Success of Digital Identity Infrastructure:
A Grounded Model of eID Evolution Success

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Abstract

Digital identities (eID) are one of the crucial building blocks of a digital infrastructure. There are major differences between countries of the European Union when it comes to the success of digital identity infrastructure, yet, we lack insights into the conditions for successful digital identity infrastructure evolution (eID evolution success). Taking the outset in a digital infrastructure perspective, we conducted 18 expert interviews in the context of the European Union with the focal case of the eID infrastructure in Germany. We used the grounded theory method to develop a model of eID evolution success. We discuss how the model can be useful to governments, practitioners and researchers alike.

Keywords: Success of eID, eIDAS, Digital Identity, Grounded Theory, E-Government

1. Introduction

Digital infrastructures are collections of technological and human components, networks, systems and processes that contribute to the functioning of an organization, an industry, or an entire nation (Henfridsson & Bygstad, 2013). Digital identities (eID) are one of the crucial building blocks of a national digital infrastructure. Both, the private and the public sector, can benefit from digital identities, as a large number of services start with identity verification (e.g., identification of natural persons, organizations or objects). The digital identity is not only tied to the digital space (e.g., online services), but it can also be used in hybrid contexts by service providers on site, offering digital and physical service components. Market researchers estimate that the economic benefits of a successful national digital identity infrastructure could be 3-4% of the gross domestic product per country by 2030 (e.g., USA: 1 trillion US Dollar) (McKinsey, 2019). However, there are major differences between countries, inside and outside of the European Union, when it comes to the success of digital identity infrastructure. On the one hand there are countries like Estonia where eID is considered as part of the critical infrastructure and more than 2/3 of citizens regularly use eID services that the state offers (Tsap et al., 2020). On the other hand, there are countries like Germany, where only 7% of the German citizens' have ever used the eID function of their electronic ID card (PwC, 2021). The heterogeneity of individual EU states is addressed by the eIDAS Regulation, which tries to create a uniform framework for the cross-border use of electronic means of identification and trust services.

Henfridsson & Bygstad (2013) use a biological metaphor regarding the success of digital infrastructure evolution, whereby evolutional success can be seen as a question of survival and by filling a relevant role over time. Broadly referred, digital infrastructure evolution can be described as a "gradual process by which a digitally enabled infrastructure changes into a more complex form" (Henfridsson & Bygstad, 2013). The digital infrastructure evolution is viewed as a self-reinforcing, socio-technical process (macro-to-micro, socio-technical action, micro-to-macro), that is driven by the generative mechanisms of innovation, adoption and scaling. The generative mechanisms innovation, adoption and scaling are self-reinforcing processes, by which new products and services are created as (technical) infrastructure malleability spawns recombination of resources (innovation), by which more users adopt the infrastructure as more resources are invested to increase the usefulness of the infrastructure (adoption) and by which an infrastructure expands its reach as it attracts new partners by offering incentives for collaboration (scaling) (Henfridsson & Bygstad, 2013). These mechanisms have so far been investigated only separately by the previous eID literature. For example, Zefferer & Teufl (2015) address the adoption, Ribeiro et al. (2018) the scaling and Anand & Brass (2021) the innovation of eID solutions. However, we lack knowledge on the success of digital identity infrastructure evolution

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(eID evolution success) that takes into account all of the underlying mechanisms of digital infrastructure evolution. This also leads to the research question of this study: "*What are the attributes that affect the mechanisms of eID evolution success and how can these attributes represented in a grounded model?*"

There are three objectives of this study: First, we want to explore the attributes that affect the mechanisms of eID evolution success. Second, we want to connect these attributes with the theory of digital infrastructure evolution (Henfridsson & Bygstad, 2013). Third, we want to develop a grounded model of the phenomenon *eID evolution success,* which represents the explored attributes. We applied an explorative and qualitative research approach, using the grounded theory method (GTM), by conducting 18 expert interviews. As eID evolution success is an emerging topic in the field of e-government, we have an abbreviated review of the literature in this study.

In the next sections, we outline our grounded theory method and case selection (2.), our findings (3.), we discuss the findings, outline the limitations of this study and the implications for research and practice (4.).

2. Methodology

In this research, we applied the grounded theory methodology (GTM) (Glaser & Strauss, 1967) following the paradigm described by Strauss & Corbin (Corbin & Strauss, 2015; Strauss & Corbin, 1990) and the GTM procedure described by Wiesche et al. (2017). The context of this study is the European Union whereby Germany was selected as the focal case with its multiple embedded units of analysis, represented by various eID projects and infrastructures. Germany is a particularly critical case in the European Union regarding successful digital identity infrastructure evolution, because it differs from other EU states in terms of adoption, scaling and innovation of digital identity infrastructure. A lack of adoption is present in Germany, since only 7% of the German citizens' have ever used the German eID service. There is also a lack of scaling regarding eID partner services in Germany, because seven out of ten German citizens' say, that they have not used the eID function yet, because the necessary use cases are not available (PwC, 2021). Additionally, there is, following the theoretical innovation mechanism of Henfridsson & Bygstad (2013) and the technical malleability as a prerequisite of the innovation mechanism, a lack of innovation, because there have been no major technical changes and recombination's

of resources to provide new services since the launch of the electronic ID card in the year 2010 in Germany.

Therefore, Germany represents a critical case regarding eID evolution success. We applied a critical case selection in our study, by choosing Germany as focal point, as part of an information-oriented selection, which describes the counterpart of random selection. A critical case can be defined as having strategic importance in relation to the general problem and achieves information, that permits logical deductions of the type (Flyvbjerg, 2006). Since in Germany the need for a successful eID evolution is particularly high and as Germany is a critical case regarding the mechanisms adoption, scaling and innovation, we expect attributes which could be particularly evident. Due to the embedding of Germany in the European Union, the large differences between individual EU countries and the simultaneous need for joint cooperation in the field of eID (e.g., eIDAS regulation), we also focused on deliberate overlaps to other countries regarding the data collection and examination. This overlap with other countries facilitates the generalizability of the grounded model.
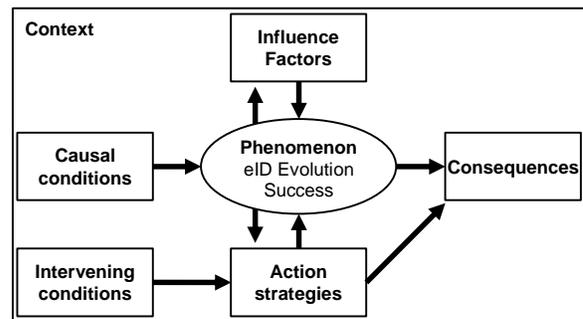

Figure 1. GTM study model adapted from Corbin & Strauss (Corbin & Strauss, 2015)

The study pursued an exploratory qualitative research approach by conducting expert interviews and analyzing them qualitatively. The study took place over a period of six months from January to June 2022. Methodologically, this study was based on nine steps regarding GTM described by Wiesche et al. (2017). During the steps of theoretical sampling (1) and role of prior theory (2), and in addition to identifying the research gap, deriving the research questions and data acquisition, we used Strauss and Corbin's GTM paradigm (Strauss & Corbin, 1990) to define a GTM study model and to design our interview guidelines for the expert interviews. Our GTM study model (Figure 1) consists the categories causal conditions, phenomenon, context, influence factors (divided in general, drivers, barriers and critical success factors), action strategies, intervening conditions and

consequences. The categories represent external origin effects, surrounding the phenomenon, and in which the attributes need to be found. Based on the theory of Henfridsson and Bygstad (2013), the phenomenon was determined as *successful digital identity infrastructure evolution (eID evolution success)*, with its internal mechanisms of adoption (A), scaling (S) and innovation (I) and the socio-technical (ST) mechanism. The internal mechanisms should be connected to the attributes with its external origin effects. In our GTM study model the influence factors are referred to the action strategies. To address a wide range of possible action strategies, reference was made within the category of action strategies to the four quality dimensions technology, information, human and process of Walke & Winkler (2022). These quality dimensions were expanded to include an additional dimension called systemic, which was used to query organizational, regulatory, structural and strategical factors, from a system theory (Luhmann, 2017) perspective with regard to the actions strategies.

The experts for the interviews were recruited from the public, private, private-public and non-profit sector. A total of 18 experts were interviewed. The prerequisite for participation was, that the experts are professionally active in the field of eID, hold high-ranking positions in their sector and have influence on what is happening regarding eID in Germany. Since eID in Germany is mainly controlled by the government, the focus of the interviews was on eID experts from the public sector. The interviews were processed with open and explorative questions related to the given GTM study model category.

The data analysis steps of open coding (3), axial coding (4), selective coding (5), theoretical coding (6), constant comparison (7) and memoing (8) described by Wiesche et al. (2017) have been performed using MAXQDA Software and were based on the coding system of the GTM study model (Figure 1). Since the coding paradigm, the core category and the relations between the categories have already been predetermined by the GTM study model, the step of theoretical coding (6) was used to connect the theory (Henfridsson & Bygstad, 2013) with the attributes, which need to be discovered. The theory connection took place by analyzing the qualitative data regarding effects that focus on the elements of the individual mechanisms (e.g., micro-to-macro, technical malleability, more users adopt, partners attracted). We also used the step of selective coding (5) twice, to identify theoretical terms through constant comparison (7) and memoing (8), if multiple attributes could be condensed. The step of the final connection to the coding paradigm (9) was used to develop the final grounded model.

3. Findings

We present the findings of this study successively based on the categories of the GTM study model and by separating the findings in three coding steps, axial coding, selective coding and theoretical coding, especially to provide a logical chain of evidence. The presentation of the coding results is based on the explanations of Williams & Moser (2019). The step of open coding is described textually and provides an excerpt of critical and relevant attributes that were expressed by the interviewees. Additionally, we highlight relevant findings of the coding process with expressive and direct citations from the experts.

Based on Henfridsson & Bygstad (2013), the pre-given *phenomenon* of eID evolution success was defined as a question of survival and by filling a relevant role over time. Unclear was, how the relevance and success regarding eID can be measured. The qualitative data shows, that the success of eID could be measured through its traction, which means that the amount of transactions, in which the national eID function has been used, could be one possible indicator to measure eID evolution success.

Regarding *context*, we address the question of the contextual determinants of eID evolution success. The interviewees answers could be classified to five contextual dimensions: Infrastructure (1), model (2), quality (3), systemic (4) and international (5) context. The infrastructure (1) can be described through projects, technology (e.g., protocols), identity management (e.g., user accounts, register) and services. The main eID function in Germany is the electronic identification with the German national ID card, which can be connected to a card reader or a NFC-enabled smartphone, by using an ID card app. There also co-exist the union citizen card, the electronic resident permit, federal state eID services, municipal eID services, numerous private sector eID service provider (e.g., for video-identification) and numerous publicly funded eID projects. The current infrastructure was called a "*patchwork rug*" (Private sector interviewee). The model (2) is described through the eID source (e.g., public or private source of eID) and the paradigm behind eID. In Germany a public eID source is present. A prominent paradigm which was described by most of the experts is Self-Sovereign-Identity (SSI), where was especially pointed out "*that the data should be available in a decentralized manner and should also be with the users themselves*" (Public sector interviewee). The quality (3) context consists in general of an evaluation of the current situation regarding services (e.g., statistics, conditions), information (e.g., identifier, enterprise data), governance (e.g., eID market entry)

and technology (e.g., technology caused lack of scaling) quality. The systemic (4) context consists of organizations involved (e.g., companies, authorities), administrative division (e.g., federal structures) and national regulation (e.g., money laundering act and online access act). The *international* (5) context consists of the community (e.g., EU, eIDAS), technology (e.g., foreign smartphone operating systems) and international best practices (IBP). IBP was named as a positive counter-example to Germany, since "*we don't have a reasonable eID infrastructure in Germany at the moment. We just don't stand there as broadly as we could stand there.*" (Public sector interviewee).

In the category *causal conditions*, the axial codes could be condensed during selective coding to one attribute: Necessity of identification (Table 2), which can be named in a theoretical term a socio-technical condition. Identification is associated with every public administration process and is also a necessity in many private-sector processes:

> *Because in many processes it is simply necessary to start a transaction with a unique identification and yes, just like I show my ID card in the natural world, in the digital world I basically need to have a way to present a digital document.* (Private sector interviewee).

Digitalization, efficiency and participation has also been mentioned, since there is a need for transferring analogue identity to digital identity, for reducing physical processes and for facilitating participation in processes (e.g., rural population).

Table 2. Causal conditions and their coding

Axial Coding	Selective Coding	Theoretical Coding
Identification		
Necessity		
Participation	Necessity of Identification	Socio-technical condition
Efficiency		
Digitalization		

In the category *influence factors*, the open codes could be condensed during selective coding to five attributes (Table 3): Public-private-link (1), service diversity (2), IT-focus (3), user premises (4) and systemic factors (5). The influence factors itself were divided in general influence factors, critical success factors, drivers and barriers, while drivers and barriers are subsumed under antagonistic influences, because drivers and barriers seem to have a specific counterpart, in which the experts often cited an opposite effect in one coherent paragraph (Table 3).

Regarding the public-private-link (1) there have been highlighted the missing competition in the area of eID, since the public eID is provided mainly by two public-private-partnership organizations in Germany. Additionally, in general, the focus of eID in Germany is since now on public sector services. A private-sector-link seems to be seen by all experts as a driver behind eID evolution success. The generative mechanism behind public-private-link is scaling, since the qualitative data indicates a scaling effect through the attraction of new partners.

Service diversity (2) has been identified as a critical success factor of eID evolution, which consists of diversity of use, service conditions and a uniform user account for different cases of application. Regarding service conditions, a daily relevance of the eID services (e.g., bank login), broadness of uses, low-threshold offers and added value of services seem to be critical success factors. Additionally, services need to be affordable and provide good user experience, without media discontinuities. The services have also been named as use cases, offers and points of acceptance. Regarding diversity of use, the experts pointed out, that it is important, that different kind of services in different contexts need to be provided, which also has been named flexibility of use by the experts. The uniform user account is a critical success factor, as it can offer the bridge between the differing services. The generative mechanism behind service-diversity is adoption, since the qualitative data indicates an adoption effect through increased user adoption and increased usefulness of the services.

IT-focus (3) contains usability, which seems to be the counterpart of security. Usability is the attribute, in which the most answers of the experts have been made, saying that usability is a necessity and a strong driver in successful eID evolution, especially for the generative mechanism adoption. Additionally, they mentioned that the previous focus in Germany was on the counterpart security. A similar relationship is mentioned regarding software solutions (drivers) and hardware solutions (barriers). Since in Germany the main focus of eID is on the hardware based identification with the ID card, which has the highest trust and security level possible, software solutions for eID services have been neglected so far. Software solutions could enable faster eID evolution success regarding development and application, whereby the generative innovation mechanism is present. Hardware solutions are part of the IT-focus attribute and connected to the IT vendors and its general influences. Regarding IT vendors, the experts pointed out the importance of country-specific location of IT vendors, smartphone operating systems and manufacturer, whereby the innovation mechanism is affected, since technical malleability is in this context primarily based on IT vendors like smartphone manufacturer. IT configuration has been mentioned in

the context of the scalability of used technology, so the mechanism of scaling is given. The experts mentioned, that the current IT configuration regarding eID in Germany "*just doesn't scale up. It also won't scale to width [in future]*" (Public sector interviewee). "*This type of eID as we have it now will not prevail in the next 20 years, and that's why it's incomprehensible to me that the [responsible authority] really still holding on to it and doesn't go in a different direction*" (Private sector interviewee).

The user premises (4) consists of the antagonistic pair of trust and skeptical mentality and the general influence factors established user habits, awareness and acceptance. With regard to awareness, it was noted, that the prominence of the eID service is relevant and that not only the advantages are seen by the users with regard to eID, but that the authenticity of identity verification can also have negative connotations. The acceptance of eID by the citizens' is a general and critical influence factor, especially in Germany. The established user habits are related to existing behaviors with products and services of the private sector. The public sector could fail with services, especially regarding acceptance, if the services require new and challenging behaviors from users. Trust is a driver and skeptical mentality a barrier for eID evolution success, while both seem to be country specific and closely related to the privacy paradox phenomenon. The generative mechanism behind user premises is adoption, since the "users drive the adoption mechanism" (Henfridsson & Bygstad, 2013).

The systemic factors (5) consist of general influences of regulation, public management culture, political awareness and antagonistic influences regarding regulation and organizational structures. The generative mechanism behind the systemic factors is the socio-technical mechanism, since macro-micro level, micro-macro level and socio-technical actions are present. The eIDAS regulation seems to have a driving effect, while national (over-)regulations and the General Data Protection Regulation (GDPR) seem to have an inhibiting effect. A legal obligation to use eID seems to be a particularly critical driver, regarding end-users and involved organizations. Overall, an organizational centralization of digitalization actions was described as a driving force, whereby the complex organizational circumstances in Germany having an inhibiting effect. Regarding political awareness, it was noted that discussions in politics are present, if a digital identity should be dominated and driven by the private sector (e.g., tech giants). Regarding the public management culture, it was mentioned that often flagship projects are initiated, however there seems to be a problem with the transfer of projects into regular

operation. Additionally, it was noted that a sectoral way of thinking prevails in Germany and that there are no overlaps or interfaces between sectors (e.g., health, administration or security sector). The understanding that eID could create a bridge between these sectors does not yet seem to prevail in Germany. Even within a sector, this understanding does not yet exist, since eID has not yet been taken into account in the federal state implementation of digitalization actions.

Table 3. Influence factors and their coding

Axial Coding	Selective Coding	Theoretic. Coding
General Influence Factors		
Regulation	Systemic Factors*	Socio-technical
Public management culture		
Political awareness		
IT vendors	IT-Focus*	Innovation
IT configuration		Scaling
Established user habits	User Premises*	Adoption
Awareness		
Acceptance		
Critical Success Factors		
Diversity of use	Service Diversity	Adoption
Service conditions		
Uniform user account		
Antagonistic Influence Factors		
Drivers (→) (←) Barriers		
Private sector link ↔ Public sector focus	Public-Private-Link	Scaling
Competition ↔ Monopolization		
Usability ↔ Security	IT-Focus*	Adoption
Software solutions ↔ Hardware solutions		Innovation
Trust ↔ Skeptical mentality	User Premises*	Adoption
Use of new technologies ↔ GDPR / Privacy	Systemic Factors*	Socio-technical
Harmonized regulation (eIDAS) ↔ National over-regulation		
Obligation to use ↔ Freedom of non-use		
Organizational centralization ↔ Complexity of responsible authorities		
*Coding categories have been grouped together across general and antagonistic influences		

The *action strategies* are divided in five dimensions, based on the framework of Walke & Winkler (2022): Technology, information, human, process and systemic (Table 4). In every single dimension we identified during selective coding one core action strategy with the highest impact in their given dimension, which are presented below.

In the technology dimension we identified during axial coding the attributes providing alternatives,

modernization and alignment shift. Providing eID alternatives is one major action strategy, where a decreased substantial assurance level was requested, instead of a high assurance level:

The online ID function is high [assurance level], it is actually even more than high, so it fulfills more than what one would actually have to fulfill for high. And that means that you can definitely have, for example, substantial means of identity, which then just reach a substantial level of assurance, which are then simpler. That is definitely possible and it would also be possible in principle in parallel with the current eID [online ID function]. (Public sector interviewee).

The technological modernization should focus on interfaces and their standardization. The technological alignment should be shifted to eID wallets and to a smartphone focus, where user held identity data. The term of a "killer application" was mentioned, whose implementation could be an effective action strategy, especially if it would be combined with a driving influence factor like a banking login (public-private-link). An open source software based solution would be a driver, compared to a proprietary solution, which also addresses the issue of sovereignty: *I'm a big proponent of open source technology that you build on, open standards, open code that you see, yes that's exactly what I think that's the answer, so you shouldn't be doing extremely proprietary software* (Private sector interviewee). Regarding the underlying issue of sovereignty, there have also been mentioned that "*in Germany there is currently no [potent] hardware manufacturer for mobile phones, which is really a sensitive point, so that's why I've always been more a fan, also thinking about software solutions to a certain extent.*" (Private sector interviewee). A technological alignment shift and its underlying issue of technological sovereignty could be addressed through operating systems and smartphone devices, that have their origin in the EU. During selective coding we condensed the three attributes providing alternatives, modernization and alignment shift to the attribute technological shift (1).

In the information dimension we identified during axial coding the attributes distribution, quality and availability. There was an increased information distribution requested regarding digitalization, because several IT projects are running side by side and do not know from each other:

Many movements, within this level of the federal administration are doing a lot of things, but they may not know anything about the many efforts of digitalization, because things are running in parallel and have the same focus, then in the end you realize,

oh you actually have exactly the same thing implemented. (Public sector interviewee).

Regarding information quality, the attributes conciseness, intelligibility and findability were prominent informational quality attributes, that need to be focused, since distributed information is often too extensive (e.g., specifications), difficult to understand and difficult to find. This also leads to the availability of information, this actually trivial prerequisite does not yet seem to be sufficiently available with regard to eID and digitalization. A comprehensive information structure and information atlas were requested. During selective coding we condensed distribution, quality and availability to the attribute informational organizing (2).

Table 4. Action strategies and their coding

Axial Coding	Selective Coding	Theoretical Coding
Technology		
Providing Alternatives	Technological Shift	
Modernization		
Alignment Shift		
Information		
Distribution	Informational Organizing	
Quality		
Availability		
Human		Socio-technical strategies
Internal Expertise	Internal Premises Shift	
Mindset		
Process		
Collaboration	Collaborative Governance	
Communication		
Governance		
Systemic		
Strategic alignment	New Systemic Alignment	
Structural conditions		
Regulation		

In the human dimension we identified the attributes internal expertise and mindset. Building internal expertise seems to be a critical action strategy, while external consultants have been criticized. Poor payment in the public sector must be addressed to increase human resources: "*What I think is fundamentally missing in these areas is, I think that's the case in all authorities, you actually have too few internal people who know their way around or are willing to read up on the relevant things.*" (Public sector interviewee). Regarding mindset there seems to be a general mentality thinking in risks, which should be switched to an openness for new technologies. Additionally, a cost awareness and a user-centric mindset should be build, instead of an administrative mindset: "*They [private sector] have already internalized the idea of better service, simply because*

they have to, they need customers. The joke is, public authorities do not need customers, at worst, they do not want any. At the same time, they are essential to administer the laws that society has given itself in order to enable social coexistence." (Public sector subject). This given quote also discovers a user-centric paradox in the public sector, between the non-given need of customers and its function of a societal enabler. We condensed the two attributes internal expertise and mindset during selective coding to the attribute internal premises shift (3).

In the process dimension we identified the attributes collaboration, communication and governance. Regarding collaboration, the cooperation between the ministries and federal states and the participation of all political partners seem to be critical strategies for successful eID evolution. The concept of interministerial working groups was mentioned as a possibility for improved cooperation, which can possibly be seen as a counter-model to the centralization of digitalization and eID activities. Also the collaboration between the public and private sector needs to be improved (e.g., implementation of conversational levels, common wording). Regarding communication, there seems to be a lack of marketing in general, because the elementary basics such as press relations, highlighting customer benefits and holistic communication are missing, which seem to be important strategies regarding eID evolution success. The communication needs to "*make it [eID] sexy*" (Private sector interviewee). Regarding governance, the digitalization-check of laws, that laws are digitizable, a more transparent law-making process (especially for eIDAS) and a one-for-all-approach was highlighted. The one-for-all-approach has not yet prevailed during digitalization activities at the federal state level. General improvements through lessons learned from IT-projects and process streamlining within digitalization should be considered. During selective coding we condensed collaboration, communication and governance to the attribute collaborative governance (4).

In the systemic dimension we identified the attributes regulation, structural conditions and strategic alignment. Regarding regulation, the focus of alignment should lie on eIDAS, with regard to an eIDAS novelization that is able to increase cross-border eID traction, and also the standardization and adaption of national laws. Laws such as requiring physical signatures should be avoided as a matter of urgency. Committees decisions should have a binding character. Regarding structural conditions have been highlighted the breaking up of monopolies. Authorization assignment for eID is done by one organization in Germany: "*And then of course they A,*

will dictate the price and B, will also dictate the process of how you get your turn." (Public sector interviewee). Regarding structural conditions, the centralization has been mentioned concerning four different topics: competences, digitalization, budget sovereignty and the power to direct. In Germany every ministry (e.g., finance, economic affairs and climate action, digital and transport, interior and community) has its own budget and each federal ministry manages his portfolio independently and under his own responsibility. Different ministries are responsible for various digitalization tasks and are not forced to cooperate regarding digitalization. This leads to individual IT projects that do not lead to uniform digitalization progress:

First of all, digitalization would have to be centralized, yes, we often notice this at the federal level, I think there are 16 departments or something, that are all involved in digitalization somewhere, where nobody sets the direction, because everyone does their own thing somehow (…) the [two different ministries], which are relatively antagonistic, they set intense boundaries from each other, they don't want any synergies or they don't try to find huge synergies between their two ministries. (Public sector interviewee).

The competences are connected to the centralization of digitalization, whereby the centralized alignment of digitalization would have to be combined with a centralization of competences. A very far-reaching and effective action strategy, which would force uniformity, is the centralization of budget sovereignty and the power to direct:

The problem is, there is no power to direct and each ministry still has its own budget and can also self-sufficiently decide about it, how they implement and what they implement, whether they do something alone or whether they do it all together (…) and there is a lot of money in circulation, the budgets are anchored in the individual ministries (…) and I think that's a point, if we have budget sovereignty and also a centralized responsibility for digitalization. (Public sector interviewee).

The previous federal government made an attempt to counteract this situation by anchoring a digital minister in the highest authority, the Federal Chancellery (2018-2021). The model was not pursued further due to a change of government. A possibly counter-model to budget sovereignty and power to direct could be the interministerial working groups. With regard to distribution of funds, better controlling was requested and with regard to centralization, the need to implement an independent digital agency was also pointed out, which should be available to provide

independent advice to the organizations involved. Regarding the strategic alignment, there has been highlighted the strategic requirements, that there is a need for strategies, which focus on overall-digitalization and pursue an overarching and uniform approach. Additionally, strategies should be taken into account, which focus on the rollout of eID services. There should also be strategies, which provide experimental options and regarding IT-project management, there should be more iterative strategies, which result in minimum viable products, to slowly approach the customers and their acceptance, instead of building the whole system completely at the beginning. Regarding strategies, there have been highlighted the cooperation with economy, subsidies for eID, funding projects for EU operating systems and smartphones, adoption of international best practices (IBP), a substantial notification, a profile notification and task forces for municipalities. In general, there should also be a consideration of object and organization identification, and not only a limitation to an identification of natural persons. The adoption of international best practices was the most highlighted attribute regarding strategies and can be understood as a high-level strategy of strategy adoption. Foreign activities regarding eID should be brought into focus much more often (e.g., SPID in Italy, Netherlands eHerkenning, Danish National eID MitID, Electronic Identity in Estonia and BankID in Sweden). During selective coding we condensed the three attributes regulation, structural conditions, strategic alignment to the attribute new systemic alignment (5). All attributes in the action strategy category have been mapped to the socio-technical mechanism during theoretical coding, since the action strategies rely on the mechanisms macro-to-micro, socio-technical action and micro-to-macro (Henfridsson & Bygstad, 2013).

Table 5. Intervening conditions and their coding

Axial Coding	Selective Coding	Theoretical Coding
General digitizability	Digitizability	Socio-technical condition
Regulatory free spaces	Open spaces	
Open attitudes		
Agreement of interests		
Political sphere		

Regarding the category *intervening conditions*, we identified during axial coding five attributes (Table 5), regulatory free spaces, open attitudes, agreement of interests, political sphere and general digitizability as intervening pre-conditions for the action strategies. General digitizability was mentioned regarding digitizability of laws and processes. If laws exist, that are not digitizable (e.g., physical signature requirement), action strategies regarding eID can not

be implemented. General digitizability has been condensed during selective coding to digitizability, which represents a socio-technical condition.

The regulatory free spaces consist of experimental clauses, real-world labs and regulatory freedom which could make action strategies possible, especially regarding the new systemic alignment attribute. Under open attitudes have been condensed an equal treatment of economy and public administration, a try out mentality and breaking up deadlocked ministerial attitudes. Since political decisions are important intervening conditions for actions, political will and a political majority must first be won (political sphere). The agreement of interests has also been mentioned as an intervening condition. During selective coding we condensed the four attributes regulatory free spaces, open attitudes, agreement of interests and political sphere to the attribute open spaces, which represents the highest impact intervening condition. Open spaces are considered in this study as a general socio-psychological concept of a high impact intervening condition, in which thoughts can be openly expressed in free spaces, independently of laws and premises, and equal participants can come together at eye level, in which thoughts and new development options can be discussed. Regulatory free spaces, open attitudes, political majority and agreements of interests could be a result of an open space. There do exist cognate methods of conducting meetings and conferences in an open space (Owen, 1998). Innovative methods of group moderation and structuring of meetings should be the basis for the mentioned interministerial working groups in the action strategy category.

Table 6. Consequences and their coding

Axial Coding	Selective Coding	Theoretical Coding
Opportunities	Socioeconomic shifts	Socio-technical consequence
Economic		
Systemic		
Process		
Risks		
Social		

The *consequences* category can be divided in the two dimensions opportunities and risks (Table 6), which are the result of the qualitative analysis of the data. Within the opportunities we identified during axial coding three relevant attributes: economic, systemic and process. The positive aspects (opportunities) of eID evolution success were prioritized by the experts: "*But I actually believe that the positive things, the positive points, outweigh the negative ones and, in my opinion, can then be put into perspective by mitigating measures.*" (Private sector interviewee). Regarding economic, cost savings, economic growth and a service enabling effect were

mentioned. Regarding systemic, transparency, acting more ecofriendly, equity, cross-sector synergy effects, legal certainty and secure identification, especially regarding identity abuse under criminal aspects, were mentioned. Regarding process, the following opportunities have been mentioned: process streamlining, acceleration of administration, more efficiency, better political advice, acceleration of digitalization, reducing bureaucracy and automation, especially with the meaning of automatized administrative processes. Within the risks we identified during axial coding one relevant attribute: social. Regarding the social attribute have been mentioned data desires, data kraken state, cyber attacks and a transparent citizen, which all represent social risks that could take place with eID evolution success. Opportunities and risks have been condensed during selective coding to the attribute socioeconomic shifts, which represents a socio-technical consequence.
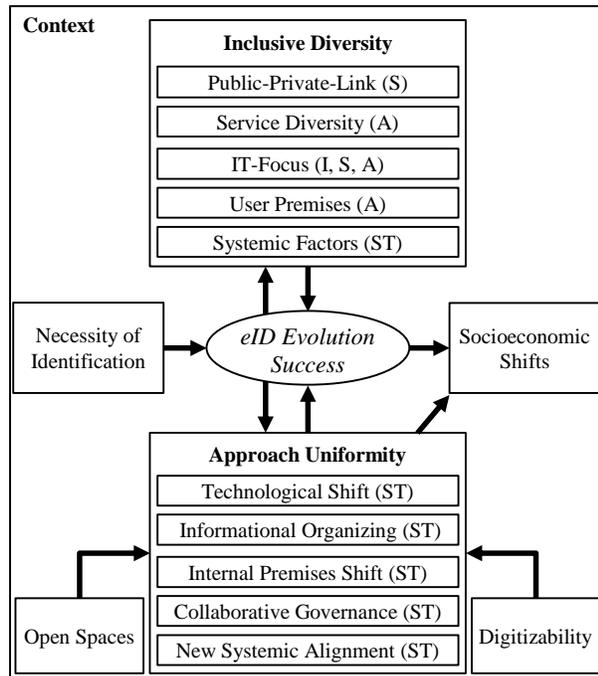

Figure 2. Grounded model of eID evolution success

Since every GTM study category, except influence factors and action strategies, have one single representing attribute, we have done the selective coding step twice regarding influence factors and action strategies. Through constant comparison and memoing we identified an overarching action strategy and influence factor. Regarding action strategies, the results indicate that the *uniformity of an action strategy approach* has the highest impact on eID

evolution success, since most of the expert answers have repeatedly mentioned the concept of uniformity across all action strategies and emphasized its importance:

"*I don't really care whether I'm at a bank, at the administration or at the doctor's office. What I am doing here is identification, authentication, and why does it always have to be different. What is exactly missing here is the framework for this, so to speak, above all the regulatory framework. What's missing is, let's say, a uniform approach with regard to procedures, methods, and solutions.*" (Private sector interviewee).

We have systems, but we just have use case-related systems, we have administration, we have banks, we have others. And there is no uniform overall system. (...) it is very difficult to communicate to the user why he can use it in one place but not in another place. So from that point of view, there should be an identity that can be used everywhere. (Public sector interviewee).

The qualitative data indicates that the overarching influence factor is *inclusive diversity*, as the results from the expert interviews indicate an effect, that the greater the inclusivity of services, the private sector, innovative technologies and users and the greater the diversity of these components, the greater the influence on eID evolution success. Inclusive diversity is therefore chosen as the influence factor with the highest impact on eID evolution success. The attribute inclusive diversity and approach uniformity are therefore part of the influence factors and action strategies, which are presented next to the other attributes in the final grounded model of eID evolution success (Figure 2), which is based on the GTM study model (Figure 1).

4. Discussion and Conclusion

In this study we followed an exploratory and qualitative research approach regarding the phenomenon—*eID evolution success*—using the grounded theory method. The research question was addressed by discovering the attributes that affect the mechanisms of eID evolution success and by representing these attributes in a grounded model. The context of eID evolution success can be described using five dimensions: infrastructure, model, quality, systemic and international. The results of this study show that necessity of identification is the causal condition and socioeconomic shifts the consequence of eID evolution success. The phenomenon of eID evolution success is mainly influenced by inclusive diversity, public-private-link, service diversity,

IT-focus, user premises and systemic factors. Successful eID evolution can be driven with the action strategies technological shift, informational organizing, internal premises shift, collaborative governance and new systemic alignment, whereby open spaces and digitizability represent intervening conditions. We have connected the found attributes to the theory of digital infrastructure evolution. The connection to theory shows, which mechanisms work in relation to successful eID infrastructure evolution and it can be shown, that the digital infrastructure evolution theory can also be combined with attributes of an eID infrastructure. It also shows, that the IT-focus addresses three mechanisms at the same time, so this attribute should be given special consideration when establishing an eID infrastructure.

The study results can be useful for governments and practitioners, since the understanding of categories and attributes can provide clarity and fuel a discussion among stakeholders involved in eID implementation projects. A practical implication for governments is, that there need to be an approach uniformity when it comes to successful eID evolution. Practitioners should take a technological shift into consideration, if less success regarding eID is reported. Additionally, informational organizing, an internal premises shift, collaborative governance and a new systemic alignment should be considered. The influence factors of eID evolution success implicitly contain action strategies, as an increased adoption, innovation and scaling regarding eID evolution success is present with a public-private-link, increased service diversity and by taking user premises and a differing IT-focus into account.

The following limitations merit consideration. The study focuses on eID evolution success, the failure of eID evolution was given little consideration. The experts in this study mentioned, as a risk of inaction, that the dependencies to tech giants could increase. The study includes a sample of 18 expert interviewees from Germany, which represents a critical case selection. A similar approach should be carried out with experts from other countries and with different cases in future research, to ensure that the results can be generalized.

The establishment of a successful digital identity infrastructure can bring about numerous beneficial socio-economic changes and represents a unique opportunity, especially for developing countries with regard to digitalization, to create a cross-sectoral infrastructure (e.g., health, administration, security) and therefore numerous resource-related benefits. It could also counteract barriers and structural weaknesses in a nations digital infrastructure and can be considered as a major accelerator of digitalization.

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