# THE FAILED IMPLEMENTATION OF THE ELECTRONIC PRESCRIPTION IN GERMANY – A CASE STUDY

*Complete Research*

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## Abstract

*Many countries worldwide are striving for improving the quality of care and for reducing costs in the health care sector by establishing large IT infrastructures. In Germany, the introduction of the electronic health card and the national telematics infrastructure is lagging years behind the original schedule. In this paper, we describe and analyze a case study of one selected part of this ultra-large intervention. The selected part is the failed implementation of the electronic prescription. The related activities started in 2003 and ended in 2010 when a decision was made to abandon this part of the intervention. We present a detailed analysis of the project and identify 14 reasons in five categories for the project's failure. Furthermore, we provide a multi-layered overview of the episodes and subprojects.*

*Keywords: electronic health card, failure, prescription, ultra-large projects, health infrastructure*

## 1 Introduction

Around the world, many countries are fostering the use of IT in their health care systems. They aim at enhancing the information flow among different actors in the health care system in order to improve the quality of care and to reduce costs. However, until now, the health care sectors are often lagging behind compared with the IT use in other industries. To address this shortcoming, governments in many countries have started eHealth initiatives (Clegg and Shepherd, 2007; Conford and Hibberd, 2014; Cripps et al., 2011; McGrath et al., 2008; Sunyaev et al., 2009a; Tamburis et al., 2011). These initiatives spend a lot of money for establishing new IT infrastructures. The projects for implementing these infrastructures do often have a tremendous size in terms of peoples involved, effort spend and money invested. Nevertheless, some of these projects fail to achieve their goals (KPMG, 2012a, 2012b).

In this paper, we address the following question: Why did the implementation of the electronic prescription in Germany fail? The electronic prescription is one of the major applications for Germany's electronic health card and the according telematics infrastructure. For answering the research question, we conducted a case study based on documentary materials.

In the following section, we summarize related research. In the third section, we describe the methodological approach we used. In the fourth section, we present the results from our case study. In the fifth section, we discuss the results regarding their contribution, limitations, and the framework we used for our analysis. The paper closes with a summary and an outlook.

## 2 Related Research

We identified three main streams of related research. The first stream analyzes the implementation of large health infrastructures in Germany and other countries. The second stream covers the failure of IS/IT projects in general. The third stream addresses IT implementation in inter-organizational and ultra-large settings and projects.

The **German health card project** has been analyzed in a few publications. Sunyaev et al. (2009a) describe the basic applications that are mentioned in the respective law. When this paper was published, the decision of abandoning the electronic prescription has not been made. It provides some basic process models of the prescription process. The empirical evaluation in this work only focuses on the voluntary applications. As the electronic prescription is mandatory, this paper does not provide any new data regarding this application. Other papers suggest new applications which might be added to the telematics infrastructure in the future (Duennebeil et al., 2009) or address security issues (Sunyaev et al., 2009b).

Worldwide, many other countries seek to improve their health care systems by developing and implementing new IT systems. Comparative studies from KPMG revealed that many of these initiatives fail to achieve their goals and exceed financial and time limits (KPMG, 2012a, 2012b). In the **United Kingdom**, an electronic prescription service has been implemented as a part of the 'National Programme for IT' (Cornford and Hibberd, 2014). In August 2013, around 800 general practitioners and 10.000 pharmacies were using the new version of the prescription system (EPS R2) (ibid.). It is still in the implementation and rollout phase. In the **Netherlands**, a system for supporting the prescription process in the practices was established from 1999 until 2001 (Boonstra et al., 2004). The main intention of this system was to reduce costs for medication by giving advice to the physicians. There was no central infrastructure in place and an electronic transmission has not been part of that project. In **Finnland**, the government decided in 2000 to implement an electronic prescription system (Salmivalli, 2006). The first clinical pilot started in 2004. By the end of 2005, only 800 electronic prescriptions were processed by the system. In June 2006, the pilot project ended. **Other countries** have also started similar initiatives like the **US** (Teich et al., 2005), **Sweden** (Bastholm Rahmner et al., 2004), or **Spain** (Pina Vera, 2006). Each of these programs has different starting points, contexts, implementation processes and technical solutions (Salmivalli, 2006). Due to the limited space, we cannot provide detailed information on each of these projects in this paper. Furthermore, detailed information on some of these projects is outdated or not available. With our contribution, we seek to foster the comparison of success and failure in these projects be giving detailed insights into the German project, which might later on be used for giving a multi-national overview.

The **failure of information systems** has been a subject in IS research for forty years (Lucas, 1975, Dwivedi et al., 2014). Chris Sauers book "Why information systems fail" (Sauer, 1993) and Lyytinen and Hirschheim's (1987) article on "Information system failures" are often referenced as publications that initiated the investigation of IS failure. A major insight of Sauer's analysis is that failures should be expected and that there is no mechanism to guarantee success. He stresses that developing and implementing information systems is an innovation process, which is an uncertain process by its very nature. Instead of trying to avoid failures by optimizing planning techniques, he argues for better analyzing the project's context (especially regarding support, power and politics), for ongoing evaluation and for tracking flaws and their resolutions. Lyytinen and Hirschheim analyzed empirical literature and identified different classes of IS failure. They differentiate between development and use failure. Furthermore, they trace the reasons for failure back to the features of the IS and the IS development process. While this early research mainly focusses on IS failure in intra-organizational projects, more recent publications also analyze the failure of large inter-organizational IS projects (e. g. Kreps and Richardson, 2007). By drawing on the results from several large-scale public-sector IT projects in UK, Kreps and Richardson name some common problems in these projects including a creeping scope and escalating costs (ibid.). In 2014, Dwivedi et al. still see research on IS success and failure as a prominent stream in IS research (Dwivedi et al., 2014). They demand for an extended perspective, which takes multiple perspectives into account, moves beyond too narrow considerations of the IT artifact and includes rather unexplored organizational contexts (such as the public sector).

As the third and last stream of research relevant to our topic, we draw on the literature on **ultra-large projects** and **projects in inter-organizational settings**. Project planning and management gets increasingly complex with the growing size of projects (Priemus et al., 2008). Additionally, in many of these settings, no central governance exists like in hierarchical organizations (Lundrigan et al., 2014).

In internationally distributed large firms, interventions of ultra-large scale are performed and a growing amount of knowledge on how to conduct them is available. However, despite of distributed and stepwise roll-out in different countries, these transformations are still characterized by a central governance and they are driven by standardization (regarding both, processes and IT). In contrast, in the German health care system, many actors act rather autonomously. First and continuously, they need to be convinced to participate in a common project. The research subject in such settings lies beyond a focal (even internationally distributed) organization, but it is constituted by an inter-organizational construct (including the patient/customer and hence even beyond a network organization). In IS research, there is a long tradition in analyzing the development and implementation of inter-organizational information systems (IOIS) (Barrett and Konsynski, 1982; Elgarah et al., 2005; Rodon, 2006) including the health care sector. In our research, we seek to capture the extended environment with the concept of business ecosystems (Iansiti and Levien, 2004; Moore, 1993; Moore, 1996), as it is based on the idea of autonomous actors and because it stresses the relevance of economic relations instead of technical systems. Nevertheless, business ecosystems today are of a socio-technical nature and often rely on ultra-large IT systems (Feiler et al., 2006). This extended perspective requires new tools and methods for planning and conducting interventions and might lead to different results when analyzing the failure of interventions.

# 3 Methodological approach

For analyzing the focal project, we decided to conduct a case study based on documentary materials (Bowen, 2009). As the project for implementing the electronic health card is funded with public money, many relevant documents are available to the public. These documents contain laws, project plans, cost-benefit analyses, evaluation reports and press releases. We iteratively searched for relevant materials regarding the implementation of the electronic health card. By drawing on intermediate results from our analysis, we identified questions that required further material to be answered.

As the phenomenon we investigate goes beyond the borders of a single organization, we needed a guiding frame for our analysis, which takes account for this extended perspective. In this paper, we draw on the framework for analyzing IT-based interventions in business ecosystems from Drews et al. (2014). This framework has been developed by reflecting three cases of large IT implementation projects in different industries, including the project of the electronic health card implementation in Germany. It includes a structural and a dynamic perspective with seven basic concepts in each perspective (see Table 1). For a detailed description of these concepts see Drews et al. (2014).

| **Structural perspective** | **Dynamic perspective** |
|---|---|
| A1: The system and its borders | B1: Project’s drivers and goals |
| A2: The system’s environment and its influences | B2: Potentials of IT innovations |
| A3: Actors and classes of actors | B3: Co-design on multiple layers |
| A4: Strategic business relations and competition | B4: Design alternatives and implications for transformation |
| A5: Operational processes, information and material flow | B5: Adoption and transformation plans |
| A6: IT/IS, infrastructure, networks, standards, data and information | B6: Overall assessment |
| A7: Spatial structure | B7: Realization of operations and monitoring |

*Table 1. Basic concepts of business ecosystem’s dynamic and structural perspectives according to Drews et al. (2014)*

We are aware of research projects, which applied the actor network theory (ANT) for similar cases (see e.g. Greenhalgh and Stones, 2010; Rodon et al., 2008). While we see the value of the ANT for a long-term process perspective, we seek a stronger conceptual basis for the structural perspective. The ANT starts with a "flat ontology" and demands for treating all kinds of actors alike in the beginning (Latour, 2005). Unlike the ANT, we see a layered structure – or architectural perspective based on the methods of enterprise architecture management – as a mean for better supporting the analysis of the environment in which a large-scale intervention takes place (Drews and Schirmer, 2014).

# 4 A case study on the failed implementation of the electronic prescription in Germany

In this section, we describe our analysis of the failed project for implementing the electronic prescription in Germany's health care system. As mentioned in the previous section, we use the categories from the above mentioned framework for guiding our analysis. In the following, we refer to the framework's concepts in the text by naming the respective concepts in brackets (A1, A2, etc.).

## 4.1 Drivers and goals of the electronic health card project and related IT innovations

We start by describing the project's drivers and goals (B1). Since 1993, Germany's compulsory health insurance has issued a chip card to all its members (around 70 million people). In the late 1990s, a study from Roland Berger & Partner, a consulting company, revealed that Germany has not yet adopted and implemented innovative eHealth technologies (Roland Berger & Partner, 1997). This study lead to several discussions and initiatives, but none of them had the power and size of the health card project that followed some years later. The lipobay drug scandal in 2001 was often referred to as being a major trigger for the health card project (Weichert, 2004). The inability of identifying possible drug combinations with adverse effects lead the government to think about how to avoid such problems in the future. In 2003, the ministry for health and social security finished a bidding process and a project called "bIT4health" ("better IT for better health") was started. In this project, a consortium of IBM, a Fraunhofer research institute, SAP, ORGA (a chip card system developer) and InterComponentWare defined a basic architecture for the future telematics infrastructure (Bunz et al., 2004). In the same year, the German Government passed a law for modernizing the compulsory health care system. As a part of this law, the introduction of a new chip card (called "electronic health card") and a national telematics infrastructure was codified. According to this law, the new health card should be introduced by the first of January 2006.

The law § 291a SGB V also describes the services (or applications), which the new electronic health card should provide. Beyond the functionality of identifying the insured, it also includes the European Health Insurance Card (EHIC). The EHIC is not chip card based. It consists of standardized insurance data printed on the back of each electronic health card. The third mandatory service defined by the law is the electronic prescription service. It should allow the transmission of electronic prescriptions. In addition to these mandatory services, the electronic health card should support nine optional services. "Optional" in this case means that patients can decide on their own if they want to use these services or not. These optional services comprise the collection, processing and use of the following data: (1) medical data for emergency treatment, (2) electronic physician letter, (3) drug safety data, (4) electronic patient record, (5) data provided by the patient, (6) data on health services used by the patient and their costs, (7) data on the patient's will regarding the donation of organs, (8) data regarding the place where information on the patient's will regarding the donation of organs is stored and (9) data on the advance directive and the appointment of a healthcare proxy.

The whole idea of the project was also supported by the potentials of IT innovations (B2). The chip card technology made progress and new card generations could provide more space for storing data and allow to perform digital signatures. Furthermore, software for checking medication for adverse drug effects was realized. However, such software was only used by a few actors when the project began. And third, based on the growing influence of the internet and related technologies for building large interoperable and distributed systems, the realization of a complex national health IT infrastructure became into reach.

## 4.2 The structure of the intervention's socio-technical ecosystem

In the next step, we describe the socio-technical ecosystem, in which the ultra-large intervention takes place following the framework's structural perspective. According to the framework, we first have to clarify **the system and its borders (A1)**. The system we are analyzing is bounded by Germany's borders. Health care legislation in Europe is still the domain of the European Union's member states. Furthermore, we have a strong sectoral border with the focus on the health care system. Due to the intervention's scope, not only health providers and their associations but also vendors for health care IT belong to the ecosystem. The (unclear) intermingle between decision makers from politics and legislative authorities in health care – inside the ecosystem – and general political episodes – which we position outside the ecosystem – add to the complexity of this health ecosystem.

Since the health care system is of high value for most people, it is an important part of society in general. As Germany's population is aging, the health care system is expected to be under pressure in the future. The expenditures for health services will rise due to the increasing percentage of elderly people. Today, the health expenditures have already started to increase not only because of the aging society but also because of high costs for new medical technologies and drugs. On the basis of these "external" influences, the health care system is under continuous pressure for improving the quality of care and keeping costs under control at the same time (**A2: the systems' environment and its influences**).

The intervention aims at influencing the work and life of a tremendous amount of different "inhabitants" in the health care system. For gaining an overview, we need to identify relevant actors (**A3: actors and classes of actors**). Additionally, we need to define classes of these actors and to count the actors in each class. Furthermore, the concept of "actors" refers to considering their responsibilities and interests. First, the patients are part of the system in their role of insured people and service consumers. Hence, the intervention effects the whole population. The compulsory health insurance system in Germany covers about 70 million people. The private health insurance system serves about 9 million people with its full tariffs (meanwhile, the private insurance companies abandoned the project – see below). The main interest of the patients is to receive state-of-the-art medical treatment when needed. Regarding the goals of the health card project, the interests of patients are quite diverse. People with chronic diseases are often mentioned as being more interested in a better IT infrastructure as they suffer from media discontinuities and barriers in the information flow between different actors. Second, the health care providers need to participate in the project. 120.000 registered physicians are working in about 90.000 practices scattered all over the country (BMG, 2014). About 2.000 hospitals and more than 20.000 pharmacies are involved (ibid.). Third, around 150 compulsory health insurance companies and more than 40 private health insurance companies need to set up the infrastructure and to issue cards for their insurants (ibid.).

Beyond these core classes of actors, many (German and international) software and hardware vendors also participate in the intervention. The vendors had to develop new devices and to modify their software to meet the requirements defined in the specifications. According to a statistic based on the ambulatory billing data of practices and hospitals, there were 176 different software solutions used in Germany (KBV, 2014). 22 of those 176 are installed in more than 1% of the practices (ibid.). Hence, the changes required to connect practices to the telematics infrastructure have to be realized in all 176 software systems.

Each of the classes of actors mentioned above has a powerful national representative association. These associations bundle the interests of their members and play an important role in the so-called “self-administration”. This, together with the political and legislative agents, form the specific decentralized responsibility of governance for strategy and overall decision making.

For understanding the health care system, we also need to take a closer look at **strategic business relations and competition (A4)**. Many of these relations are shaped by the large number of laws regulating the health care system. Physicians, for example, need be registered at the compulsory health care system to be allowed to bill for services provided to the people insured by this system. As a further example, the market for pharmacies is highly regulated in Germany. Each pharmacist may only own up to four pharmacies. This leads to a fragmented situation without any larger players in the market.

In the next step, the framework guides us to look at operational processes as well as at **information and material flows (A5)**. The core prescription process is rather simple, yet cross-organizational. The patient plays a central role in it: A patient visits a physician (of his or her choice) who – if needed – issues a prescription on a defined form and hands it over to the patient. The patient carries the prescription to the pharmacy (again of her or his choice) and receives the drug after passing the prescription to the pharmacist. In some cases, the patient has to pay a certain amount on her or his own. The pharmacist passes the prescription forms to a billing service provider. These companies scan and digitize the prescription and transfer the data to the patients’ insurance companies. The pharmacies than receive the payment from the respective insurance companies.

As the intervention intended to change this cross-organizational process, we have to take the number of actors of the different actor classes involved and the number of prescriptions per year into account. The process of issuing a prescription has more than 600 million instances per year in Germany (Gematik, 2006). Zooming into practices, this means that a physician may issue up to 50 or 100 prescriptions per day.

When large national interventions strive for implementing a new infrastructure, they need to consider the existing IT landscape with its networks, servers, applications and the data stored in these systems (**A6: IT/IS, infrastructure, networks, standards, data and information**). When the health card project began, nearly all physicians, hospitals and pharmacists had an application for supporting their administrative processes in place (practice information system or pharmacy information system). In most practices, internet access was available. Though, many of them had a dedicated network for the practice information system, following a recommendation of the Association of Statutory Health Insurance Physicians. The infrastructure and diverse existing application systems in the practices, hospitals and pharmacies became relevant as the health card project planned to connect these service providers to the national telematics infrastructure. Additionally, the new chip card terminals should be connected via network. The practices needed to provide additional network outlets and were expected to connect their systems to the infrastructure via a connector box in the future.

While in other industries, production processes are centralized in large facilities or are scattered around the world in global value chains, the provision of health services is rather decentralized. Physicians and hospitals are expected to be reachable for patients without travelling too far. This spatial distribution of the actors (**A7: spatial structure**) is relevant to the project as the technical infrastructure needs to reach out to all those distributed organizations and locations. Technical and organizational changes effect these distributed entities. Therefore, the project has to plan and anticipate how this change can be achieved.

## 4.3 The intervention’s course of episodes and events

After we have described the socio-technical ecosystem in which the intervention took place, we now retrace the course of episodes and events in the overall 10-year period of the intervention based on a structured timeline. For providing a better overview, we created a graphical representation of the episodes (see Figure 1). In order to structure the large number of events on a time line, we assigned them to different layers.

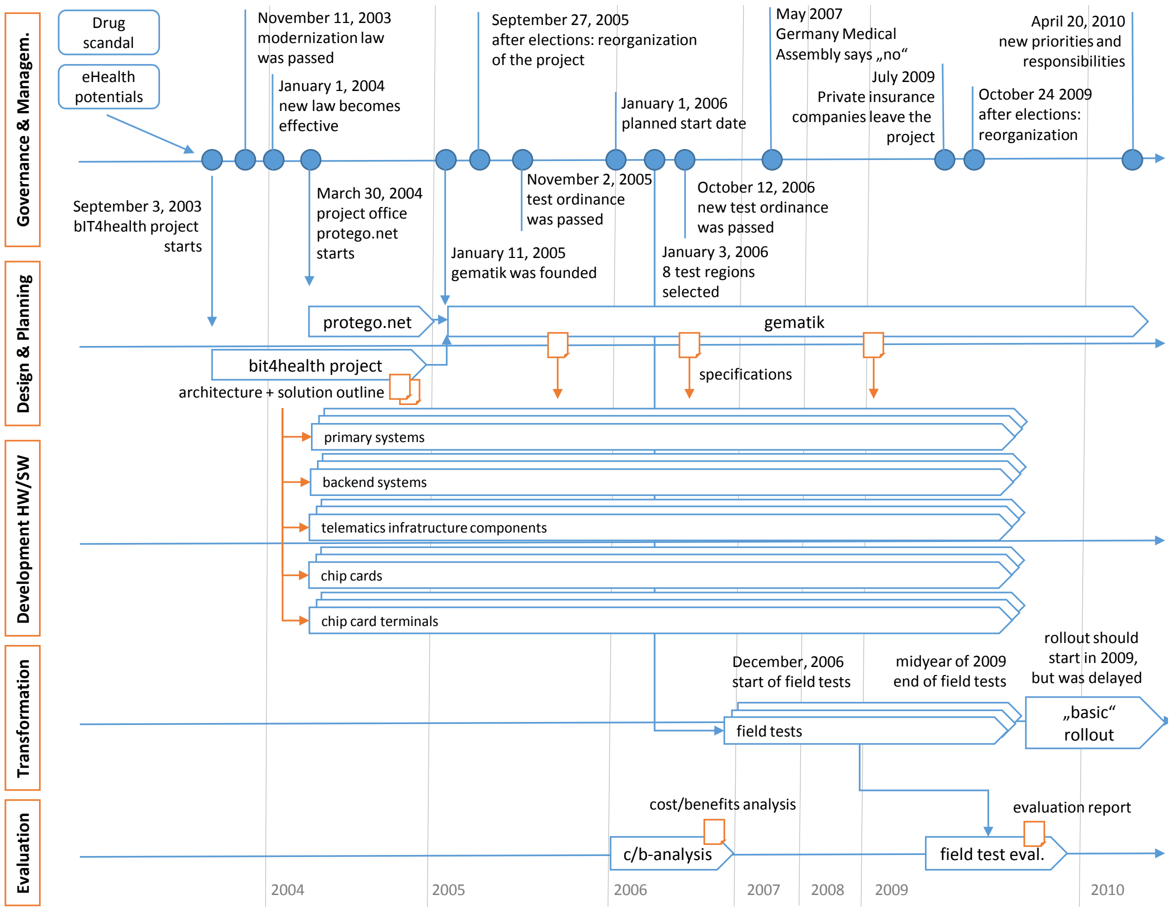


*Figure 1. Electronic prescription in Germany – timeline with events and projects*

We used the following layers for structuring the episodes and events:

- **Governance & management layer:** setting overall goals; reprioritizing and taking responsibility for the overall intervention; planning, coordinating, directing and initiating the monitoring/evaluating of the ultra-large intervention
- **Design & planning layer:** designing the intervention and redesigning the ecosystems' architecture (processes, IT landscape, IT infrastructure), in the large and in the small
- **Development layer:** developing and/or adopting new technologies of the to-be IT landscape and infrastructure forming a prerequisite for the intervention
- **Transformation layer:** test and rollouts for performing the intervention, changing the architecture in the ecosystem
- **Evaluation layer:** activities to analyze the intervention's overall status and performance
- **Operational layer:** providing successive services needed in the roll-out and post-rollout, i. e. post intervention together with monitoring facilities (not included here as a roll-out beyond the test phase did not take place so far).

Overall, due to the complexity and magnitude of involved actors, processes and systems, each layer may include a multitude of parallel projects. These are (partly) coordinated by the management layer and (partly) enforced by law. Additionally, each project needs to be adopted to the local context (e. g. of a certain hospital or IT vendor). According to the different character of projects on each layer, we introduce different project types and name them accordingly, design-, development-, transformation- (i.e. test and rollout), operational-related projects.

**Governance and management layer**: We start describing the course of events by going along the timeline of strategic decisions that took major influence on the projects. Since the 1990s, several discussions in Germany took place regarding national activities on fostering the use of IT in the health care system. The potentials of eHealth technologies increased with the growing internet and new possibilities provided by IT. Additionally, as described above, the lipobay scandal happened and the policy makers searched for new ways to prevent such events in the future. In 2003, the Government passed a law to modernize the compulsory health care system. As a part of this law, the introduction of a new electronic health card and the according infrastructure – based on the results of the architectural design project (see design and planning layer) – was defined as a goal. The law determined that this introduction should be done by January 1, 2006. The new law became effective on January 1, 2004.

In March 2004, a project office called "protego.net" was installed as a new management actor. This office was transformed into a new organization called "gematik". This organization started its operation on January 11, 2005. Several months later, a new government was elected. The new government planned to reorganize the project. At this point, the whole project was far away from its original schedule as defined in the 2004 documents. In 2005, a new ordinance was passed. It defined how the lab and field tests should proceed. After the planned start date of January 2006 had passed, the ministry of health decided that eight test regions (called "model regions") should carry out the tests together with the gematik and the other actors involved. In October 2006, the ordinance for the test phase procedure was changed again leading to new and more detailed test plans.

By the end of 2006, the test regions were ready to start with the field tests. Only a few months later, when the first experiences were made in the test regions, the German Medical Assembly (representation of all physicians in Germany) agreed on a statement saying that they do not support the electronic health card project as it was planned at that point of time. In July 2009, the private insurance companies left the project as they did not see any positive returns on the required investments.

In 2009, a new government was elected. It again decided to reorganize the project based on the results of the experiences, which were made during the test phases. This lead to a decision on how the project should succeed. It was published on April 20, 2010. With this decision, the electronic prescription was abandoned. A new set of applications was defined to be tested and rolled out. The electronic prescription was no longer a part of the next steps. Until today (2015), the official project plans do not include any details on if and when the project for implementing the electronic prescription will be part of the health card project in the future. The text of the law still lists the electronic prescription as a mandatory application of the electronic health card. A new eHealth law is currently under way.

**Design and planning layer**: In 2003, the German government launched the architectural design project bit4health. This project had the task to develop a general architecture for the future national eHealth infrastructure. Two major documents called "framework architecture" and "solution outline" were written in this project and published in 2004. After the gematik was founded in 2005, they had the responsibility for developing detailed specifications. They published large sets of documents describing details of the services and infrastructure on the gematik website. Interested people could get involved and comment on these documents. With the ongoing project, several larger changes were necessary to keep up with decisions made by the governance and management layer.

**Development layer**: Each software or hardware vendor (for primary or back-end systems) had its own projects for developing new devices or changing software according to the specifications provided by the design and planning layer. For example, all vendors of hospital information systems, which were used by one of the hospitals in the "model regions" had to be changed according to the specifications. Hardware vendors had to develop new card readers that are capable of accepting two cards at the same time. Unlike for the layers described before, there is only few information available by the hardware and software vendors on how large these projects were and how much time and money they invested.

**Transformation layer**: Each hospital and each practice in the "model regions" had one or several projects for implementing the health card into their own processes and organization. They had to redesign their enterprise architecture and to perform the transformation for example in the area of patient admission. Similarly, each physician practice had to change its infrastructure and IT-landscape together with its processes.

**Evaluation layer**: Two major evaluations of the whole electronic health card project took place during the focal time period. The first was an overall cost-benefit analysis, which was not published but leaked shortly after it was finished. The second ended up in an evaluation report on the field tests. The results in this report had influence on the decisions made in 2010 to reprioritize the project's activities.

## 4.4 Reasons for the intervention's failure

Apart from the overall course of events, we have to focus on some details of the intervention up to its halt and reprioritization. For this closer consideration, we come back to the character of intervention projects outlined in the framework. We draw on the dynamic perspective's concepts to systematically describe the 14 reasons for failure we have identified (see Table 2).

| # | Reason | Category |
|---|---|---|
| 1 | Merely technical design focus, too less focus on processes and organizational change | B3: co-design on multiple layers |
| 2 | An overall and integrated architecture was not provided in the beginning and not developed over time | |
| 3 | No appropriate time frames for development projects | |
| 4 | Wrong decision to start with the electronic prescription | B4: design alternatives and implications for transformation |
| 5 | "no" by German Medical Assembly was not taken seriously | |
| 6 | Additional time has to be spend by those actors (physicians) who do not profit from this service | B5: adoption and transformation plan |
| 7 | Unclear benefit of nearly simultaneous starts of the field test projects | |
| 8 | inflexibility regarding the reprioritization of tasks | |
| 9 | not enough time to deeply test the technology in the laboratory | |
| 10 | cost-benefit analysis was carried out too late and not published | B6: overall assessment |
| 11 | negative benefit for a five and ten year perspective for the electronic prescription | |
| 12 | bias in cost/benefit became even worse | |
| 13 | Assessments during the course of the interventions were not taken too much into account | |
| 14 | governance structures were not clear and changed over time | B8: intervention governance |

*Table 2. Reasons for the failure of the electronic prescription project in Germany*

We start with the framework's concept of **co-design on multiple layers** (B3). Drews et al. (2014, p. 6) describe this as "changes in the design have to be done both in the large (cross-actor processes and telematics infrastructure) and in the small (changed processes and extended infrastructure in the practices)". Furthermore, the design has to be done on all layers – from governance to the operation layer as described in the previous sub-section and includes social dimensions as well as technical.

**Reason 1**: The design focus was merely technical, processes and organizational change were not extensively considered in the first step. This is noticeable in the early and leading design documents (bIT4health architecture and solution outline). Co-design of processes and IT is nearly not covered in these documents. Considering the redesign of processes could have given indications already at design time that enacting an electronic prescription would require more time than a paper-based counterpart – a fact that was revealed much later. Another example is the assumption that standards for technical interfaces would be sufficient to solve challenges of inter-organizational cooperation.

**Reason 2**: An overall and integrated architecture comprising and relating different design layers together with steps from the as-is to the to-be status was not provided and not developed over time. The overall architecture could have had a guiding and identifying function for each of the many following projects, informing likewise vendors and health providers. During the intervention's progress, it could have served to inform about changes in the to-be architecture due to delays or other difficulties (e.g. by continuation with tests offline as the infrastructure needed for online tests is not available in time). The overall architecture also could have been stepwise enriched by detailed project results. A possible stepwise realization of the overall architecture – with storing data only on the card in the first step and in the telematics infrastructure in a second was abandoned or not considered. At the end, the stepwise realization was necessary due to delays in realizing the telematics infrastructure which needed manifold components and the involvement of diverse parallel development projects performed by a large number of vendors.

**Reason 3**: The given time schedule and estimation did not include appropriate time frames for development projects. This is surprising out of two reasons: (1) the provision of newly developed or adopted software and hardware formed an indispensable prerequisite for the next intervention steps, (2) the multitude of different vendors and organizations involved impeded the monitoring of in-time production. Furthermore, delays in the implementation activities were not addressed fast enough by starting a necessary rescheduling.

We continue with the concept of **design alternatives and implications for transformation** (B4).

**Reason 4**: The choice of the electronic prescription as the starting application/service among other alternatives in the overall intervention to introduce the electronic health card and the telematics infrastructure is questionable. A careful assessment about its benefit and the interests of the different actors involved was at least not made public. In contrast, the facts show that the chosen process has more than 600 million process instances per year (Gematik, 2006).

**Reason 5**: The "no" by the German Medical Assembly was not taken seriously. In the early test phase of the project, the German Medical Association (the national association of the physicians) announced that they do not support the electronic health card project in the form it had at that time. Several reasons were given for that decision. Three major reasons were: the need for additional data security, the unclear situation of costs and benefits and the negative impacts they saw for the operational processes in the physicians practices.

With the next concept of the framework, we analyze the interventions' **adoption and transformation plans** (B5).

**Reason 6**: During the test phase, it turned out that the process of issuing a prescription takes more time than expected. The results from the test regions showed that the duration of the process increases from 29.5 seconds to 43 seconds (and even to 55 seconds during the test phase when the prescription had to be printed in addition) (Universität Bayreuth et al., 2009). Based on the assumption that some physicians issue up to 100 prescriptions per day, these 13.5 seconds sum up to 22.5 minutes per day. This additional work has not been considered in the cost-benefit calculation. Even worse, this additional time has to be spend by those actors (physicians) who do not profit from this service. Additionally, the benefits of the electronic prescription were not realized, as the online billing process was not part of the test scenario.

**Reason 7:** The benefit of nearly simultaneous starts of the field test projects in eight regions is not clear (with the goal of 10.000 patient in each region). Of course, in each region, local organizations had different IT systems (like hospital information systems and practice information systems) and different processes in place. Therefore, a test in different regions might have brought up some differences that would have been overseen if they were not included. But, due to time pressure and too few tests, the new systems did not work properly (as the evaluation report summarizes) (Universität Bayreuth et al., 2009). As a consequence, the negative experiences with the premature status of the technology was made by many people at the same time and thus pushed a great wave of negative impressions and feelings to the public.

**Reason 8**: Though the first problems became visible very early in the test regions, the plan for introducing the different services was changed three years after the tests begun. This demonstrates an inflexibility regarding the reprioritization of tasks as a result of the experiences made during the test phases.

**Reason 9**: The new technology was brought too early into the test regions. The gematik and the software and hardware vendors did not take enough time to deeply test the technology in the laboratory. Otherwise, the increased time needed to issue a prescription would have been noticed earlier leading to the need to further improve the technology or to reprioritize the service testing.

The concept of **overall assessments** (B6) puts the focus on ex-ante, intermediate and ex-post reviews and evaluations of the intervention.

**Reason 10**: The cost-benefit analysis which has been carried out two years after the start by a consulting company (Gematik, 2006) should have taken place in the beginning for choosing the right service to start with. The resulting report was not published by the government but it was leaked by a hacker organization. This report provides a cost-benefit calculation for each service planned to be realized as a part of the health card project. Such relevant information should be made publically available.

**Reason 11**: The cost/benefit analysis showed a negative benefit for a five and ten year perspective for the electronic prescription (Gematik, 2006). In comparison with all other services, the electronic prescription had the lowest net benefit of -376 million Euros in a five-year period. These calculations were based on the assumption that the electronic prescription will not lead to additional work. As the results from the test phases showed, this assumption was wrong. If the additional time needed in the practices would have been taken into account, the expected benefit should be even lower than calculated. The cost-benefit analysis revealed (upfront) an unbalanced distribution of the costs and benefits among the different stakeholders for the electronic prescription. While the health insurance companies would profit from savings in the billing process, the physicians and the pharmacists would have higher costs than benefits. Work would be shifted from the health insurance companies for digitizing the prescription data used for billing purposes to the physicians.

**Reason 12**: The bias in cost/benefit became even worse in later phases of the intervention. In the test phase, the benefits for the insurance companies (to integrate their back end systems) could not be realized due to delays in realizing the telematics infrastructure.

**Reason 13**: Assessments during the course of the interventions – such as those mentioned above or further risk analysis e. g. about timely availability of security infrastructure – mentioned were not taken too much into account. They were neither mitigated in the further steps nor did they quickly lead to reprioritization or rescheduling.

We added an additional concept to the framework, which we missed during our analysis. We call the concept the **intervention governance** (B8).

**Reason 14**: Throughout the whole intervention, the governance structures were not clear and changed over time. They were challenged several times by the diverse actors involved. The self-administration (mainly consisting of health insurance companies and health providers) in some situations was not able to meet a decision. In these situations, the ministry of health decided how to proceed. The newly founded central actor gematik had the role of writing specifications and testing devices. Though the people at the gematik gathered most knowledge about the whole system, the organization remained a weak actor.

The framework includes two other concepts, which we have not addressed in this section. As the project did not reach the mode of operations and monitoring (B7), we skipped this concept. An ongoing analysis of potentials of innovations (B2) might be necessary in long-lasting ultra-large projects. In the electronic health card intervention, the rise of mobile technologies, for example, will challenge existing decisions on how the patient might want to interact with his or her health data.

# 5 Discussion

After we have described our main findings regarding the failure of the project, we discuss the results in this section. We first outline the contributions of our work to the body of knowledge. Second, we address the limitations of our work. This is followed by a reflection on the use of the framework for analyzing IT-based interventions in business ecosystems.

So far, the failure of the implementation of the electronic prescription in Germany has not been analyzed in the scientific literature. With the case study presented in this paper, we seek draw the attention towards this failure. Until today, many countries are on the way to build or extend their national health infrastructures in order to realize additional services for patients and health care professionals. However, until today, detailed and current information on similar projects and failures is scarce.

A major discriminator from other projects is the weak governance performed by the German policy makers. The distributed power structure and its large size hinders the German system from quickly implementing new technologies. In smaller (e. g. Scandinavian) countries and in those with more centralized governance (like in the UK) the implementation of such projects seems to be easier.

While the governance structure will not be changed rapidly, it is worth to look for other ways of how to proceed. Two things seem to be of greater importance: First, the savings, which might arise from the changes in the billing process should be realized right on from the beginning. If the effort for the physicians rises (which needs detailed evaluation), it might be necessary to transfer a part of the generated savings to them as a compensation. The overall cost/benefit-situation needs to be analyzed and tracked carefully. Second, detailed socio-technical and architectural analyses should be carried out throughout the project. Defining standards and specifications that do not consider the situation in practices and hospitals are likely to fail. Though ultra-large projects and architectures need some ex-ante planning, the projects should rather proceed in an iterative way. There is no reason to set up eight field tests at the same time all running into similar problems. A permanent alignment between central activities and the hundreds or even thousands of decentral projects in hospitals and at the hardware and software vendors involved is required. This permanent alignment process should also be capable of taking new technologies into account. Large parts of the German projects were planned at a time were smartphones were not available, for example. As such technological shifts are likely to happen in the future, national health IT projects should include mechanisms to adopt new technologies.

Similar to the findings of Kreps and Richardson (2007), the project's sheer size, scale and complexity can be seen as a major cause for its failure. Compared to their list of "issues in IT project failure" (ibid, p. 443), we can identify several similarities. First, in both cases, the systems were delivered too late. Second, needs of the 'users' and 'stakeholders' were not taken into account as required. Especially, there was a lack of consultation with the physicians in both cases. Third, in both cases, the existing legacy systems were not considered appropriately. In our case, the time needed for implementing new functionality and interfaces was dramatically underestimated. The projects' focus on the new infrastructure and systems seems to lead to an underestimation of the effort needed to change the existing systems (and processes). Fourth, the scope changed in both projects. In the German project, the shift towards using the offline-mode in the prescription process was a major scope "creep".

As we have described above, the framework from Drews et al. (2014) was developed iteratively out of three cases. While it turned out to be a useful frame during the analysis, we see four major differences that emerge from the use of the framework in this paper. First, we started with the project's drivers and goals for setting the scene. This was important as the focal project shaped the boarder of the ecosystem's parts that are relevant for our analysis. Second, we have introduced a timeline, which provides an overview on different episodes and projects. So far, the dynamic perspective did not include a concept for explicitly describing the course of the project along the timeline. In an ex-ante consideration and planning of an IT-based intervention, this timeline has the character of a project plan. In our case, the timeline was used to structure the events of the past. In both cases, the timeline is a useful tool that should be helpful for other cases as well. Third, our focal intervention consists of many separate projects. We have defined several different types of projects (like planning & designing). In large interventions, there may be several instances (up to several hundred or thousand) of these projects. Fourth, the governance and management layers we used in the timeline point out that several actors might be much more influential in large projects than others. They define laws, standards or may protest against the planned changes. In the German health care system, the leading associations are very powerful actors following their own strategies and agendas. Analyzing their behavior and their major decisions helps to better understand the factors leading to success and failure. The impact of their decisions on other actors and activities should be carefully analyzed in such large systems.

Our analysis is limited as we used only publically available documents for grounding our empirical findings. For taking a closer look and for gaining a better understanding of certain decisions, which were made during the project, additional expert interviews would be a valuable resource. Additionally, the applied framework might be a restriction as it guides the analytical focus with its concepts. A more open and bottom-up approach or other frameworks might lead to different results.

# 6 Conclusion and outlook

In this paper, we have analyzed the failed introduction of the electronic prescription in Germany. By drawing on a framework for analyzing IT-based interventions in business ecosystems, we were able to present a brief overview of important activities during this intervention. Furthermore, we identified 14 reasons for its failure and used the framework for categorizing these reasons. This list is not comprehensive, additional data, especially from expert interviews with people involved in that project might provide further insights from “behind the scenes”.

Additionally, we proposed some extensions to the framework from Drews et al. (2014) by adding a timeline with different layers to the dynamic perspective. For our analysis, we did not strictly follow the framework’s concepts. Instead, we switched forth and back, gathered further material and went back to analysis. The framework should be enriched to become an architectural framework for analyzing ultra-large IT-based interventions. In order to fulfill this task, appropriate modelling languages should be identified for each layer. Furthermore, the framework should interconnect the different layers and assure an integrated way for analyzing and planning ultra-large architectures. Such a framework should help to avoid failures like the one we have analyzed in this paper.

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