responsibility of the platform user. Whereas IDM gives access to the respective functions the role has on the platform, the decision of whether a transaction takes place often relies on the resource provider in contrast to traditional e-commerce where transactions are executed automatically (e.g. Nachbarschaftsauto). In future, it can be expected that a growing number of transactions will be automatically enabled through the shareconomy platform

²⁹ Information regarding authenticity and confidentiality can be found in the terms and conditions on the respective websites, e.g. on Nachbarschaftsauto, Autonetzer and AirBnB.

³⁰ Derived trust is based on transitivity, that is for example when Alice trusts Bob and Bob trusts Claire, Alice can derive a measure of trust in Claire based on Bob's referral due to her trust in Bob (Josang, 2005:625).

with electronic keys to resources increasing the pressure for installing measures to ensure authentic identities and trustworthy actors.

Data security and anonymity

14 out of 16 platforms state that personal data is only being stored in order to fulfill the business processes and will not be transferred to external third parties. Excluded is the transfer of data in the case of orderly settlement agreement as well as legal obligations (e.g. in the case of legal claims). Thus, they are compliant to the Directive 95/46/EC on data privacy which was installed by the European Union (EU) in 1995. Two platforms (Couchsurfing and CommonVintage) do not exclude the transmission of private data. In the case of Couchsurfing, this is due to their company base in the U.S., which has looser data privacy regulations installed than the EU.

On all platforms, participants' behavior is being analyzed in an anonymous manner for statistical and marketing purposes, the redirection to a unique identity is impossible. Websites portals use cookies, server log files including the IP address, remote host, time, status, geo data and transferred data as well as browser information are evaluated for this purpose. In case of a federated login via Facebook or else, the external agent has access to the data which is being generated on the platform. This in turn allows social media portals to get a clear picture about the user behavior and relate it back to an explicit identity. Facebook also uses a plugin³¹ (like-button) which allows them to track user behavior and relate back to a Facebook account when the user likes the website. In contrast, shareconomy web portals do not get access to external parties' information about an identity. The login provider can access the information stored on the service website and the other way around. Furthermore, the activities on the website are being sent and saved by social networks in the case of being logged in to improve add targeting of third parties.³²

None of the portals allows users to keep track of which exact information is transmitted to which parties or let them decide about the same. Despite vast data security policies in the German law, concrete restrictions or control policies are not installed to monitor these platforms. Facebook for example has been sued for spying and using all contact and address details of their users' smartphones (Spiegel Online, 2014). According to Kuneva (2009), "Personal data is the new oil of the Internet and the new currency of the digital world." Many companies have adopted a business model, whereby selling user data is one of the revenue sources. Shareconomy is a very data-intensive field which holds information about the users (entities) themselves and about their behavior, preferences and alike. Since a lot of personal data (email, name, address, birthdate, telephone number, payment details etc.) is usually requested by the platforms, a more transparent and user-controlled approach to data handling is desirable.

Only few platforms (AirBnB, CarZapp, Nachbarschaftsauto and Couchsurfing) work with a secure infrastructure (web encryption technology) such as SSL³³. Submitted data is being encrypted and thus implies larger barriers to data theft as in normal http protocols. On the downside, not only CAs but everyone can issue SSL certificates which can impose a danger if the certificate issuer is not trustworthy.

³¹ For a full overview of Facebook plugin policies see www.facebook.com/privacy/explanation.php.

³² Other external agents are Google Analytics (stores user behavior and IP addresses), Google +1 and Twitter's Re-Tweet (both analogue to Facebook plugin).

³³ SSL (Secure Sockets layer) refers to a protocol for transmitting private documents via the Internet using cryptographic systems with two keys to encrypt data. In most cases, URLs that require an SSL connection start with https instead of http.

The overall results of the analysis regarding data security and anonymity and IDM in relation to trust is displayed as a two scaled diagram:

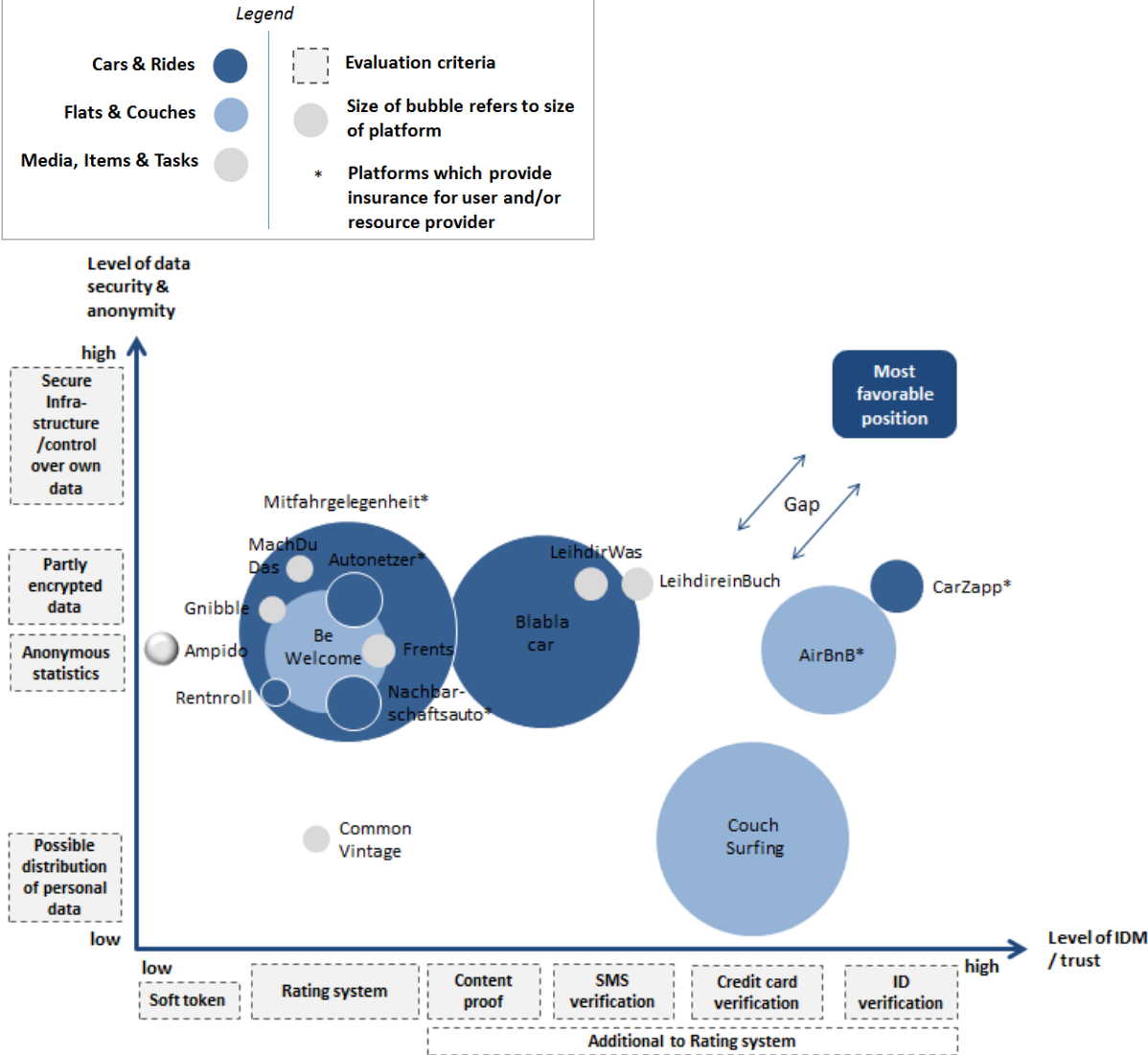


Figure 8: Analysis of data security and IDM & trust of shareconomy platforms

As both security and anonymity (privacy) and IDM in relation to trust are core ingredients to a trustworthy shareconomy environment, there is a large gap between the status quo and the most favorable position or situation for users as marked in Figure 8.

4.3. Further requirements of an identity solution

Tasks and functions regarding IDM are constantly increasing and becoming more complex due to the wider functions IDM covers, a growing user base, higher security standards and increased worthiness of fraud and theft (Gartner, 2012). At the same time, identification methods on shareconomy platforms are still in their infancy. People possess a multitude of digital identities where often they have forgotten the entry requirements or use the same or simple username/password combination which significantly lowers the security level.

Shareconomy services are lacking trust services which ensure the reliability of their actors. Trust is usually only being achieved through rating systems. Ease of use and comfort for users is currently not established

on these platforms. Increased choice of (secure) authentication methods, provision of a user focused identity management and incorporation of accounts from other platforms are currently lacking.³⁴ This is partly due to the lack of readily available IDM solutions which address the needs in this particular field. Especially in the peer-to-peer business, where personal items are shared, an assurance to the correct usage of these items is critical to success. As a result, shareconomy offers a high potential in introducing identity solutions which are more complex in the back-end, more convenient in the front-end and target challenges in identity management as addressed in paragraph 2.2: trust, obliviousness of account details, identity fraud and theft, data security and personal control over data.

To work towards a holistic IDM solution, further requirements of identity management as pointed out in the analysis are being summarized:

- An **increasing implementation of authentication methods** which could efficiently ensure a person's authenticity. **Offline verification methods should be shifted to the online world** in order to improve the transaction process.
- A **bundling of accounts** which reduces the number of person's partial identities to improve the user-friendliness of services within shareconomy (e.g. through SSO).
- **Federation solutions** which follow a more **confidential** approach.
- As reputation systems are main pillars to establish trust and implemented on nearly all platforms, a **federation or pooling of reputation systems** appears to be a viable approach which goes hand in hand with the establishment of identity federation.
- Since a lot of personal data (email, name, address, birthdate, telephone number etc.) is usually requested by the platforms, a **more transparent and user-controlled approach to data handling and data minimization** is desirable to prevent misuse.
- In summary, the core is to protect a user's **privacy and anonymity** while holding the user **accountable** in the case of fraud commitment.

Further requirements are mainly identical with current research initiatives which have been pointed out in chapter 2.3. Already developed solutions can be taken into consideration when developing and establishing new methods for shareconomy in order to avoid redundant research. How this could be accomplished in detail would exceed the scope of this research but would be worthwhile to investigate.

Given that IDM is not yet regarded as core to shareconomy services and there is a large gap between the status quo and the best possible solution as illustrated before, an integrative IDM solution which addresses all needs is required. Filling the current gaps can lead to the establishment of a shareconomy community, attract more users, and eventually increase reputation and revenue for shareconomy portals. Technologies are necessary which do not only add functions to the current state but also change the fundamental thinking about IDM towards privacy and trust ensuring technologies in the shareconomy context.

In order to sufficiently address data rights, protection and user security the trusted service platform should follow a privacy-by-design approach.³⁵ Privacy-by-design represents a paradigm shift from restoring privacy and trust to a precautionary approach in the development process. Core ideas of privacy-by-design are

³⁴ Except for the inclusion of a Facebook API, no platform provides additional IDM functionalities such as SSO, federation or other alternatives.

³⁵ EU Data Protection Directive (also known as Directive 95/46/EC) is a directive adopted by the European Union designed to protect the privacy and protection of all personal data collected for or about citizens of the EU, especially as it relates to processing, using, or exchanging such data. Directive 95/46/EC encompasses all key elements from article 8 of the European Convention on Human Rights, which states its intention to respect the rights of privacy in personal and family life, as well as in the home and in personal correspondence. The Directive is based on the 1980 OECD "Recommendations of the Council concerning guidelines Governing the Protection of Privacy and Trans-Border Flows of Personal Data."

transparency, trustworthy data, frugality of data and a strict division of personalized and contextual data (Schaar, 2010:15ff.).³⁶

Especially with hindsight to the connection of different actors, e.g. applications within or between IDM systems, a standardized approach is required. To stimulate and drive the trend of sharing, effective, feasible and user-friendly TSP infrastructures are needed which adhere to certain criteria:

- high ease of use for platform users,
- flexible and standardized access to multiple services,
- implementable by a high number of shareconomy platforms,
- simple connection to existing identity management systems and
- the provision of trust (security, credibility, ease of use, transparency).

³⁶ To give an example of the privacy-by-design approach the electronic German identity card can be pointed out (Welzel et al., 2012:18).

5. Conclusion and outlook

In view of the current development of increasing marketplaces, a growing number of accounts and digital identities, this paper has shown that new solutions have to be developed to handle digital identities today and in future in order to provide necessary trust relations between the actors. To this respect, the work has concentrated on examining the relation of trust in identity management and the emerging field shareconomy as well as further needs of a respective solution.

Research findings can be summarized as follows:

- Identity management, particularly its authentication function, is the core to ensuring secure identities and trustworthy conditions in environments, where transactions are taking place between numerous unknown users. Particularly the concepts of integrity, non-repudiation and confidentiality are of utmost importance. Trends and research programs are pointing towards less facilitated identity handling, privacy enhancing technologies and protected user identities, user-controlled personal data and secure identification.
- Trust can be regarded as one of the core criteria to enabling a shareconomy environment, where peers can share resources with anonymous users and misuse of resources and data are high barriers to engage. Inter-community trust, personal trust and trust in technology have been identified as main concerns and enablers for shareconomy users which have to be addressed by an identity solution in shareconomy. The main value of the TSP is creating trust between the shareconomy platform and its users.
- Current peer-to-peer shareconomy identity solutions hardly address the needs of shareconomy users regarding the prevention of resource misuse and data scarcity. They are mostly based on weak identification and do not show user-controlled approaches. Therefore, potential can be assigned to creating solutions which pay greater respect to users' preferences.
- An enhanced solution can be an independent identity management provider with the core functions to handle the authentication management in order to provide secure and verified identities while safeguarding privacy, bundle existing and future accounts to minimize the weak password dilemma, offer a user-controlled data management to work towards transparency and data minimization, provide a secure infrastructure to ensure data security and offer the possibility for federation and SSO to once more increase security and particularly ease of use.

The initial concept displayed in this work shall contribute to further thoughts on developing improved identity management solutions in shareconomy and beyond. In this regard, further research should be conducted towards how identity management solutions can be composed in other areas of the digital life (e.g. e-commerce, banking etc.) and evaluate how and if a holistic solution could be installed which facilitates account handling even further. Here, special attention must be paid to privacy and data protection topics.

In addition, further areas of interest beyond identity management could be identified for shareconomy within this work: the topics of policies and regulations of privately shared assets will emerge in future as incumbents feel threatened by upraising shareconomy business models and regulatory uncertainty dominates the market (The Economist, 2013, European Commission, 2013). Respective strategies and laws should be developed for shareconomy intermediaries to avoid legal charges and succeed on the market.

Start-ups engaging in shareconomy need to know to which extent regulation might prohibit competing with the conventional industry and how the market will be able to develop (European Commission, 2013:16). Moreover, research should be conducted on how shareconomy business models will influence traditional businesses and which changes, chances and challenges are to be expected in future.

The visions of peer-to-peer shareconomy are much greater than sharing resources several times per year. High growth rates can be expected when individuals or companies buy resources merely to rent them out and incumbents are getting involved as well transforming to hybrid business models of selling and sharing (e.g. hotels offering rooms via AirBnB or BMW with DriveNow). Moreover, the trend is going towards intelligent objects, such as houses, heaters, electricity modules, household appliances etc. of which some are simultaneously resources in shareconomy (e.g. cars, key systems etc.). In future, a general shift from physical access token to digital ones can be expected unlocking a huge potential for shareconomy. Resources can be shared more efficiently without physical contact, central storing of keys or transfer per mail. Flexible working environments like sharing of hardware, software, devices, and bring-your-own-device (BYOD) play an ever increasing role (Ansaldi, 2013:63).

At the same time, the more resources will be accessible through digital tokens, the higher are the risks of misuse via hacking and certificate theft. Barriers of digital crimes are much lower than physical crimes (e.g. stealing a car key), and access possibilities much larger. Thus, a secure and user friendly infrastructure will play an ever increasing role in this development. Since every digital action is easier to recognize and store for a very large amount of time, anonymity and data concerns are equally rising and have to be faced with appropriate methods. A suitable identity solution which builds trust between actors will open up new potentials for shareconomy at the same time as it is urgently required in this field.

Appendix

i. Clarification of terms

Shareconomy/sharing economy/share economy

“Shareconomy” is often also referred to as “Sharing economy” in current literature and online sources. Hence, these terms can be used interchangeably. In order to follow a consistent approach, the author will only refer to the term shareconomy. “Share economy” originally refers to Martin Weitzman’s concept which describes sharing of labor payment. He states that benefits for the society are increased as payment is dependent on a company’s profit and thus the company can overcome market pressure without laying off workers (Weitzman, 1984). His concept is often mentioned in the context of shareconomy due to an increased value by sharing parts of the income but is not directly addressed in this research paper.

User/customer/service provider/resource provider

In the traditional business context, one usually refers to the seller and buyer or provider and customer. Since in the digital space, numerous intermediaries have come to life, the classification here is somewhat different:

Resource provider refers to the actual owner of the resource which is being offered via a digital platform. The end user is the party which makes use of the resources. The end user and resource provider role can comprise the same person. When speaking about the platform itself, the term mostly relates to the users who will access services via an online platform to use or provide resources on the platform and therefore requires an identity management. The middleman/shareconomy platform is the intermediary, the party that gives access to numerous resources in the shareconomy by bundling them on a platform and enabling the communication between resource provider and resource user. Service provider can also be used as a synonym to middleman, because this party also facilitates the provision of a product or service by matching the resource provider and the end user, providing the necessary platform and insuring the operation of the business process.

The relation between these actors can be illustrated as follows:

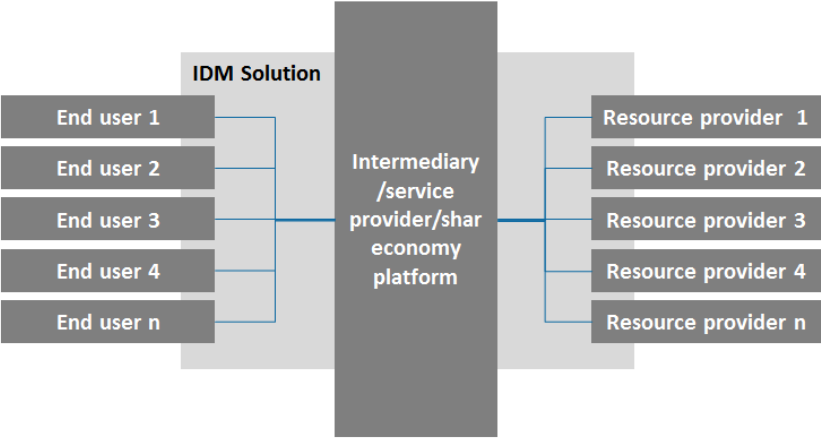


Figure 9: Relation between user, service provider and resource provider

TSP/identity service bus/identity broker

The terms TSP/identity service bus/identity broker will be used as synonyms in the course of this research paper. Trusted service platform (TSP) refers to the project with the partners Fraunhofer Institute FOKUS and Bundesdruckerei. Since the overall functionalities of the TSP equals those of an identity service bus and an identity broker, the terms can be used interchangeably. Additionally, the research questions addressed and examined here can be mostly transferred to any identity service bus and are not only limited to the boundaries of the trusted service platform project.

ii. Case study: current IDM solutions in shareconomy

Table 1: Current IDM methods of selected shareconomy platforms

Type	Platform	Link	Participants (year)	Main IDM Method and attributes	Additional IDM Methods	IDM/Trust	Data security and anonymity	Payment model
All share	Gnibble (GmbH i.L.)	www.gnibble.com	300 (2013) ³⁷	direct sign-up with username, password, email	Facebook, Twitter, Gmail	rating system, no assurance/proof of identity or data correctness	stores relevant data, no distribution of personal data, anonymous data for statistics purposes, no SSL	free of charge
Book share	Leih Dir ein Buch (GmbH)	www.leih-dir-ein-buch.de	833 (2013)	direct sign-up with username, password, email, name, birthdate and telephone number	n.a.	status system (according to number of transactions), identity proof copy can be requested by platform	stores relevant data, no distribution of personal data, anonymous data for statistics purposes, no SSL	system charge of 0,33 €/book, payment charge of 0,25€/payment
Carshare private	CarZapp (GmbH)	www.carzapp.net	700 (2013) ³⁸	direct sign-up with username, password, email, name, address, telephone number, payment data, driver's license number and date of issue	n.a.	rating system, verification through personal submission of ID and driver's license at a representative office	stores relevant data, no distribution of personal data, anonymous data for statistics purposes, SSL	rental charge, CarZapp charge (30-40%), insurance charge
Carshare private	Rent-n-Roll (GmbH)	www.rent-n-roll.de	500 (2013)	direct sign-up with username, password, email, birthdate, address, telephone number, driver's license date of issue, car data, ID card number	n.a.	rating system, no assurance/proof of identity or data correctness	stores relevant data, no distribution of personal data, anonymous data for statistics purposes, no SSL	rental charge, provider charge (15%), insurance charge ³⁹
Carshare private	AutoNetzer (GmbH)	www.autonetzer.de	10.000 (2012) ⁴⁰	direct sign-up with username, password, email, name, birthdate, address, telephone number	Facebook	rating system, optional link to social networks, no assurance/proof of data correctness	stores relevant data, no distribution of personal data, anonymous data for statistics purposes, no SSL	rental charge, provider charge (15%), insurance charge

³⁷ <https://www.facebook.com/gnibbleme>

³⁸ <https://www.facebook.com/carzapp>

³⁹ <http://www.flexauto.de/pages/privates-carsharing/rent-n-roll.php>

⁴⁰ http://www.business-angels-region-stuttgart.de/aktuelles/aktuelles.html?&news_id=307437

Carshare private	Nachbarschafts-auto (GmbH)	www.nachbarschafts-auto.de	10.000 (2012) ⁴¹	direct sign-up with username, name, password, email and location	Facebook	rating system, very limited assurance/proof of identity or data correctness	stores relevant data, no distribution of personal data, anonymous data for statistics purposes, SSL	rental charge, provider charge (15%), insurance charge
Clothes share	Common Vintage (GmbH)	www.commonvintage.com	n.a.	direct sign-up with username, password, email, name, address, birthdate	Facebook	"favorites" system, no assurance/proof of identity or data correctness	stores relevant data, opt-out distribution of personal data, anonymous data for statistics purposes, no SSL	transaction charge
Couch share	Couchsurfing (Certified B Corporation)	www.couchsurfing.org	3 million (2011)	direct sign-up with username, name, password, email, city, birth date	Facebook	rating system, credit card verification	stores relevant data, distribution of personal data, personal data for statistics and commercial purposes, SSL	registration charge of 19€
Couch share	BeWelcome (NPO)	www.bewelcome.org	45.000 (2013)	direct sign-up with username, password, email, address	n.a.	commentary system, no assurance/proof of identity or data correctness	stores relevant data, no distribution of personal data, anonymous data for statistics and commercial purposes, no SSL	free of charge, break-even through donations
Flat share	Air BnB (Corporation)	www.airbnb.de	1.5 million (2012)	direct sign-up with username, password, email	Facebook	rating system, verification via social networks or copy of identity card ⁴²	stores relevant data, distribution of personal data to network partners, anonymous data for statistics and commercial purposes, SSL	rental charge and provider charge, payment charge (3-12%)
Goods share	Leih Dir Was (GmbH)	www.leihdirwas.com	3.000 (2013) ⁴³	direct sign-up with username, name, password, email, birthdate	Facebook	rating system, sms verification, deposit	stores relevant data, no distribution of personal data, anonymous data for statistics and commercial purposes, no SSL	transaction charge (15%)
Goods share	Frents (GmbH)	www.frents.com	1.500 (2013) ⁴⁴	direct sign-up with username, name, password, email, postal code, birthdate	Facebook	rating system, no assurance/proof of identity or data correctness	stores relevant data, no distribution of personal data, anonymous data for statistics and commercial purposes, no SSL	free of charge (changes reserved)

⁴¹ <http://www.boell.de/de/navigation/wirtschaft-soziales-interview-nachbarschaftsauto-christian-piepenbrock-16248.html>

⁴² <https://www.airbnb.de/help/question/450>

⁴³ <https://www.facebook.com/leihdirwas?fref=ts>

⁴⁴ <https://www.facebook.com/frents>

Parking spot share	Ampido (GmbH)	www.ampido.com	1.000 (2013)	direct sign-up with username, password, email, address, birthdate, payment info	n.a.	no assurance/proof of identity or data correctness	stores relevant data, no distribution of personal data, anonymous data for statistics and commercial purposes, no SSL	transaction charge (30%)
Ride share	Mitfahrgelegenheit (GmbH)	www.mitfahrgelegenheit.de	4 million (2013)	direct sign-up with username, password, email, gender	Facebook	rating system, no assurance/proof of identity or data correctness, insurance for online booked travels	stores relevant data, no distribution of personal data, anonymous data for statistics and commercial purposes, no SSL	transaction charge
Ride share	Blablacar (Comuto SA)	www.blablacar.de	3 million (2013)	direct sign-up with username, password, email, name, birth year, gender, telephone number, picture	Facebook	rating system, sms verification, proof of contents (e.g. recognizable pictures) ⁴⁵	stores relevant data, no distribution of personal data, anonymous data for statistics and commercial purposes, no SSL	free of charge (changes reserved)
Task share	Mach Du Das (Limited)	www.machdudas.de	n.a.	direct sign-up with username, password, email, address	n.a.	rating system, no assurance/proof of identity or data correctness	stores relevant data, no distribution of personal data, anonymous data for statistics and commercial purposes, no SSL	transaction charge (3€)

⁴⁵ <http://www.blablacar.de/vertrauen-sicherheit>

iii. User survey

n=98

1. How many digital identities do you possess approximately all together (e.g. e-mail-accounts; accounts in social networks such as Facebook, Xing; accounts in marketplaces and e-business/e-commerce such as Amazon, Ebay etc., travel accounts such as Expedia, Easy Jet, Lufthansa, Deutsche Bahn etc.)?

1-5	6-10	11-25	26-50	51+
8%	41%	31%	16%	4%

2. Are you getting confused with remembering your account details from time to time? If so, how often?

< once/month	once/month	once/week	2-5 times/week	5+ times/week
33%	45%	16%	6%	0%

3. Would you prefer using fewer accounts (thus remembering less account details) to log into all kinds of portals?

yes	no	comments
70%	30%	if security and data protection are ensured (6)

4. Would you use single-sign-on identification?

[SSO means after having logged on once to a portal, all services which are included in the "net of trust" can be accessed without logging in again (as for example Yahoo where you can use several services with only logging in once)]

yes	no	comments
64%	36%	if security and data protection and privacy are ensured (7)

5. Would you like to have more control over your personal information in digital accounts (which data you provide to the system, which data can be transferred, which data can be stored)?

yes	no	comments
94%	6%	--- (0)

6. For some services, would you prefer a more secure identification, for example via two-factor authentication (e.g. SMS TANs), electronic cards such as the German identity card or other tokens which protects personal accounts and guarantees the authenticity of a person?

yes	no	comments
82%	18%	--- (0)

7. If you would prefer a more secure identification, for which services would that be?

Online banking	Online booking	Online purchase (E-commerce)
85%	45%	68%

8. In shareconomy (people sharing a resource instead of single ownership and use) services such as Mitfahrgelegenheit, Couchsurfing or AirBnB, where personal assets (here: cars or properties) are shared, do you think a more secure identity management is necessary?

[The most applied authentication method today is username/password. Stronger identity management are electronic cards such as the identity card or credit card.]

yes	no	comments
74%	26%	--- (0)

9. Would a more secure identification be a driver for you personally to use these shareconomy services (either for providing or using resources)?

yes	no	comments
60%	40%	--- (0)

10. Which potential in the facilitation/improvement of current identity management systems would you assign to the fields transparency, security, user control and ease of use?

[Explanation of terms:

- transparency: security and personal data use policies are displayed comprehensively;
- security: protects personal accounts and guarantees the authenticity of a person;
- user control: more control over personal information,
- ease of use: easier account management through SSO}

rank	very high	High	moderate	low	none
	4	3	2	1	0
transparency	27,91%	41,86%	23,26%	2,33%	0%
security	45,45%	31,82%	15,91%	4,55%	0%
user control	30,23%	46,51%	16,28%	4,65%	0%
ease of use	27,91%	46,51%	23,26%	2,33%	0%

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ISBN

978-3-00-046715-8

2014



