Dimensions of e-government interoperation: 
Discoveries from a case study on digital medical certificates

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Abstract

Interoperability, i.e. how different public agencies and their digital artifacts work together, is considered to be an important area for a successful evolvement of e-government. Key knowledge in this area is the structuring into four different layers of interoperability: legal, organizational, semantic and technical interoperability. This paper challenges this received view of digital interoperation. It does so through an in-depth qualitative case study on digital medical certificates and an inductive data analysis. Nine dimensions of digital interoperation have emerged through this study: relational, performative, semantic/cognitive, interactive, normative, regulative, economic, architectural, and technical. The emergence of these dimensions went through a formulation of concise empirical statements of the case followed by an abstraction into theoretical statements. Based on empirical insights and theorizing, the paper argues for a broadening of interoperability as only capability to interoperate. A broader notion comprises a mix of organizational, human and digital pre-conditions for interoperation.

Keywords: interoperability, digital interoperation, e-government, case study, inductive emergence, medical certificates

1 Introduction

Interoperability in e-government is concerned with how different public administrations interact with each other through the use of digital means. This topical issue has been studied through the use of many different conceptual labels. Some examples of different concepts are “inter-organizational information systems” (Castelnovo & Simonetta, 2008), “interorganizational information integration” (Pardo & Tayi, 2007), “e-government integration” (Scholl & Klischewski, 2007), “information sharing and integration” (Yang et al., 2014), “interagency collaboration” (Fedorowicz et al., 2014), “inter-organisational information sharing” (Ziaee Bigdeli et al., 2011; Karlsson et al., 2017), “interoperation in a shared work practice” (Öhlund, 2017). All these conceptual labels imply the exchange of digitalized information across organizational boundaries. The classical notion of inter-organizational information system (Suomi, 1992) means that IT-based information is transferred between information systems within different organizations. The notion of an information system has successively been replaced, in the scholarly discourse, by the notion of an ‘IT’ artifact’ (Orlikowski & Iacono, 2001). The conceptual and terminological evolution has furthered this into a ‘digital artifact’ (Nambisan et al., 2017). This is the key concept used in this article with the meaning of a concerted artifact consisting of software and digital information relying on IT
hardware. I will use the term ‘digital arrangement’ to mean an ensemble of digital artifacts that are designed and ordered to work together (i.e. to interoperate).

Scholars consider digital interoperation as one of the great challenges within e-government: “Academics worldwide have little doubt that this lack of interoperability leads to missing out on fully reaping the potential benefits of e-government” (Kubicek et al, 2011, p 6). There are several other scholars who emphasize the importance of e-government interoperability and the need for more knowledge on this topic (e.g. Scholl & Klischewski, 2007; Charalabidis et al, 2008; Ray et al., 2011; Pardo et al, 2012; Bannister & Connolly, 2012). One way to address such challenges has been through the development, deployment and application of Interoperability Frameworks (IF); see e.g. such frameworks from the European Union, which have been continually refined (EC, 2004; 2010; 2017; Criado, 2012). Interoperability frameworks contain often principles and recommendations for the establishment and governance of arrangements for digital interoperation. A salient component in such IF:s is the structuring of interoperability in different layers. There exist different versions of such layering of interoperability (see e.g. EC, 2004; 2010; 2017; Kubicek et al, 2011). A recent layering can be found in the “New European Interoperability Framework” (EC, 2017), which makes a division into the following four layers:

- Legal interoperability
- Organizational interoperability
- Semantic interoperability
- Technical interoperability

The structuring of interoperability into such layers (or levels) can be seen as a dominant thought model among both practitioners (see e.g. the different EC documents mentioned above) and scholars (e.g. Peristeras & Tarabanis, 2006; Scholl & Klischewski, 2007; Kubicek et al, 2011; Gasco, 2012; Öhlund, 2017). This kind of interoperability layering implies conceptual and instrumental knowledge. It has a clear purpose to be used for the governance of digital interoperation among public authorities. The layering directs attention to different aspects intended to be addressed in the development of inter-organizational processes and supportive digital artifacts. A continual application of such interoperability frameworks, both in practical development and in scholarly inquiries, may function as validating this kind of knowledge. Such validation also comprises a stepwise modification of this knowledge, which can be seen in the continual development of European IF:s as mentioned above. For example, the layer of legal interoperability was added in EC (2010) in relation to EC (2004). The content description of the different layers has also evolved over time.

From the perspective of pragmatist epistemology (Dewey, 1938; Van Strien, 1997; Cronen, 2001; Friedrichs & Kratochvil, 2009), this is an acknowledged way of knowledge evolution. Adequacy of the knowledge is demonstrated through its application and constructive effects. However, there may be a risk that even if this conceptualization of interoperability is shown usable, there may be other ways conceptualize these phenomena which have not yet been developed. An application of these established IF:s reinforces this way of thinking about egov interoperability. It becomes “true” since this is the way practitioners and scholars talk about it and use it. A desire would be to have, not only usable knowledge, but really useful knowledge.

The interoperability layering is not without objections. For example, the layer of organizational interoperability is considered as a kind of residual layer and its contents are considered as fuzzy.
Is it time to challenge this received view of e-government interoperability? There exist actually other ways to conceptualize e-government into different dimensions and aspects (e.g. Ray et al., 2011; Pardo et al, 2012; Bannister & Connolly, 2012). Should such other ways be investigated and compared with the established four layers of interoperability? The research presented in this paper wants to problematize the four layers of egov interoperability that seem to dominate both practical and scholarly thinking on this subject. Is it possible to view egov interoperation with fresh eyes? And, if we look at egov interoperability without preconceived layers or dimensions what can be seen and discovered?

One way to address a subject area with a minimum of preconceived categories is through in-depth qualitative case studies and inductive data analysis. This is the kind of research strategy applied in this inquiry. It has been deliberatively chosen in order to possibly detect other dimensions of egov interoperation that have not been put in the foreground through established IF:s. This research orientation has of course also influenced the main inquiry questions applied in the study. Two related inquiry questions have been formulated: 1) What influences digital arrangements for workpractice interoperation? This comprises what considerations, deliberations and other circumstances that influence digital design. 2) How do digital arrangements affect workpractice operation and interoperation? The first question is concerned with how digital artifacts are arranged to enable interoperation between different actors in public sector contexts. This means issues of governance and development of work activities and digital artifacts. The second question is concerned with operations and interoperations by support of digital artifacts. These two questions mean shifting focus between 1) pre-conditions for digital design, and 2) the use and consequences of digital design.

The paper is structured as follows: In the next section (2), the review of interoperability and other related concepts will continue. In section 3, the research approach is further elaborated and motivated. A case study on the management of medical certificates comprises the empirical material of this research. This case study is presented and described in section 4. An analysis of the case, with the focus on clarifying dimensions for egov interoperation, is made in section 5. The paper is ended, by a concluding discussion, in section 6.

2 Interoperability in e-government - a review of discourse

Based on the stated inquiry questions above, this section accounts for a review of the scholarly and practical discourse on e-government interoperability. This means a continuation of the discourse review started in section 1 above. This review is restricted to issues and concerns directly related to the inquiry perspective taken. The focus is on how to conceptualize interoperability. There exist, as stated by Scholl & Klischewski (2007) and Ray et al. (2011), in the egov literature a lack of clarification of concepts like interoperability and interoperation.

Several publications (Charalabidis et al., 2011; Kubicek et al., 2011; Öhlund, 2017) express the origin of “interoperability” from the military sector. References are made to a classical NATO definition as a conceptual foundation: “The ability of systems, units or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together”. The essence of this definition and view seems to be, in a transferred sense to public administration and e-government, that there exist different organizational units and that such units, possibly by the aid of artifacts, provide services to other units, and reciprocally, such units receive and utilize service content for their
operations. Interoperation implies *working together* and doing this in an effective way. It is, however, important to acknowledge that interoperation is based on a differentiation of tasks. Working together means to perform separate tasks but to accomplish these tasks in an interoperational manner. Togetherness means that different actors fulfill their tasks in a web of interconnected objectives and tasks.

As indicated above, the term ‘interoperability’ is not always treated in an unequivocal way in the literature. Peristeras & Tarabanis (2006) have identified numerous different definitions of interoperability. They even talk about the “misuse” of this term (ibid., p 61). Goldkuhl (2008) made a linguistic analysis of this concept and emphasized that it is, essentially, an attributive concept although in a noun form. It is a nominalization of the attribute ‘interoperable’. i.e. something has the property of being interoperable. A linguistic comment is also made by Kubicek et al. (2011, p 24): “Interoperability, as the last seven letters of the term depict, refers to ability”. There are numerous authors that have defined interoperability as ability/capability to interoperate (e.g. Guijarro, 2006; Pardo et al, 2012; Öhlund, 2017). In some cases, this is done in a restricted sense as “technical capability” of digital artifacts (e.g. Scholl & Klischewski, 2007). Many others adopt a broader view referring to organizations as having a capability to interoperate (e.g. Pardo et al, 2012; Öhlund, 2017). Actually, the layering of interoperability can be seen as a way to relate interoperability to different objects (organizations vs. artifacts). However, this entails the risk of making this concept vague and ambiguous. One such example is Pardo et al. (2012) who present a multidimensional interoperability framework. Interoperability in their framework refers mainly to organizational capabilities for governance of interoperational arrangements (like policymaking, leadership and project management) rather than capabilities within such interoperational arrangements.

I will make some provisional definitions as a basis for further inquiry. A basic concept is interoperator as an actor that participates in interoperation. An *interoperator* can be a human actor (e.g. a citizen) or an organization (e.g. a public agency). A human actor can in interoperation be supported by digital artifacts. An organization is in its actions represented by human actors (usually employees) and supportive digital artifacts (Ahrne, 1994; Taylor & Van Every, 2000). *Interoperation* is defined as an ensemble of related activities, belonging to different interoperators, and these activities have inter-communicative patterns within a common theme. Provisionally, *interoperability* is seen as an actor’s capability to interoperate. This will be further discussed in section 6.2 below.

### 3 Research approach

This research is based on pragmatist epistemology and methodology (Dewey, 1938; Van Strien, 1997; Cronen, 2001; Friedrichs & Kratochvil, 2009; Goldkuhl, 2012). One key ingredient in such research approach is knowledge evolution through the practical application of knowledge. However, as stated in section 1 above, a sole reliance on application might not be optimal in the long run. Knowledge application needs to be balanced with other epistemological ideals and strategies. In the grounded theory approach, different canons for abstracted knowledge (theory) are stated, such as workable knowledge, understandability and fit with empirical data (Glaser & Strauss, 1967; Strauss & Corbin, 1990). Their reasoning on empirical fit resides on a conviction that knowledge needs to emerge from data and not the other way around, i.e. preconceived categories are forced on data. Glaser & Strauss (1967) warn us against working in a deductive fashion when analyzing data and validating theory: “seldom can the [empirical]
example correct or change it [the theory] ... since the example was selectively chosen for its confirming power” (ibid, p 5).

The research approach chosen, which is close to the ideals of grounded theory (GT), is to work inductively in order to look at e-government interoperation with as fresh eyes as possible. This should thus enable the discovery of something different than the received view of four levels of e-government interoperability. In qualitative research, following the ideals of GT, there is an emphasis on discovery. This concept is, however, not without criticism. Bryant (2002, p 34) suggests that to talk about discovery in the GT-way is “unfounded and naïve”. There are some unfortunate wordings in Glaser & Strauss (1967) that might give rise to such interpretations. However, a discovery orientation in qualitative research is here equated with 1) the attempt and possibility to see new things in the studied empirical field and 2) the generation of new knowledge, as to formulate new categories, through a data-sensitive analysis (Goldkuhl & Cronholm, 2019).

As a pragmatist inquiry, this research has started from the formulation of problematic situations as drivers of inquiry (Dewey, 1938; Van Strien, 1997; Cronen, 2001; Goldkuhl, 2012). These situations can be framed with different emphasis in relation to different target groups of the research. From a practical view, this research has been governed by an interest in challenges how to manage digital artifacts in inter-organizational settings of public administration. From a scholarly view, one can emphasize the challenges of how to conceptualize and theorize interoperability in e-government. Even if this research has a clear conceptual aim - to elaborate appropriate conceptualizations on egov interoperability - there is an underlying constructive vein: To ultimately develop knowledge that can guide the governance of digital interoperation.

The research has been performed through a qualitative case study with an explicit aim for developing abstract knowledge based on this empirical case (Eisenhardt, 1989; Diaz Andrade, 2009). As stated above, the purpose was to investigate e-government interoperation in order to possibly formulate an alternative conceptualization than the established four-layered model. The idea was thus to use the case study in a revelatory sense (Yin, 2014) although digital interoperation has been studied in many research endeavors before. The approach was, based on an in-depth case study, to let dimensions of egov interoperation emerge in a grounded theory fashion. This is contrary to the approach taken by Kubicek et al (2011), where they use a large sample of cases and deductively code that case material with a pre-formulated conceptual schema. In such an approach it is hard to challenge the received view.

A case study for this specified purpose needs to fulfil selection and access criteria. A case study on management of digital medical certificates has been selected; see description in section 4 and analysis/theorizing in section 5. This case comprises digital and other interaction between different public organizations (as healthcare providers, the Social Insurance Agency, the National Board for Health and Welfare), and also with citizens (patients) and their employers. Two scholars conducted the research with good access to case material. We used the following main methods for collection/generation of data:

- Interviewing and workshops with knowledgeable practitioners
- Document studies
- Digital artifact studies
Through workshop sessions, we interviewed recurrently practitioners that were responsible for governance and development of digital artifacts for the healthcare providers. One of the practitioners is a doctor with long experience from issuing and management of medical certificates. We also interviewed those responsible for digital interoperation at the Social Insurance Agency. We collected and studied many types of documents, such as policy documents, laws and other statutes, investigation reports, research articles, newspaper articles, project plans, audit reports, development documentation, system and routine descriptions, presentation slides, and paper forms. We conducted also inspections and explorations of the focused digital artifacts (Nielsen, 1993; Goldkuhl, 2019a). In these studies, we acted as potential users and collected empirical data concerning digital functionality, interactivity and information. Screen shots were generated and annotated with comments on critical concerns.

There exist misconceptions that the researcher acts as a “blank slate” in GT studies (Urquhart & Fernandez, 2013). However, this is not a proper position. There need to be deliberated focus areas which also can include the use of sensitizing concepts that act as “search-lights” without forcing restrictive categories onto data (Bowen, 2006; Goldkuhl & Cronholm, 2019). We intentionally investigated different parts and aspects of the case. We did not only focus relations and interactions between digital artifacts as evident in an egov interoperability study. We studied also, in a typical case study manner, contextual aspects in the digital practices such as roles and actions of stakeholders, digital work processes, goals and values, laws and regulations, and properties and contents of digital artifacts such as digital functionality, digitalized information, and digital interaction (user-interfaces). The case study has generated rich data, which have enabled us to apply other foci than interoperability on the case material (Goldkuhl, 2019bc; Goldkuhl & Röstlinger, 2019).

As stated above, the data analysis has been conducted in an inductive manner close to ideals of grounded theory. The emergence of abstract knowledge has followed an evolving approach for theory construction with a clear differentiation of empirical statements and different kinds of theoretical statements (Goldkuhl, 2020). This analysis is shown in section 5 below.

4 A case study on digital medical certificates

This case study covers digital arrangements related to doctors’ issuing of medical certificates (MC) and the transfer of those certificates to patients, their employers and the Social Insurance Agency (SIA), that manages sickness benefit cases. A medical certificate, issued by a doctor, is needed by citizens/employees to prove a legitimate sickness leave to the employer and SIA. These practices related to the management of medical certificates and sickness leave are nowadays supported by several connected digital artifacts. DigCert a healthcare system containing digital support for issuing, storage and transfer of certificates. MyCert is a module in the national health portal where each citizen/patient can manage his/her medical certificates. The patient can retrieve and view certificates. There is also a possibility to download them to his/her own digital device and to print the certificate for delivery to the employer. SIA has an e-service for the patient’s submission of sickness benefit applications and an internal case handling system for sickness benefits. DigCert has an embedded decision support, called “Health-Insurance Decision Support” (HIDS), which guides the doctors to set adequate sickness leave periods as to different diagnoses. HIDS is a digital knowledge product created by the National Board for Health and Welfare (NBHW). HIDS exists also as a separate
The practices of medical certificate management, including the stakeholders and the mentioned digital artifacts are illustrated in figure 1. The common theme in this case study (following the definition of interoperation in section 2) is management of medical certificates.

Before the digitalization, the medical certificates were issued by doctors on paper forms. A certificate form was provided by the Social Insurance Agency to healthcare organizations. After the medical certificate was issued, the doctor handed it to the patient who was responsible to distribute it (or copies of it) to the employer and to SIA. There are still some doctors that use this old form and procedure.

Figure 1. The digitalized practices of medical certificate management

The different digital artifacts are arranged in a digital landscape with connections for digital transfer (figure 1). As can be seen from this figure there exist three different ways to transfer the digital medical certificate from healthcare to SIA for their case handling. 1) There exist restrictive privacy regulations in Sweden, and therefore it was not permitted for the healthcare to just distribute the medical certificate to SIA. An explicit consent from the patient is needed. If this is given and then recorded by the doctor in DigCert, the issued medical certificate could be transferred digitally to SIA. This is done directly after the doctor has digitally signed the certificate in DigCert. 2) Another way to transfer the certificate digitally is by the patient through the use of MyCert. After selecting a specific certificate in this web application, the patient can initiate a digital transfer to SIA. 3) The first two weeks of sick leave are paid by the employer. After this period, the patient/employee needs to apply to SIA for sickness benefits. This can be done digitally by the patient through SIA:s e-service. In this application process, the medical certificate can be digitally retrieved from DigCert and attached to the application.
The case handling process of sickness benefits at SIA is substantially facilitated by receiving MC in a digital format. To obtain medical certificates in digital format was a strong motivating force in the design of digital solutions. To ensure the receipt of MC in digital format, these three alternative ways of digital transfer were designed and implemented. However, these alternative digital solutions have dysfunctional effects. The three digital transfer solutions are built on different communication logics. The first two are based on a push-logic. In these, the medical certificates are digitally pushed from the healthcare organization or the patient to SIA. Such digital transfers of medical certificates are made in advance before a sickness benefits application is submitted. If the patient gets well during the first two weeks, there is no need to submit any benefits application to SIA. In such a situation, SIA receives medical certificates that have no function for their case handling. However, the case handlers at SIA cannot just throw them away. According to administrative regulations, SIA must open a case and try to reach the health insured/patient and request a sickness benefits application. This is a completely unnecessary administration that costs time and money. The third situation builds on a pull-logic. The digital medical certificate is submitted, as a digital attachment, together with a sickness benefits application.

The medical certificate is colored by a health-insurance language. The form is structured on a certain health-insurance assessment logic. The assessment of the working ability of the patient should be conducted by the doctor in three steps: 1) set a Diagnosis, 2) clarify Functional reduction and 3) Activity limitations. This is called the DFA-chain and these items should be recorded in the MC form. Based on this DFA information the doctor should recommend a sickness leave period for the patient. This can be done with the aid of the HIDS decision support, which is embedded in DigCert:s digital service for issuing MC. HIDS contains a repository of medical diagnoses and recommended periods of sickness leave for each diagnosis. These standards guide the doctor to select an appropriate sickness leave period. If the doctor issues a period that deviates from the standard period, the doctor is prompted by the digital service to motivate such a deviation. DFA and HIDS are ways to ensure that doctors apply a health-insurance procedure when issuing a medical certificate. If a medical certificate is completed following these health-insurance procedures, then the case handling at SIA will be facilitated. If a medical certificate lacks information to make a proper sickness benefit decision at SIA, then the case handler needs to contact the doctor and request additional information. Eventually, there is a risk that the benefits application will be rejected by SIA.

Many investigations have reported that doctors have problems to apply the different health-insurance concepts. Such investigations also report that there exists hostility between the doctors and SIA case handlers due to different views on patients’ working abilities.

The MC paper form has been transformed into a digital form as an element in the digital service for MC issuing in DigCert. This digital artifact has been developed by a public IT supplier that is owned by the main healthcare providers (HCP). Even if DigCert is a digital artifact that is collectively owned by the public healthcare providers, this product has been heavily influenced by the public agencies SIA and NBHW. SIA has actually maintained the design responsibility for the interactive service for issuing MC and its new digital form. The development of digital artifacts for medical certificate management has mainly been financed by a national program for sickness leave potentiation. SIA was the main decision-maker for allocating the
development budget and this public agency has thus the possibility to influence many design decisions.

5 Theorizing digital interoperation

5.1 Empirical statements: interoperational circumstances

The case study analysis has revealed different issues of digital interoperation. Following the pragmatist inquiry approach (section 3 above), the “search-light” has been on when is and what makes e-government interoperation successful or unsuccessful (Scholl & Klischewski, 2007). In a pragmatist inquiry like this one, it is fruitful to alternate between using
- an *appreciative eye* and looking for what works well, i.e. smooth and successful accomplishments (Ludema et al., 2001; Goldkuhl, 2011)
- a *critical eye* and looking for what does not work so well, like frictions, disturbances, breakdowns, unintentional effects and other problems (Dewey, 1938; Goldkuhl & Röstlinger, 1993; Goldkuhl, 2011)

This analysis of case data has implied the formulation of *interoperational circumstances* (table 1; second column). An interoperational circumstance is a *condition or efficacy in the digitalized practice*. Conditions are expressed in *descriptions* (condition statements). One example is #9 “Lack of written information about illness and treatment in MC to patients”. Condition statements comprise usually a description of 1) entity-objects or processes or constellations of these and 2) properties of such “possessor-objects”. An MC is a *symbolic object* (1) and through an evaluative empirical analysis it has been considered to have *properties* of information shortage (2).

<table>
<thead>
<tr>
<th>#</th>
<th>Case example</th>
<th>Abstraction (theoretical statement)</th>
<th>Dimensions</th>
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<tbody>
<tr>
<td>1</td>
<td>SIA was financially responsible for prioritizing &amp; deciding on MC digital design.</td>
<td>There may exist economic power relations between interoperators (regulators vs. certifiers) regarding the development of digital interoperation.</td>
<td>Economic Relational</td>
</tr>
<tr>
<td>2</td>
<td>The interaction design of the digital service/form for doctors’ issuing of MC was heavily influenced by SIA.</td>
<td>One interoperator (regulator) may influence the design of digital services of another interoperator (certifier).</td>
<td>Performative Interactive Relational</td>
</tr>
<tr>
<td>3</td>
<td>Discrepancy between objectives of HCP (healthcare to patients) and SIA (to keep benefits low).</td>
<td>Different interoperators may be guided by diverse (possibly disharmonious) objectives.</td>
<td>Normative Relational</td>
</tr>
<tr>
<td>4</td>
<td>Specific health-insurance concepts are enforced by SIA to HCP (information requirements in digital MC service/form).</td>
<td>One interoperator (regulator) may enforce the use of concepts onto another interoperator (certifier).</td>
<td>Semantic Relational</td>
</tr>
</tbody>
</table>

Table 1a. Interoperational circumstances: empirical and theoretical statements with dimensions of interoperation
Efficacies are expressed in *explanations* (functional statements), that build on and relate two or more conditions. A *functional statement* comprises two clause elements: *pre-conditions* (“causes”) and *post-conditions* (“effects”). Sometimes there might three or more clauses (preconditions, intermediary conditions, post-conditions). Usually one of the conditions in a functional statement is a process-condition following our pragmatist foundations. A process can be a human individual action, a human collective action, an institutional action, or a technical operation.

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<tbody>
<tr>
<td>5</td>
<td>Specific health-insurance procedure (DFA) is enforced by SIA to HCP (interaction design of digital MC service).</td>
<td>One interoperator (regulator) may enforce the use of a procedure onto another interoperator (certifier).</td>
<td>Performative Relational</td>
</tr>
<tr>
<td>6</td>
<td>Specific health-insurance knowledge (HIDS) is provided by NBHW to HCP and its use is demanded by SIA (embedded informing service in interactive MC form).</td>
<td>Interoperators (regulators) may provide and enforce the use of certain knowledge to another interoperator (certifier).</td>
<td>Cognitive Interactive Relational</td>
</tr>
<tr>
<td>7</td>
<td>Health-insurance concepts and procedures are not in the core competence of doctors and they may have difficulties to apply them.</td>
<td>Concepts and procedures may be hard to apply for an interoperator (certifier) if they originate from other interoperators (regulators).</td>
<td>Semantic Performative</td>
</tr>
<tr>
<td>8</td>
<td>Unclear/lack of information about different MC communicative functions may confuse doctors &amp; patients.</td>
<td>Information deficiencies may have disturbing impact on interoperators (certifiers and requesters).</td>
<td>Semantic Relational</td>
</tr>
<tr>
<td>9</td>
<td>Lack of written information about illness and treatment in MC to patients.</td>
<td>Digital information from one interoperator (certifier) to another one (requester) may lack important content.</td>
<td>Cognitive Regulative Relational</td>
</tr>
<tr>
<td>10</td>
<td>Possible to adapt MC to employers in compliance with the law on sickness leave (filtering functionality).</td>
<td>Adaptation of digital information to interoperators (controllers) may be advantageous to those and other interoperators (requesters).</td>
<td>Performative Cognitive Regulative</td>
</tr>
<tr>
<td>11</td>
<td>No arranged digital transfer of MC to employers, which necessitates that patients handle the transfer of MC (lack of functionality and digital connection).</td>
<td>Lack of digital transfer to interoperators (controllers) may put demands on activities of other interoperators (requesters).</td>
<td>Performative Architectural Technical Relational</td>
</tr>
</tbody>
</table>

*Table 1b. Interoperational circumstances: empirical and theoretical statements with dimensions of interoperation*
There are several functional statements in table 1. One such statement is #2 “The interaction design of the digital service/form for doctors’ issuing of MC was heavily influenced by SIA.” This is a process-to-result statement, where the process is the interaction designing and the resulting condition is a digital service with certain properties. Another example of a functional statement is #16 “A transferred MC to SIA in advance leads to unnecessary administrative work at SIA.” This is an antecedent-to-process statement, where the antecedent condition is a property of a digital artifact (transferred MC) and the process condition is SIA administrative work (which is characterized as “unnecessary”).

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<th>Abstraction (theoretical statement)</th>
<th>Dimensions</th>
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<tbody>
<tr>
<td>12</td>
<td>An MC in digital format facilitates case handling at SIA.</td>
<td>Information transferred digitally to an interoperator (controller) may facilitate activities of that interoperator.</td>
<td>Performative Semantic Normative</td>
</tr>
<tr>
<td>13</td>
<td>There exist different ways of digital transfer of MC to SIA based on different initiators of transfer (competing functionalities).</td>
<td>Digital arrangements may comprise different ways of digital transfer based on disparate interoperators as initiators.</td>
<td>Performative Architectural</td>
</tr>
<tr>
<td>14</td>
<td>In order for HCP to transfer digital MC directly to SIA, there is a need for a recorded consent from the patient.</td>
<td>Digital transfer of information from one interoperator (certifier) to another (controller) may be dependent on regulations and recorded permits.</td>
<td>Relational Regulative Performative</td>
</tr>
<tr>
<td>15</td>
<td>MC can be transferred in advance to SIA, before a sickness benefit application (superfluous functionalities).</td>
<td>Different digital information items that need to be connected for an interoperator (controller) may be transferred separately to that interoperator.</td>
<td>Performative Architectural</td>
</tr>
<tr>
<td>16</td>
<td>A transferred MC to SIA in advance leads to unnecessary administrative work at SIA.</td>
<td>Inadequately transferred information to an interoperator (controller) may cause extra work.</td>
<td>Performative Regulative</td>
</tr>
<tr>
<td>17</td>
<td>A completed MC by a doctor following the health-insurance argumentation logic (of DFA and HIDS) will facilitate the review of sickness leave benefit cases conducted by SIA case handlers.</td>
<td>Accountable and clear digitalized information created by one interoperator (certifier) may facilitate the work of another interoperator (controller).</td>
<td>Semantic Performative</td>
</tr>
</tbody>
</table>

Table 1c. Interoperational circumstances: empirical and theoretical statements with dimensions of interoperation

An identified and described digital circumstance is something that relates positively or neutrally or negatively to the task of digital interoperation. One positive example is #12 “A MC in digital format facilitates case handling at SIA”. One negative example is #16 “A transferred
MC to SIA in advance leads to unnecessary administrative work at SIA.”. These statements are thus not neutral functional statements. They are functional statements that also are evaluative statements resulting from assessments of identified efficacies.

5.2 Theoretical statements: interoperalational concerns

Based on these empirical statements (table 1; column 2), abstractions have been made and theoretical statements have been formulated (table 1; column 3). One example is #4 with the empirical statement “Specific health-insurance concepts are enforced by SIA to HCP”. The DFA concepts are enforced by SIA to the doctors through the digital issuing service in DigCert. Based on this empirical observation (formulated in the mentioned empirical statement) an abstracted theoretical statement has been formulated: “One interoperator (regulator) may enforce the use of concepts onto another interoperator (certifier)”. Case-specific properties have been excluded in this abstraction process, i.e. the kinds of concepts (of health-insurance character) and the actors (SIA, HCP). Instead of mentioning these case-dependent actors, a general actor characterization has been made. All actors are, in the theoretical statements, considered as interoperators, i.e. participants in interoperalational practices. However, different roles in the interoperation can be identified. I have taken a communicative perspective and specified different roles in relation to the communication of medical certificates and other messages. The role of the patient is a requester, i.e. a requester of a medical certificate and sickness benefits. The doctor, who issues a medical certificate, is certifier. The employer and SIA use the medical certificate for controlling sickness leave. This role is called controller, which includes decision-making. SIA has another role in the interoperation, that of a regulator. SIA has regulatory power to enforce health-insurance procedures and concepts on doctors (certifiers). Even NBHW has such regulator role. These different communicative roles are used as qualifiers to the general role of an interoperator in the theoretical statements of table 1. This is done to give more substance and precision in the theoretical statements.

The formulated theoretical statements express interoperalational concerns in an abstracted manner. The theoretical statements in table 1 are formulated on the basis of the corresponding empirical statements. This means that the principal statement character (condition statements, functional statement) from the empirical formulations are maintained, even if the grammatical sentence structure is made differently in some cases. In some theoretical statements, complementary knowledge from the case description has been utilized in the abstraction process to make those theoretical statements more comprehensive. One such example is #10 with the empirical statement “Possible to adapt MC to employers in compliance with the law on sickness leave”. In the corresponding theoretical statement “Adaptation of digital information to interoperators (controllers) may be advantageous to those and other interoperators (requesters)”, a clarification has been made that there may be several interoperators involved in this type of interoperalational situation. The theoretical statement is also formulated in an explicitly evaluative manner with positive post-conditions (“advantageous to”).

5.3 Dimensions of digital interoperation

Each identified interoperalational circumstance (formulated both empirically and theoretically) have been scrutinized with a dimensional eye. What aspects of general character can be found in these circumstances? This was part of the planned inductive research strategy in the selected
egov case. Important interoperational circumstances have, as shown above, been identified and documented (table 1). This comprises both positive conditions and frictions/problems. The identification of such interoperational conditions and efficacies were made without any consideration of interoperability layers or other dimensions. A continued inductive analysis has been performed. For each interoperational circumstance, different characterizing aspects have been conceptually generated and formulated. Results from this *dimensional labeling* can be found in column 4 of table 1 and column 1 of table 2.

Some examples to illustrate the kind of reasoning applied in this generative process: #9 “Lack of written information about illness and treatment in MC to patients”. One empirical insight from the case was that the medical certificate is optimized to one actor, i.e. the Social Insurance Agency. Other actors (patients and also employers) lack information for their purposes. The lack of information is coded as “cognitive”. Another given code is “regulative”. This is given due to legal statutes that healthcare providers should inform patients clearly, in writing if demanded, about personal health issues. The “relational” code is given due to the situation of healthcare providers/doctors communicating to patients. Another example is #2 “The interaction design of the digital service/form for doctors’ issuing of MC was heavily influenced by SIA.” This interoperational circumstance is coded performative, interactive and relational. The code “performative” originates from the digital functionality (digital service) for issuing medical certificates; i.e. an action performed by doctors. “Interactive” is given dependent on the interaction design of the user-interface of the digital service. SIA has influenced this interaction design of a digital service/interactional form that is owned by the healthcare providers and used by their doctors. This implies a particular relation between these interoperators; hence the code “relational” is stated.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relational</td>
<td>Interoperators have different workpractice roles and thus different relations and communicative patterns to each other that frame and influence the arrangement of digital interoperation.</td>
</tr>
<tr>
<td>Performative</td>
<td>The conduct of digital activities by one interoperator can be designerly influenced by other interoperators. Provided digital functionality may enable, facilitate, direct, constrain and prevent desired activities by interoperators, which may have significance for functional interoperation.</td>
</tr>
<tr>
<td>Semantic/cognitive</td>
<td>The workpractice language in a digital service aimed for some interoperator can be designerly influenced by other interoperators. Information deficiencies in digital services may constrain interoperators’ understanding and activities. Information of good quality emanating from one interoperator may improve the activities of another interoperator and thus the interoperation outcome.</td>
</tr>
<tr>
<td>Interactive</td>
<td>Interaction surfaces used by one interoperator can be designerly influenced by other interoperators. The quality of interaction surfaces may influence the quality of created information and thus the interoperation outcome.</td>
</tr>
</tbody>
</table>

*Table 2a. Dimensions of digital interoperation*
<table>
<thead>
<tr>
<th><strong>Dimension</strong></th>
<th><strong>Explanation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Normative</td>
<td>Different values and goals of interoperators and other influential stakeholders may impact digital interoperation. Common values/goals may be held by different interoperators. Different interoperators may have diverse values and goals that govern their respective practices. Different goals/values may be disharmonious and thus hard to fulfill simultaneously.</td>
</tr>
<tr>
<td>Regulative</td>
<td>There may exist laws, statutes, agreements and other rules that regulate the whole interoperational practice or parts thereof. Such rules may be inscribed into digital artifacts that participates in the digital interoperation. There may exist rules that are disharmonious and thus are hard to comply with altogether.</td>
</tr>
<tr>
<td>Economic</td>
<td>Investments in digital interoperation can be made, to a various extent, by different interoperators. Hence, the design influence may differ between different interoperators.</td>
</tr>
<tr>
<td>Architectural</td>
<td>Digital interoperation is based on different digital artifacts that are organized in a digital landscape and where these artifacts function together in certain ways. Different digital artifacts need to be connected in thoughtful ways for actors to interoperate constructively; otherwise different obstacles and disturbances for interoperators may occur.</td>
</tr>
<tr>
<td>Technical</td>
<td>Technical mechanisms for capture, processing, storage, retrieval, transfer, and presentation of digital information are needed for digital interoperation. Technical interfaces between interoperators that are functional need to be established and sustained.</td>
</tr>
</tbody>
</table>

*Table 2b. Dimensions of digital interoperation*

The different identified interoperational dimensions are listed in table 2 (column 1). Based on the dimensional characterizations in table 1, a clarification of these different interoperational dimensions is made (column 2 in table 2). The formulation of these dimensions is mainly done following the inductive approach applied. Hence, they are empirically grounded in the empirical case material. Some broadening of the descriptive scope has, however, been made based on general knowledge on digital interoperation. This has been made due to a desire to reach conceptually clear and workable descriptions. One change has been made in relation to the identified dimensions in table 1. The dimensions of semantic and cognitive have been merged in table 2. They are both concerned with information. The semantic dimension has an orientation towards the *type of information*; what linguistic concepts are used. Cognitive means an orientation towards *informational contents*. 
6 Discussion and conclusions

6.1 Interoperational dimensions

The concern for digital interoperability seems to have emerged from the challenges of exchanging information between digital information systems. In order to transfer information from one system to another one, it is necessary to clarify technical issues (transfer protocols etc.) and the semantics of the transferred information (i.e. a specification of the information items). This means that the technical and semantic dimensions are foundational for addressing interoperation. However, in order to reach functional interoperation, other aspects need to be addressed besides this minimal scope of semantics and technics. Historically, organizational interoperability emerged as a dimension covering such broader aspects. This became, however, a kind of residual category without enough conceptual precision.

In the proposed dimensional framework, there is no separate dimension of the organizational. Such a dimension did not emerge through the inductive analysis. Instead, there exist several dimensions that relate to such an organizational cluster. There are dimensions of the relational (what actors and their roles and relations to each other), the normative (what values and goals that govern the actors’ work), the economic (how actors decide on economic governance of digital arrangements for interoperation), and the performative (what activities and actions that are performed by organizations through their human and digital representatives; both internally and as interacts to other actors).

In the proposed dimensional framework, there are two dimensions that seem to be taken for granted in earlier conceptualizations: the relational and architectural dimensions. In the very notion of digital interoperation, it comprises that different actors exchange information through the use of digital artifacts. This means that there must exist some relations between actors (the relational dimension) and that digital artifacts have some kind of connection (the architectural dimension). This means that these dimensions are seen as essential when discussing egov interoperation. My claim here is that they should not be excluded just because they are presupposed in the definition of digital interoperation.

The case study has also revealed that issues of digital interoperation definitively go beyond transfers and interfaces between digital artifacts. Through an interoperational perspective (how do organizations, humans and digital artifacts work together) several circumstances were identified where other interoperators (SIA, NBWH) influence the way one interoperator (healthcare provider/doctors) works; see #2 -#7 in table 1. Objectives, knowledge, language, and procedures have been enforced on doctors through the design of digital services and interactional forms. These are influences that relate to normative, semantic, cognitive and performative aspects and these influences are mainly implemented through the design of digital services and interactional forms, thus performative and interactive dimensions. The digital tool (DigCert) that doctors use to issue a medical certificate is heavily influenced by general demands and specific design interventions made by those other interoperators. This means that even a user-interface utilized by one actor cannot be excluded from a study of digital interoperation. An inquiry on interoperation in e-government should have a broad scope on all possible issues that impact how actors work together through the use of digital artifacts.
Legal interoperability corresponds to the regulative dimension in the emerged framework. The view taken here is that one needs to investigate what laws and other regulations that frame and influence the digital interoperation. It is not only a case of having fully compatible regulations because this is seldom the situation. Different regulations are formulated and issued at different points in time and due to different demands. Hence, there will seldom exist full regulative compatibility. A regulative view on digital interoperation should mean to clarify the “regulative landscape” and investigate retrospectively how actors have navigated in this through digital arrangements and other workpractice designs, and proactively suggest better arrangements for regulative compliance and resolution of identified controversies and incongruencies.

The different interoperational dimensions has emerged as suitable characterizations of interoperational circumstances (table 1). They are abstractions from such identified interoperational circumstances in the case. In this abstraction process, there was an aim to reach distinct and separate dimensions. However, there must be admitted that there exist some overlap and also some closeness between some of the dimensions. There may exist a partial overlap between the normative and the regulative dimension. Certain public values may be codified in laws and other statutes. This means that such concerns are both normative and regulative. Not all values are legally codified, why there exist a value set that is normative and not regulative. On the other side, there may exist formulations in statutes that are more “technicalities” than typical value statements.

The dimensions of architectural and technical are close. The architectural connections between different digital artifacts rely fully on technical mechanisms for transfer. There is also a closeness between the performative and interactive dimensions. Digital functionalities for end-users (as examples of performatives) must be accessed through user-interfaces, thus such interaction surfaces hold different functional services. Even if digital functionality and digital interactivity coincide to a large degree it is meaningful to see them as distinct dimensions. The performative dimension comprises more than end-user functionality (see table 2). The interactive dimension covers other aspects than just functional. It covers also informational aspects (as the presentation of digital forms). This means that there is closeness between the interactive and the semantic/cognitive dimensions. Information is not only presented in interactive forms. It occurs in other digital media as well as outside the digital domain.

Workpractices and arranged digital interoperation within those are intricate and complex socio-technical arrangements. Therefore, it seems hard to reach a dimensional framework without any conceptual overlaps or close connections. Future research will contribute to possible refinements and/or modifications.

6.2 Interoperability as more than capability

In section 2 above, interoperability was provisionally defined as capability of actors to interoperate. A broader view has emerged through this case study and the conducted inductive analysis. It is not only capabilities of organizations, humans, and artifacts that frame interoperation. There are also other pre-conditions (beyond capabilities) that influence success and failure in digital interoperation. There may be unresolved dilemmas in the workpractices that influence the effectiveness of digital interoperation. There exist different regulations, which are not fully harmonious and such rules may entail frictions in the digital interoperation.
There may be digital capabilities (like redundant transfer functionalities) that exist to ensure some purpose (to receive information in digital format) while entailing other effects that are considered as dysfunctional (#13, 15, 16). There exist focus dilemmas in the doctors’ work. A medical focus in doctors’ work may take away attention from health-insurance procedures. A health-insurance focus in doctors’ work may take away attention from health information to patients.

To have a restricted focus on interoperability as capability, one can miss taking into account other pre-conditions than those intentionally arranged. Instead of interoperability as capability, the conclusions from this study are to rather use the notion of interopational pre-conditions. There will exist organizational pre-conditions (values, arranged workprocesses etc.), human pre-conditions (intentions, values, competencies etc.) and digital pre-conditions (functional, semantic, interactive, architectural, technical arrangements).

6.3 Final remarks

The discovery-oriented research approach of this study does not give any evidence for a restricted four-layered view on digital interoperation. Given this empirical case, I cannot see the point to talk about layers. A more fruitful view seems to be: dimensions of digital interoperation.

The main contribution of this paper is the dimensional conceptualization of e-government interoperation. This conceptualization has emerged from and is based on (intermediary and supplementary knowledge contributions such as) a case study description with empirical formulations and corresponding theoretical statements.

These contributions should be seen as knowledge in progress according to pragmatist epistemology (Dewey, 1938; Friedrichs & Kratochvil, 2009). This means that such knowledge contributions should be considered as additions to a continuous scientific discourse and not as something finalized. Future research can further investigate dimensions for egov interoperation. There are needs for more empirical studies as a basis for further conceptual emergence and validation. More studies on scholarly and other literature for conceptual comparison could be done. Other published empirical material can also be used for further generation, validation and application of conceptual constructs. The formulated theoretical statements (in table 1) constitute a potential for further theorizing. These statements can be synthesized and further developed together with other theoretical contributions from the knowledge base on interoperation in e-government.

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