

ADAPTIVE NETWORKED GOVERNANCE OF E-HEALTH STANDARDS: THE CASE OF A REGIONAL HEALTH INFORMATION INFRASTRUCTURE IN NORWAY

Research paper

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Abstract

Due to local idiosyncrasies and professional variations in the capture and use of patient information, healthcare providers often struggle to facilitate smooth transfer of patients along with essential information about them. This puts pressure on national and regional authorities to consolidate e-health standards, but they often lack the legitimacy, capacity or mandate to implement significant changes. We have looked at the rather successful governance of e-health standards in one health region in Norway. Through the establishment of a coordinative network, health professionals share knowledge and continuously improve e-health standards across hospitals in the region. We conceptualize the phenomenon as an adaptive network-oriented standards governance model for very large information infrastructures. For e-health standardization practitioners, we advise that the inherent consolidation problem in standards governance in healthcare may be mitigated through the establishment of profession-based network groups that can mediate between top-down and bottom-up standardization activities. Theoretically, we contribute with a fresh standards governance model, which takes into account the process, structure and technical perspectives necessary to manage large-scale standardization efforts.

Keywords: Information Infrastructure, E-health standards, Governance, Networks

1 Introduction

“In a hospital in our health region, an elderly woman got a potentially fatal allergic reaction to muscle-relaxing medicine during prefaces of anesthesia, but was saved by skilled personnel. The same woman was later undergoing surgery at another hospital in the same health region. There, she received the same medicine, and experienced the same adverse reaction to it. The same happened again when she needed emergency surgery at our [the third] hospital.” (Anesthesia doctor at the third hospital, 2016).

Healthcare is an increasingly complex enterprise (Pettigrew et al., 1992; Ballantine and Cunningham, 1999; Pollock and Williams, 2010) with a growing number of clinical specialities and geographically distributed services that require new governance models. Typically, patients visit several healthcare organizations and departments during their care trajectories. Patient information is collected continuously and needs to be accessible across healthcare providers. Clinical guidelines, e-health standards and IT portfolios need to be aligned if the prospect of swift and quality healthcare is to be achieved. Information systems governance in healthcare is known to be a challenge (Middleton et al., 2005; Berner et al., 2005; Greenhalgh et al., 2008; Bygstad and Hanseth, 2016), and the lack of integrated solutions becomes particularly visible when care paths travel across organizations, as illustrated by the anecdote above. In this

study, we focus on governance of e-health standards, which we refer to as syntactic, semantic and functional standards, implemented in healthcare IT solutions. These allow healthcare personnel to capture, store, process and share information based on clinical practice needs.

One strand of information systems research considers the development of very large and complex assemblages of information systems in organizations and refer to them as information infrastructures (II). IIs constitute ensembles of heterogeneous IT portfolios, work practices, organizational stakeholders and standards without a single point of centralized governance and control (Hanseth and Lyytinen, 2010; Hanseth and Monteiro, 1997). Central to this literature is a discussion on how desirable change can be implemented in such loosely coupled ensembles of shared IT capabilities. Proponents of a top-down approach have argued for a clear IT governance regime that can guide prioritization and coordination of important decisions and relate them to standardized solutions (Weill and Ross, 2004). However, Constantinides and Barrett (2014) argue that a top-down approach may alienate stakeholders and lead to fragmentation of the development process, especially in healthcare. They propose a polycentric approach to II governance.

A few recent studies draw on the notion of polycentric governance to describe regional efforts to consolidate information systems across heterogeneous, distributed and semi-autonomous stakeholders in healthcare (Constantinides and Barrett, 2014; Vassilakopoulou et al., 2018; Ulriksen et al., 2016). This emergent strand of research has focused on the governance of shared IT portfolios and their functional requirements, such as e-prescription and electronic patient journal systems (EPR), rather than the governance of e-health standards. However, standards are the backbone of IIs. For instance, in healthcare, standards are critical to the reliable exchange of patient information among healthcare professionals. We extend the promising application of a polycentric II governance perspective to study a regional e-health standards governance initiative. Theoretically, we advance the polycentric II governance perspective by integrating the concepts of adaptive co-management (Armitage et al., 2010), goal-oriented networks (Provan and Kenis, 2008; Provan and Lemaire, 2012) and network orchestration (Dhanaraj and Parkhe, 2006). These concepts allow us to bring nuances into the discourse regarding top-down or bottom-up governance of IIs. For practitioners, we highlight a potential governance model to deal with complex e-health standardization efforts. This guides our investigation to answer the question: *How can a network-oriented approach to e-health standards governance coordinate a large number of diverse clinical specializations, healthcare organizations and legacy IT systems?*

Empirically, we explore e-health standards governance activities in the Norwegian South East Health Region (SEHR). We collected data between Aug. 2016 and Nov. 2018. SEHR is responsible for hospital healthcare for around half of the Norwegian population. Due to early and autonomous adoption of EPRs and other IT systems, the SEHR now maintains a diverse set of e-health standards that makes sharing of patient data difficult. Our focus is on how the SEHR manages to accommodate a diversity of medical professions, clinical guidelines, and legacy IT in their e-health standards governance approach.

In the next section, we present a brief literature review on II governance, which is followed by a description of our analytical perspective. Section 4 presents methods. Section 5 describes the case. In sections 6 and 7, we provide analysis, discussions and conclusions.

2 Related Research: Governing Information Infrastructures

II studies are concerned with the development of interconnected ensembles of information systems, including arrangements that are social (e.g., norms and work practices), technical (e.g., legacy systems and technical configurations) and organizational (e.g., structures and governance regimes). Hanseth and Lyytinen (2010) define II as “a shared, evolving, heterogeneous installed base of IT capabilities among a set of user communities based on open and/or standardized interfaces” (ibid., p. 9). The backbone of an II is standards. A number of studies contribute to our understanding of standards in II development, by elaborating on their agency in shaping practice (Hanseth and Monteiro, 1997), by their role in facilitating innovation (Hanseth and Nielsen, 2013), or by bridging between different technical standards through gateways (Egyedi and Loeffen, 2002; Hanseth, 2001). In particular, the tension between local work practices and “global” standards has been highlighted and associated with the need for flexible

standards (Braa et al., 2007), striking a pragmatic balance (Rolland and Monteiro, 2002), and the importance of creating networks to help support the local adaptation of standards (ibid., Jacucci et al., 2006; Braa et al., 2007). Despite the numerous contributions to our understanding of the role of standards in II development, advice on how to govern the development of the standards themselves remains limited and implicit.

With the Internet serving as an exemplary case, scholars argue that IIs are unbounded and can never be developed and governed in a top-down fashion due to their complexity and lack of centralized coordination and control (Ciborra et al., 2000; Hanseth and Lyytinen, 2010). Such studies emphasize how II changes through the cultivation of an already existing installed base (e.g., Hanseth et al., 2006; Hanseth and Monteiro, 1997) of socio-technical arrangements (Bergqvist and Dahlberg, 1999; Hanseth and Lyytinen, 2010; Hanseth et al., 1996) on the verge of unmanageable drift. These accounts differ, however, from studies of work-oriented IIs that serve specific inter-organizational goals, such as collaborative research networks (Karasti et al., 2010; Ribes and Finholt, 2009; Zimmerman and Finholt, 2007) or national health IIs (Aanestad and Jensen, 2011; Sahay et al., 2009). Work-oriented IIs constitute interconnected systems and modules that are developed and maintained in a distributed and episodic manner by a multitude of stakeholders with diverse interests (Aanestad and Jensen, 2011). The social and technical arrangements required to govern IIs are time consuming and costly to develop and maintain (Karasti et al., 2010; Suchman, 2002). Taking these challenges seriously, Aanestad and Jensen (2011) warn against stakeholder coordination overhead in II development. Based on a longitudinal study in Denmark, the authors compare a large top-down and integrated national EPR initiative with a small and emergent one. They find the bottom-up and emergent initiative the most successful, and propose that stakeholder collaborations, similarly to technical configurations, should be managed in a modular fashion to allow for gradual and incremental growth without congesting decision-making.

2.1 Polycentric governance of Information Infrastructure

Advocates of a top-down approach to II development have argued for the need of establishing a clear IT governance regime that can guide the effective prioritization and coordination of important decisions and relate them to standardized solutions (Weill and Ross, 2004). However, studying governance of a regional e-health initiative in Norway called “Digital Renewal”, Bygstad and Hanseth (2016) found that due to heterogeneity across hospitals, the most difficult issue was standardization, and a top-down approach was inadequate in balancing inherent tensions. According to Constantinides and Barret (2014), top-down governance may alienate stakeholders and lead to fragmentation of the development process, and have proven ineffective, especially in healthcare. This is partly because of the heterogeneity of interests and resources involved. They further state that “*there is a clear gap in the literature in better understanding how to govern the development of information infrastructures using a bottom-up approach*” (ibid., p.40). Approaching the governance of a regional health II in Crete as a collective action problem they illustrate how a polycentric approach (Ostrom, 2010) can facilitate bottom-up governance of IIs. A polycentric approach to governance implies that divergent interests and tensions are dealt with in a nested governance structure, where lower levels maintain their independence to define norms, rules and standards within a specific domain. The research represents an initiation of an emergent stream of literature that focuses specifically on the polycentric governance of II development (Constantinides and Barrett, 2014; Ulriksen et al. 2016; Vassilakopoulou et al., 2018). Vassilakopoulou et al. (2018) highlights its potential to steer “*inter-organizational systems that need to come out of brownfield development (i.e., situations where there is a multitude of systems, data repositories and actors already in place)*.” (ibid., p.11). Studying inter-organizational IT governance in the North Norwegian Health Region, Ulriksen et al. (2016) report from a program to integrate clinical systems and identify “best practices” for EPR use across the region. To resolve emergent tensions between local and regional interests, IT governance was divided into smaller domains such as EPR and radiology, with local anchoring. The authors compare this strategy to a polycentric governance model with multiple governing units and several overlapping arenas of authority and responsibility. However, the model implied significant challenges in terms of collaboration and mandates between loosely connected actors.

The early development of a polycentric governance perspective addresses the key debate in II literature on the tensions between top-down and bottom-up governance. However, the studies reported on so far do not discuss II standards governance specifically. This is an important research gap because standards are the backbone of IIs, and standardization is noted as a key challenge in II governance that requires further research (Vassilakopoulou et al., 2018; Bygstad and Hanseth, 2016). Our empirical case study from the SEHR in Norway details efforts to harmonize e-health standards in a work-oriented health II with overarching common goals of delivery of quality healthcare. We now present the analytical perspective that guides our analysis of polycentric II standards governance.

3 Analytical Perspective

Drawing on the works of Armitage et al. (2010), Provan and Kenis (2008), Provan and Lemaire (2012) and Dhanaraj and Parkhe, (2006), we have identified three key concepts to inform our analysis: adaptive co-management, goal-directed network, and network orchestration.

Adaptive co-management (Armitage et al., 2010) compensates for the limitations of top-down governance approaches. Top-down governance approaches have been criticized for allowing minimal user participation in decision-making processes, which contributes to fragmentation of IT systems in the public health sector (Skorve, 2013). Adaptive co-management has evolved as a strategy to link local communities with the government by expanding stakeholder participation in environmental governance and resource management. Distinctive attributes of adaptive co-management include learning through experimentation, collaboration across heterogeneous stakeholder groups and cyclic processes of learning and adapting (Fabricius and Currie, 2015). An adaptive management approach is preferable in dealing with complexity in conflict resolution and decentralized problem solving (ibid.).

Certain types of organizing are well-suited to fostering an adaptive co-management process. Given its structural ability to enhance collaboration and learning within and across organizations, network organizations can be perceived as a supportive adaptive co-management organizational structure. The term network is narrowly defined as “groups of three or more legally autonomous organizations that work together to achieve not only their own goals but also a collective goal” (Provan and Kenis, 2008 p. 231). A network-based structure enables organizations to be flexible so as to be able respond quickly and adapt to changes that occur in the surrounding environment. Unlike traditional hierarchical structures, networks can reorganize, create new alliances or drop ties to accommodate emerging needs, creating enabling arenas for adaptive co-management.

The literature identifies two types of networks, depending on how the network is initiated. A network can be self-initiated by groups and individuals following a bottom-up approach to increase network participants, or it can be mandated by a government unit following a top-down approach for its further evolution. *Goal-directed networks* are formally established and governed with specific purpose either by the network participants or through mandate. They “...evolve [through] conscious efforts to build coordination.” (Provan and Kenis, 2008, p. 231). They are formal mechanisms in public organizations, where collective action is the most prominent means of complex problem solving. It is a favourable structure when there is a need for flexibility, adaptability and enhancing knowledge mobility (Provan and Lemaire, 2012). According to Provan and Lemaire (2012), goal-directed networks are effective if the nodes are tied at multiple levels, and when selective integration of nodes based on needs are allowed.

Network orchestration is defined “as the set of deliberate, purposeful actions undertaken by the hub firm as it seeks to create value [...] and extract value [...] from the network” (Dhanaraj and Parkhe, 2006; p. 659). A network orchestrator engages in three major tasks: enhancing knowledge mobility, innovation appropriability and network stability. In large-scale complex organizations, a variety of tacit and explicit knowledge relevant to the performance of the organization is found dispersed across the organization. An orchestrator takes the responsibility of enhancing knowledge mobility and leveraging competencies within the network by focusing on knowledge identification, creation of common identity among members and inter-organizational socialization.

In the discussions and conclusion section, we integrate our empirical insights with these three broad concepts to develop a perspective on public sector II governance, taking into consideration the structural, processual and technological aspects of II governance. We assembled these concepts, as we believe they provide us good vocabularies to explain and understand the phenomenon we observed in SEHR.

4 Methods

The research has been conducted as a qualitative case study with data collection taking place from August 2016 until November 2018. The organization we study is the Norwegian South East Health Region (SEHR). SEHR is responsible for providing hospital healthcare services to approximately half of the Norwegian population. It is organized with a regional health trust as owner, with 11 subordinated health trusts as 10 hospital health trusts (many of them including several hospitals) and a regional IT provider trust. Around 80,000 employees enable healthcare services on a daily basis.

4.1 Data Collection

We base our study on four types of data sources. First, we studied around 50 documents related to governance of e-health standards in SEHR. Approximately 20 of these are publicly available and the rest are internal SEHR documents. Types of documents include mandates, annual assignment letters, strategy descriptions, working documents, and presentations. Second, we had access to the region's e-health standards governance tool, jira, from its initiation in 2016 to November 2018 (6830 cases). We studied around 70 cases. We selected these based on what was mentioned in interviews and documents. In addition, reading a case led, on several occasions, to reading related cases in order to obtain a fuller picture. Third, we conducted three lengthy semi-structured interviews with three key stakeholders. We had iterations with one of them while developing the case description. We used information from the informants to fill in gaps in our emergent understanding of the case collected from document studies and the governance tool. Further, the informants provided detailed descriptions about governance processes and structures, aiding us building the case in several stages as we studied the various data sources. Lastly, the first author has been an employee in the SEHR. The author partook in initial distribution of responsibility areas among network groups, and in writing the first draft of mandates for network groups. The author's perceptions and recollections have been triangulated with findings from the other sources to ensure that one person's voice does not carry the whole perspective of relevant data collection.

4.2 Data Analysis

The first author has collected the majority of the qualitative empirical data for this study, but the interpretive data analysis process has been a collaborative and iterative effort with a focus on deriving new theoretical insights (Andrade, 2009; Barrett and Walsham, 2004; Walsham, 2006). We have worked with data displays to reduce the complexity in the textual data (Miles and Huberman, 1994). The data displays highlighted important events, decision points, and tensions related to the e-health standards governance. In between regular discussion sessions among the four authors, the main author worked with different write-ups of the case material, which served as the focus point for analysis. The principal concern for our analysis was the challenge of conceptualizing the mobilization of loosely coordinated stakeholders who did not necessarily have to adopt or subscribe to the regional e-health standards, but had the local autonomy to manage important parts of existing socio-technical arrangements. Our analysis focused on the interplay between top-down and bottom-up activities and decision-making in an emergent e-health standards governance network, which we also identified as a gap in extant conceptualizations of II governance in general and polycentric governance in particular (Constantinides and Barrett, 2014). Addressing this conceptual gap and drawing on three governance-oriented concepts, namely adaptive co-management, goal-directed networks and network orchestration, we analysed our case and developed a novel perspective on II standards governance.

5 The Norwegian South East Health Region

The SEHR currently has more than 5700 IT applications (Sigurdson, 2018) after several decades of digitalization of paper systems and local innovation to provide hospital healthcare services. In the early days of digitalization, local hospitals were responsible for their own IT procurement and configuration of e-health standards. A regional IT provider organization called Hospital Partner was established in 2003. However, local e-health standard development continued according to local hospitals' needs without coordination among hospitals. The result was a plethora of IT applications and e-health standards that differed across hospitals. This contrasted the goal to enable better handling of patients between provider organizations, as the information was hard to share between different local IT systems that, in addition, had variations in e-health standards. Alerted by the growing "mess" in the IT portfolio, the regional health trust established a regional IT strategy in 2012. Focus was on tidying the "mess" by setting up a large standardization and consolidation program called "Digital Renewal". It was aimed at developing and implementing regional clinical IT systems based on regional e-health standards according to a "best-of-breed" IT configuration. Digital Renewal typically had one program or project for each IT system, with a traditional waterfall model of requirements handling and development within each project. A program board handled main priorities of investments while each IT project had flexibility within their own budgets. Results were less than anticipated, which led to a reorganization of the program in 2014. All the clinical programs were consolidated to achieve more control across all IT systems projects. An important aspect in relation to the regionalization of the clinical IT portfolio, is that each hospital still is responsible for patient safety and quality of care. Further, each hospital, according to Norwegian law, is itself responsible for having appropriate EPRs to document healthcare.

A persistent challenge for the projects was the lack of any function to hand over completed e-health standard deliverables. Neither was there any regional function that could guide how regional e-health standards should look. Some projects attracted participation from various hospitals, but the role of each hospital in standardization efforts was often unclear given the responsibilities that lie within each hospital. To tackle this, the regional health trust in collaboration with Digital Renewal, established a new and networked form of e-health standards governance from 2015. We focus on two parts of the emergent regional network configuration, namely the regional network groups with e-health standardization responsibilities and the Regional Centre for Clinical ICT (Regional Centre) with coordination responsibilities in the governance. We present this configuration in more detail to show how the network governance approach manages complexity when striving for regional e-health standards.

5.1 The Regional E-health Standards Governance – Nodes and Relations

"No e-health standards that are part of regional governance are changed without involvement from our regional network groups. They even handle new requirements from law changes. We have an ongoing case where the advice to the Directorate [of e-health] is to change the law." (Informant, 2018).

More than a thousand clinical and administrative personnel from the health region's hospitals have become included in the e-health standards governance as part of a large network (Sigurdson, 2018). What follows is the description of the main actors in the governance network and their relations.

The Regional Centre was established on the 1st of January 2016 with a mandate from the regional health trust. The centre counted 15 full-time employees in November 2018. Recruitment is primarily from the hospitals. The Regional Centre has a permanent assignment to govern the clinical IT portfolio on behalf of the health region. Its main purpose is to ensure that clinical needs are in the centre when developing and improving e-health standards in the hospitals' IT systems (RSKI, 2018). Figure 1 below depicts the Regional Centre as a coordinative function. Part of the Regional Centre's responsibility is to ensure that experiences and knowledge are shared across hospitals to enable continuous learning and improvement of e-health standards. It has a secretary function to coordinate the regional network groups and responsibility to request e-health configuration changes to Hospital Partner. The Regional Centre is also responsible for ensuring new e-health standards are implemented properly in the hospitals. This is done in collaboration with local hospital resources. For e-health standards that are integral to Digital Renewal,

the Regional Centre also collaborates with regional projects. Together with the regional network groups, the Regional Centre is part of a larger sideways e-health standards coordination effort among all four Norwegian health regions. A long-term political goal is to establish full access of patient data across all healthcare providers in Norway. The inter-regional coordination efforts gradually work towards this goal. While there are no formal processes between the regional e-health governance network and national e-health standardization organizations, such as the Norwegian directorate for e-health, “...network members participate in national arenas when relevant. For instance, for the national care summary record, our participants give feedback to further development of the solution” (Informant, 2018).

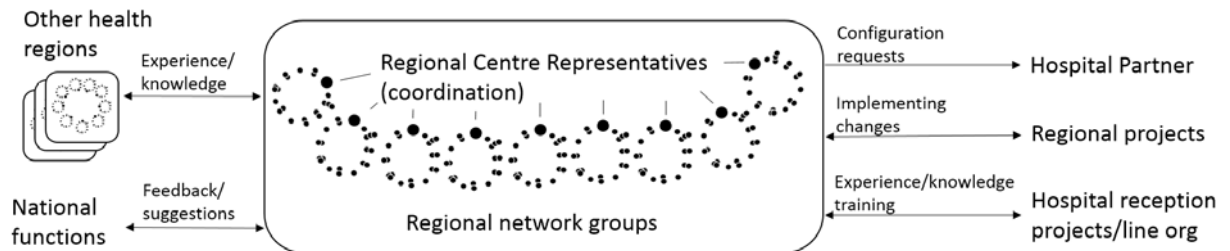


Figure 1. All the regional network groups, the Regional Centre and external relations

The regional network groups were established by the regional health trust in 2016. The groups are part of the permanent e-health standards governance structure. In November 2018, there were nine different regional network groups. Each group consists of between 15 and 35 trusted representatives employed in local hospitals (at least one person from each), from Hospital Partner and the regional health trust. At least one person from the Regional Centre is part of each group to ensure easier discovery and handling of cases that are relevant across the regional network group. Figure 2 outlines the typical structure of a regional network group with important relations.

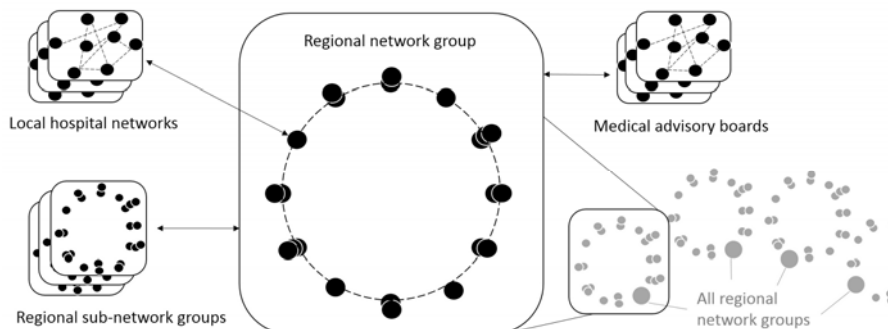


Figure 2. One regional network group and network relations. Each dot represents a person

An aim was to organize the groups according to business process areas in the hospitals. Examples of business processes areas are patient journal and administration, and medication management. The aspiration was to shift focus from IT systems (how the projects were organized) towards more business-oriented views. The experience from having an IT focus in delineating projects in Digital Renewal was that dependencies among IT systems (and then projects) were hard to handle. It was also believed that focusing on business process would enable easier visibility of relevant improvement areas. Such an approach potentially benefits the healthcare services since many process areas entail usage of several IT systems. For instance, in the area of medication management, a national project (NICT, 2011) identified 91 IT systems within the medication management chain in hospitals across SEHR.

The regional health trust together with local hospital management, have given the regional network groups responsibility to assess, harmonize and develop e-health standards on behalf of all the hospitals in the health region. An aim is that diffusion of e-health standards would proceed with less resistance since local healthcare practitioners are at the core of the e-health standards development. Each member makes e-health standards decisions on behalf of their respective hospitals. However, for necessary local legitimacy and quality on decisions, members have the responsibility to establish their own local hospital networks for discussions in standards development. “Due to the large span of cases, no one member of

the network groups had the knowledge to make good decisions themselves. A large array of practitioners from all over the hospitals are requested to provide feedback based on specific needs. This brings strength to the decisions." (Informant, 2018).

The *local hospital networks* are assembled ad-hoc based on specific knowledge needs, or are a more stable set of people that have agreed to be part of e-health standards work. While their formal power is advisory, their inputs are valued due to their specific profession knowledge. As such, a regional network group member will rarely go against the local expertise in formal decisions. However, this depends on what other group members are suggesting on behalf of their constituencies. The regional network members consolidate local hospital networks' advice to assess and decide on common e-health standards and negotiate room for local variations or deviations. In some areas of particularly high activity, the regional network groups establish *regional sub-network groups* for specific areas. During 2017 and 2018, nine sub-network groups have emerged for specific areas. An example is for Nurse Documentation.

Due to the close connection between e-health standards and medical guidelines, the regional network groups receive advice from the region's *medical advisory boards* when needed. Some of these are permanent boards, and others assemble based upon case. They are concerned with development of best practice medical guidelines. Their relation to the regional network groups is especially visible in the cancer treatment standards area. *"An ongoing case is how to handle medication documentation in our cancer treatment specification system, and our general medication system. Our oncologists [medical advisory board] make daily changes to treatment specification, which are implemented in the cancer treatment system. However, the medication system is slightly slower to move. This creates local work-arounds, where variation in practice creates variation in information in the system. Three regional network groups and a local hospital network now work to find better solutions."* (Informant, 2018).

5.2 The Regional E-health Standards Governance Practice

"The regional network groups have handled around 600 change requests to the regional EPR's e-health standards since 2013. These requests may emerge from single clinicians at a local hospital, and all the way up to director's level." (Informant, 2018)

We have identified three ways the e-health standards governance network is activated. First, a (top-down) governance process is initiated when regional projects in Digital Renewal request decisions. For instance, the regional EPR project needed expert knowledge on how functionality for nursing plans should be developed in a new version of the EPR. This did not only trigger a new process in the regional network groups, it triggered the creation of a sub-network due to the specificity of the tasks. Hospital networks are part of this. Additionally, it has become a theme in inter-regional network meetings.

Second, bottom-up initiatives trigger the e-health standards governance processes. We mention one example case we found in the regional e-health governance tool, which was also elaborated by an informant. A local hospital had created an electronic referral template for hearing aid repairs that replaced a lengthy paper-based routine. A local hospital doctor suggested it to be presented to the other hospitals via the regional network group. After the case had been circulated in local hospital networks of the other hospitals, all accepted the suggestion. The Regional Centre then sent a change request to Hospital Partner. Six weeks later, the solution was implemented in all hospitals, training included. Most bottom-up initiatives are related to local implementations of regional projects. A plethora of requests typically emerges. *"We have had to tighten the routine of feedback due to the high volume. Each hospital employee may still make requests, but through dedicated persons that will document in jira."* (Informant, 2018)

Third, the Regional Centre initiates cases on its own initiative based on its mandate. For instance, during autumn 2018, the Regional Centre initiated extensive process modelling. *"Digital Renewal chose to scope out work processes as a part of the e-health standardization efforts. Everybody agrees that understanding the work processes are important for improving healthcare services, but so far, no one is doing it – until recently, that is."* (Informant, 2018). The Regional Centre has initiated full process documentation of maternity wards in all hospitals in the region through observations and interviews. *"If the*

outcome is positive, we hope it will function as a showcase for further scaling such work as a part of the continuous improvement [of e-health standards].” (Informant, 2018)

5.3 Dealing with Standards Governance Tensions

What follows illustrates some tensions the e-health standards governance network has to deal with.

Variations in standards: Many hospitals have their particularities, making “one standard fits all” more or less an illusion. The solution is to allow for variations to the regional e-health standards. “*As an example, based on variation in internal organization of hospital functions, the journal templates need to fit to this to function well. As long as we have an overview of the variations, we will manage to cope with them when developing the standards and IT systems further.*” (Informant, 2018).

Distribution of decision-making power: Some types of decisions give challenging consequences. For instance, after disagreements among profession network groups regarding access management to patient data in 2017, The Norwegian Data Protection Authority did an assessment of responsibility distribution among stakeholders in SEHR. Its conclusion was that each hospital is responsible for its own risk in regards of data protection and access. The regional network groups agreed that data protection and access is often a part of many other e-health standard issues. This meant, “*In practice, we are a consensus-based network. Regionally, there is no way to enforce standards upon the hospitals*” (Informant, 2018).

Deviations from standards: The regional standards drift locally. “*Through a deviation from standards analysis, we found that in 2017, many deviations had emerged from what was implemented some years earlier.*” (Informant, 2018). Trying to find consensus, the regional network groups disagreed on one particular case. They escalated it to the directors’ meeting, where a final advice had to be made. A compromise was to permit the deviation for a year and a half. “*This permission opened a Pandora’s box.*” (Informant, 2018). Consequently, less effort to make standards without variations or deviations was observed in the networks afterwards. “*What has helped the Regional Centre is to further tighten the case handling processes. Deviations now always get a harmonization deadline unless the hospital director formally explains why it is not possible to close the deviation gap.*” (Informant, 2018).

Long-term governance perspectives and cooperation: We provide one illustrative example from efforts of achieving a more harmonized e-health standard for documentation of medication allergies starting in 2016. A system analysis by Digital Renewal had shown that all relevant IT systems (more than hundred) had variations in the standard. This imposed a challenge since it was difficult to integrate the information across systems and hospitals, and for clinicians, since the systems had different metadata definitions. All regional network groups were involved together with Digital Renewal in an effort to find a way to improve the standard and implement it in IT solutions. At the time, the Directorate of e-health had already made a national e-health standard for describing medication allergies. This was already implemented in a national care summary record in the hospitals for easy access to the information. The suggestion by Digital Renewal was to have a long-term goal of implementing the national standard in the local and regional systems. The regional network groups conferred with local hospital networks. Feedback was that while a common standard was appropriate, there was uncertainty in how the actual proposed standard would affect the many processes in the hospitals. The goal of a common standard was accepted, but what it would entail in the end would have to be based on experience and learning on the way. In the regional e-health standards governance tool, we found 29 different cases with discussions and decisions related to the standard suggestion after the regional network groups handled the assessment. Members from six regional network groups participated in these discussions in the tool (jira).

5.4 Tools for E-health Standards Governance

“All our cases and processes are documented in jira. Everyone has access to jira. This creates transparency for those interested. Each case is packaged and archived in a confluence solution after decision to enable documentation of a complete history.” (Informant, 2018).

The e-health standards governance uses a web-based task management tool (jira) to communicate and document all cases and processes involved in each case. Jira was initially implemented and used as a

task management tool for the regional IT projects. However, its functions fit with needs of the Regional Centre and the regional network groups, and so taken into use for e-health standards governance as well. Core functionality is to create tasks, link relevant documents, and links to dependent tasks. Each participant may include any other participant to follow a task, while everybody has the possibility to see all tasks via search. For each task, there is a discussion board for easy communication of task-related matters. We have observed that these discussions may be lengthy and highly valuable to e-health standards governance. For instance, we followed a case regarding standardizing documentation of medication allergies. A local hospital representative stated the problem in a case description. A new national guideline assigned documentation of medication allergies to be performed only by medical doctors. This created a tension at the maternity ward, where midwives, without the involvement of medical doctors, conduct most maternity trajectories, and have always entered this information themselves. Since the medical doctors did not have any direct contact with the women delivering, they did not want to do it. We followed the discussions on this particular case and found 33 entries, where different aspects to the problem and potential solutions were discussed. Following, we provide extracts from the discussion. Representative regional network group for Patient journal: *“The representatives need to get advice from the local hospital networks”*. Hospital A representative: *“We have concluded that we support that midwives still may enter the data”*. Hospital B representative: *“We do not support this. We have gotten advice from our information security advisor and our e-health representatives. We support following the national guideline”*. Regional network group representative: *“This case is too complex for one regional network group to handle. We also need advice from the medication management group”*. Hospital C local network representative (midwife): *“I have been a midwife at our hospital since 1993. 80% of maternity trajectories has no doctor involved. We need to follow current guidelines to maintain a streamlined trajectory”*. Case reporter: *“I have updated alternatives according to suggestions here”*. Three concrete alternatives emerged from the discussion. The final decision was to accept that each local hospital could deviate from the national guideline upon request as a temporary solution. After the decision, a Regional Centre representative stated: *“For hospital C, we have configured the EPR according to deviation from the national guideline”*. Architect from Digital Renewal: *“Remember that there is a chain of information flow from the maternity ward and its systems, to the main EPR and to the national care summary record (where the national guidelines are the rule)”*. The Regional Centre uses jira for managing their own e-health standards processes. Up to date, the Regional Centre has initiated more than 1500 tasks in the tool.

To sum up, we have seen that with a long history of isolated local, and large regional hierarchically structured IT programs, SEHR has struggled from lack of means for governing e-health standards across hospitals and projects. To counter this, SEHR has implemented a dynamic network governance model.

6 Analysis

Armitage et al. (2010) describe *adaptive co-management* as a way to overcome limitations of top-down governance regimes, where they claim that top-down regimes may contribute to fragmentation by minimal user participation. In our case, the long history of autonomous hospital IT management has resulted in a lack of governance of e-health standards across hospitals apart from sporadic assemblages of experts. Legitimacy for regional standards was hard to obtain. Adaptive co-management includes collaboration of heterogeneous stakeholders in an iterative manner for improved learning and adaptation. The new governance model aligns with this. Through the volume of cases documented in jira, we see a large array of stakeholders in the e-health standards governance. A majority of contributors are situated at hospitals. There is a clear focus of the Regional Centre and regional network groups for continuous learning and improvement as part of the standards governance. For instance, when a proposal of adopting a new national e-health standard description of medication allergies, the high degree of uncertainty in consequences for various clinical groups and IT systems, all the regional network groups were mobilized along with their local hospital networks. The decision was an iterative approach to standardization with continuous learning as an integral part.

While adaptive co-management lends attention to the participatory nature of decision-making within public organizations, it is less concerned with specific governance configurations. Our case describes a highly dynamic *networked* governance regime. Provan and Kenis (2008) and Provan and Lemaire (2012) describe *goal-directed networks* to evolve through conscious efforts to facilitate coordination. The Regional Centre has the responsibility of ensuring that the patient is in the centre when developing and improving e-health standards. This represents a clear overarching goal (for the network), which further informs the regional network groups' efforts to mobilize knowledge. This is in line with descriptions of goal-directed networks being well suited for complex problem solving in public sectors when there is a need for enhanced knowledge mobilization. Due to the complexity of many cases, tensions do arise. We have presented several examples whereby agreement on one e-health standard is not feasible. By accommodating local needs, the network manages to a certain extent to deal with tensions. Due to incompatible needs among different interest groups, the e-health standards have been open to variation. Transparency of process has been a key enabler for accommodating variation. Variations can be accommodated when they are well documented and documentation is accessible and open to scrutiny. This illustrates the importance of the governance tool jira in building trust and coordination in the network.

Provan and Lemaire (2012) argue that goal-directed networks are effective if selective integration of nodes based on needs are permitted. Our case shows how integration of stakeholders are highly adaptable in the e-health standards governance in SEHR. The decision makers, i.e., the regional network groups, leverage multiple extant and emergent network constellations to derive consensus-based decisions. Local hospital networks with clinical expertise are established ad hoc or on a more permanent basis based on specific standardization needs. Further, based on the volume and complexity of cases the regional network groups create regional sub-network groups to enable faster and more knowledge-intensive case handling. At the same time, clinical guidelines become an integral part of the e-health standards governance through the mobilization of medical advisory boards. To cater for IT dependencies, the e-health standards governance network also includes Hospital Partner and the regional implementation projects in Digital Renewal. The Regional Centre coordinates tightly with these IT-oriented parties when changes in IT configurations are needed, or when IT systems and e-health standards are to be implemented in the hospitals. As such, actors with knowledge of clinical practice and IT systems also shape the e-health standards mediated by the e-health standards governance network.

According to Dhanaraj and Parkhe (2006), *network orchestration* enables knowledge mobility and network stability as part of “*purposeful actions undertaken by the hub firm as it seeks to create value*” (ibid., p. 659). Network orchestration is an integral part of a goal-directed network. The Regional Centre functions as a network orchestrator, to ensure that cases relevant for several regional network groups are coordinated. This contributes to network stability as relevant network parts become activated when appropriate, and are only left out if not relevant for the specific case. In addition, with the Regional Centre's role in implementation, experience sharing and continuous learning within and across regions, the importance of this role is further intensified. Furthermore, the regional network groups function as orchestrators of local hospital networks to mobilize expert knowledge among various professions. This is dealt with in a dynamic manner. Due to the consensus-driven nature of the decisions caused by the autonomy of each hospital, orchestration is extremely important to enable local legitimacy and anchoring of decisions made in the regional network groups on behalf of the hospitals. Including the local actors for advice further legitimizes and stabilizes the network itself by showing that knowledge counts. However, our empirical case also entails a partial breakdown of the network orchestration and main governance structure. In our example, where the regional network groups did not manage to reach consensus, the case escalated to the hospital directors' Meeting. An effect of this was reduced willingness in the network to arrive at consensus with subsequent identifications of variations in standards. This shows that fragility to the standards governance network may emerge when decisions on difficult internal tensions are made outside the network structures.

However, what we see as a determinant aspect of the network governance is the role of the e-health standards governance tool. The tool enables full transparency and inclusion of all stakeholders from all levels before the decision and after. As such, the tool enables and supports orchestration of knowledge mobilization and learning as part of the standardization processes, which further legitimizes decisions.

Recognizing the importance of an IT tool that enables transparency and knowledge mobility in standards governance, we propose a conceptual framework for II standards governance that constitute the structural (goal-directed network), processual (adaptive co-management, network orchestration) and technological (the e-health standards governance tool). We dub this framework Adaptive Networked Governance. We will now discuss the theoretical and practical contributions from our findings and the framework for II standards governance.

7 Discussion and Conclusion

In the introduction, we asked the following: *How can a network-oriented approach to governance coordinate a large number of diverse clinical specializations, healthcare organizations and legacy IT systems to improve and harmonize regional e-health standards?*

In our analysis, we have shown that SEHR manages to draw on an adaptive networked governance approach to align clinical practice knowledge and an extant IT portfolio to improve and harmonize regional e-health standards from a balance of bottom-up and top-down decisions. From this, we advance theoretical and practical insights of polycentric governance in IIs (Ostrom, 2010; Constantinides and Barret, 2014; Vassilakopoulou et al., 2018).

We provide an analytical frame, Adaptive Networked Governance, for understanding polycentric governance of standards in IIs. We assemble concepts from literature about goal-directed networks, adaptive co-management and network orchestration and including a technological perspective in this frame. While the e-health standards governance approach in SEHR has changed over time, decision-making rights have remained stable in a polycentric configuration. The hospitals are autonomous units in regards of responsibility (thus decision-making) areas such as quality and safety of care, privacy protection risk and EPRs. This creates a challenge when e-health standards need to be harmonized across the hospitals. One reason is that local legitimation and anchoring of e-health standards depend on consensus within and among the autonomous units. The governance network thus needs to mobilize sufficiently locally trusted actors. Second, IT systems need to be configured in orchestration with e-health standards to accommodate legacy systems and local and clinical profession-specific differences. The adaptive networked governance approach deals with distributed decision-making power by dynamic inclusion of relevant actors, where network adaptability and permitting variances in standards are key enablers. Network orchestrators are then part of enabling transparency and partaking, where a standards governance tool (jira in our case) plays a significant role in this by sharing governance process and e-health standard content information to all relevant parties.

Similar to Bygstad and Hanseth (2016), we find tensions that arise from differences in views among various local hospital networks. Standards governance in IIs with a high level of complexity, such as healthcare organizations, benefit from a focus on continuous learning and improvement due to distributed risks and uncertainty associated with standards changes. An adaptive networked governance approach enables this, where its strengths are on network adaptability and knowledge mobilization, as opposed to more hierarchical structures where decision-making is further from core knowledgeable actors. Ulriksen et al. (2016) found that programmes with a close influence on clinical practice experienced significant challenges in terms of collaboration and defining mandates between loosely connected governing units with several overlapping arenas of authority. Hence, there is need for some element of dynamic orchestration in the governance network. Healthcare represents an extreme case of knowledge distribution regarding standards related to core business, since relevant knowledge is situated at the “fringes” of the organizations, and is highly heterogeneous. This means that the governance looks upon standardization as a process for learning and experience, where orchestrators focus on overarching goals in the process. As such, this represents an approach for goal-directed II evolution.

With our analytical frame, we present nuances regarding bottom-up or top-down governance of IIs, and for e-health standards specifically. We do this by analysing a successful network configuration that enables collective decision making and action. Previous studies of health II development have found bottom-up and emergent initiatives the most successful (Aanestad and Jensen, 2011), with the standardization strategy as the hardest issue to tackle (Bygstad and Hanseth, 2016). Our case analysis brings

further insights to II governance across multiple levels (Weill and Ross, 2004; Constantinides and Barrett, 2014; Ulriksen et al., 2016; Vassilakopoulou et al., 2018). In particular, Constantinides and Barrett (2014) identify the need better to understand how to govern the development of IIs using a bottom-up polycentric approach, with divergent interests and tensions dealt with in a nested structure. The e-health standards governance network in our case combines top-down and bottom-up approaches, where some parts are directed towards top-down, and others bottom-up. It is thus not a question of top-down or bottom-up. Rather, it is more important to understand *where* in the II these approaches are present.

For instance, the Regional Centre and the regional network groups have their annual assignments and mandates written and delegated top-down by the regional health trust. Regional IT projects run in a top-down fashion and have for many years struggled to deal with regional standardization and local anchoring in the hospitals. Complex issues associated with e-health standards are now taken care of by the governance network. This network manages to leverage on its adaptive networked governance configuration to handle complexity and anchoring. In addition, we showed that an important part of the network orchestration by the Regional Centre was the possibility to adjust certain information flows in the network to maintain manageability. It also facilitates accountability and formality from hospitals managers if they decide to deviate from created standards. However, the e-health standards governance processes function in a bottom-up manner, feeding back to IT projects, IT solutions and sharing of knowledge and learning. Having a responsibility for e-health standards decisions on behalf of the hospitals, each regional network group member has a mandate to make regional standards for local implementation. This may seem like a consortium model, where representatives from all the hospitals have to consider a limited set of alternatives to live with. In practice, however, due to the large and specialized knowledge domains, the regional network members rely on local hospital networks to reach conclusions. This means that the real decision-making power regarding the actual e-health standards lies in the advices from the hospital networks.

While research on IIs displays standards as core elements, less has been explicit on governance of standards in IIs although research on governance in IIs is a growing research area. In this study, we provide new insights by presenting a rich empirical account being explicit on e-health standards governance. For e-health standardization practitioners, we advise that the inherent complexity in standards governance may be accommodated by establishing intermediary profession-oriented network nodes that can mediate top-down and bottom-up standardization activities and enabling requirement-handling IT platforms that are transparent for users, for connecting the dots between local expert knowledge and cross-organizational needs. Our empirical case is as such a display of a potential model for this.

A limitation with our study is that we have looked at a single health region in Norway, a Scandinavian country with a history of relatively flat organizational structures and a culture for collective decision-making processes. Furthermore, we have not studied the relation between the governance configuration and architectural arrangements in the II, where for instance manageability of IT solutions may influence the possibility space for standards governance. We also believe that our finding of the importance of the technological part of the governance configuration needs further study due to its significant role for enabling communication and co-ordination across levels and organizations.

References

- Aanestad, M. and T.B. Jensen (2011). "Building nation-wide information infrastructures in healthcare through modular implementation strategies." *The Journal of Strategic Information Systems* 20(2), 161–176.
- Andrade, A. D. (2009). "Interpretive research aiming at theory building: Adopting and adapting the case study design." *The Qualitative Report* 14(1), 42–60.
- Armitage, D., Berkes, F. and N Doubleday (2010). *Adaptive co-management: collaboration, learning, and multi-level governance*. UBC Press.

- Ballantine, J. and N. Cunningham (1999). “Strategic information systems planning: applying private sector frameworks in UK public healthcare.” In: *Reinventing Government in the Information Age*. Ed. R.B. Heeks. Routledge, London.
- Barrett, M. and G. Walsham (2004). “Making contributions from interpretive case studies: examining processes of construction and use.” *Information Systems Research*. Springer, 293–312.
- Bergqvist, J. and P. Dahlberg (1999). “Scalability through cultivation.” *Scandinavian Journal of Information Systems* 11, 137–156.
- Berner, E.S., Detmer, D.E. and D. Simborg (2005). “Will the wave finally break? A brief view of the adoption of electronic medical records in the United States.” *Journal of the American Medical Informatics Association* 12(1), pp.3-7.
- Braa, J., Hanseth, O., Heywood, A., Mohammed, W. and V. Shaw (2007). “Developing health information systems in developing countries: the flexible standards strategy.” *Mis Quarterly* 381-402.
- Bygstad, B. and O. Hanseth (2016). “Governing e-Health Infrastructures: Dealing with Tensions.” In: *Proceedings of the 37rd International Conference of Information Systems (ICIS)*, Dublin, Ireland.
- Ciborra, C., Braa, K., Cordella, A., Hepsø, V., Dahlbom, B., Failla, A. and O. Hanseth (2000). *From control to drift: the dynamics of corporate information infrastructures*. Oxford University Press on Demand.
- Constantinides, P. and M. Barrett (2014). “Information infrastructure development and governance as collective action.” *Information Systems Research* 26(1), 40–56.
- Dhanaraj, C. and A. Parkhe (2006). “Orchestrating innovation networks.” *Academy of management review* 31(3), 659-669.
- Egyedi, T. and A. Loeffen (2002). “XML diffusion: transfer and differentiation.” *Computer Standards & Interfaces* 24(4), 275-277.
- Fabricius, C. and B. Currie (2015). “Adaptive Co-Management.” In *Adaptive Management of Social-Ecological Systems*. Ed. by C. R. Allen and A. S. Garmestani. Springer Netherlands, 147-179.
- Greenhalgh, T., Stramer, K., Bratan, T., Byrne, E., Mohammad, Y. and J. Russell (2008). “Introduction of shared electronic records: multi-site case study using diffusion of innovation theory.” *Bmj* 337, p.a1786.
- Hanseth, O. (2001). “Gateways—just as important as standards: How the internet won the “religious war” over standards in Scandinavia.” *Knowledge, Technology & Policy* 14(3), 71–89.
- Hanseth, O., Ciborra, C.U. and K. Braa (2001). “The control devolution: ERP and the side effects of globalization.” *ACM SIGMIS Database* 32(4), 34–46.
- Hanseth, O., Jacucci, E., Grisot, M. and M. Aanestad (2006). “Reflexive standardization: side effects and complexity in standard making.” *Mis Quarterly*, 563-581.
- Hanseth, O. and K. Lyytinen (2010). “Design theory for dynamic complexity in information infrastructures: the case of building internet.” *Journal of Information Technology* 25(1), 1–19.
- Hanseth, O. and E. Monteiro (1997). “Inscribing behaviour in information infrastructure standards.” *Accounting, management and information technologies* 7(4), 183-211.
- Hanseth, O., Monteiro, E. and M. Hatling (1996). “Developing Information Infrastructure: The Tension Between Standardization and Flexibility.” *Science, Technology & Human Values* 21(4), 407–426.
- Hanseth, O. and P. Nielsen (2013). “Infrastructural innovation: flexibility, generativity and the mobile internet.” *International Journal of IT Standards and Standardization Research (IJITSR)* 11(1), 27-45.
- Jacucci, E., Shaw, V. and J. Braa (2006). “Standardization of health information systems in South Africa: The challenge of local sustainability.” *Information Technology for Development* 12(3), 225-239.
- Karasti, H., K.S. Baker and F. Millerand (2010). “Infrastructure time: long-term matters in collaborative development.” *Computer Supported Cooperative Work (CSCW)* 19(3–4), 377–415.
- Middleton, B., Hammond, W.E., Brennan, P.F. and G.F. Cooper (2005). “Accelerating US EHR adoption: How to get there from here. Recommendations based on the 2004 ACMI retreat.” *Journal of the American Medical Informatics Association* 12(1), 13-19.
- Miles, M. B. and A.M. Huberman (1994). *Qualitative data analysis: An expanded sourcebook*. SAGE publications, Inc.

- NICT (2011), National ICT Norway, *Sluttrapport analysefase Medikasjonstjenesteprosjektet*, URL: <https://nasjonalikt.no/prosjekter/avsluttede-prosjekter#iltak-24.2-medikasjonstjeneste> (visited on 20/11/2018)
- Ostrom, E. (2010). "Polycentric systems for coping with collective action and global environmental change." *Global Environmental Change* 20(4), 550–557.
- Pettigrew, A., Ferlie, E. and L. McKee (1992). *Shaping Strategic Change: Making Change in Large Organizations: The Case of the National Health Service*. Sage Publications, London.
- Pollock, N. and R. Williams (2010) "E-infrastructures: How do we know and understand them? Strategic ethnography and the biography of artefacts." *Computer Supported Cooperative Work (CSCW)* 19.6 (2010), 521-556.
- Provan, K.G. and P. Kenis (2008). "Modes of network governance: Structure, management, and effectiveness." *Journal of public administration research and theory* 18(2), 229-252.
- Provan, K. G. and R.H. Lemaire (2012). "Core concepts and key ideas for understanding public sector organizational networks: Using research to inform scholarship and practice." *Public Administration Review* 72(5), 638-648.
- Ribes, D. and T.A. Finholt (2009). "The long now of technology infrastructure: articulating tensions in development." *Journal of the Association for Information Systems* 10(5), 375–398.
- Rolland, K.H. and E. Monteiro (2002). "Balancing the local and the global in infrastructural information systems." *The information society* 18(2), 87-100.
- RSKI, (2018) *Regional Centre for Clinical IT information page*. URL: http://admininfo.helse-sorost.no/regionalt_ (visited on 22/11/2018)
- Sahay, S., Monteiro, E. and M. Aanestad (2009). "Configurable Politics and Asymmetric Integration: Health e-Infrastructures in India." *Journal of the Association for Information Systems* 10(5), 399–414.
- Sigurdson, U. (2018). *Governance and management of technology in Southeastern Norway Regional Health Authorities*. Lecture slides. URL: [https://www.uio.no/studier/emner/matnat/ifi/IN5430/v18/presentasjoner/18_03_13-foredrag-uio-informatikk-governance-i-hso-v-1-2-\(002\).pdf](https://www.uio.no/studier/emner/matnat/ifi/IN5430/v18/presentasjoner/18_03_13-foredrag-uio-informatikk-governance-i-hso-v-1-2-(002).pdf) (visited on 19.11.2018)
- Skorve, E. (2013). "Shaping information infrastructure: complexity and management in the context of a clinical IS implementation." PHD Thesis. University of Oslo.
- Suchman, L. (2002). "Located accountabilities in technology production." *Scandinavian Journal of Information Systems* 14(2), 91–105.
- Ulriksen, G.-H., Pedersen, R. and G. Ellingsen (2016). "Establishing ICT governance for regional information infrastructures in healthcare." *49th Hawaii International Conference on Systems Science (HICSS)*, 5137–5146.
- Vassilakopoulou, P., Pesaljevic, A. and M. Aanestad (2018). "Polycentric Governance of Interorganizational Systems: Managerial and Architectural Arrangements." In: *Proceedings of the European Conference on Information Systems: Beyond Digitization-Facets of Socio-Technical Change (ECIS)*.
- Walsham, G. (2006). *Doing interpretive research*. *European Journal of Information Systems*, 15(3), 320–330.
- Weill, P. and J.W. Ross (2004). *IT governance: How top performers manage IT decision rights for superior results*. Harvard Business Press.
- Zimmerman, A. and T.A. Finholt (2007). "Growing an infrastructure: The role of gateway organizations in cultivating new communities of users." In: *Proceedings of the 2007 international ACM conference on Supporting group work*, 239–248.