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Managing as Designing: Transforming Digital Healthcare Interoperability

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Completed Research

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Abstract

Digital healthcare transformations promise improved overall quality healthcare and patient continued care among others. However, quality healthcare and continued patient care can be hampered by various challenges including insufficient collaboration among healthcare centers, and limited data exchanges between health information systems (HIS). Such challenges can be overcome through collaborative digital healthcare initiatives in which, HIS are designed with data exchange capabilities that enable healthcare centers to easily exchange patient information across boundaries. However, several existing initiatives are carried out in isolation, and there is limited practical knowledge on how to collaboratively manage and design HIS' interoperability. Consequently, this study investigated a managing as designing (MaD) approach taken by a successful HIS interoperability initiative in Sweden. Data was collected mainly through interviews with key informants within the implementation team. Based on study findings, a MaD HIS-interoperability conceptual framework that can guide the management and design of future HIS' interoperability was developed.

Keywords

Managing as designing, digital healthcare, context of integration, HIS interoperability.

Introduction

Tremendous growth and use of digital technologies over the past decades is digitally transforming the healthcare industry (Herrmann et al. 2018; Ricciardi 2019). A number of health institutions are increasingly using various health information systems (HIS), such as electronic health records' systems in order to improve overall quality healthcare and patient care (Agarwal et al. 2010; Mihailescu and Mihailescu 2018). However, digital transformation is not without challenges (Agarwal et al. 2010), for example, it is still quite a challenge to access a patients' medical history across facilities (Adebesin et al. 2013b; Bodenheimer 2008; Kobusinge et al. 2018a; Rexhepi et al. 2015), since a number of existing HIS are non-interoperable (Bygstad et al. 2015; Weber-Jahnke et al. 2012). In fact, several HIS are designed with no conformity to interoperability guidelines (Adebesin et al. 2013a). Whereas, healthcare authorities institute national interoperability implementation guidelines, HIS designers rarely follow them at the actual implementation level (Kobusinge et al. 2018a). As noted by Adebesin et al. (2013a), Adebesin et al. (2013b) and Kobusinge et al. (2018a) that HIS designers in most cases work in isolation and usually implement HIS with no interoperability obligations. However, Hjort-Madsen (2006) believes that digital healthcare interoperability can be enforced when healthcare managers and HIS designers jointly manage and design HIS' interoperability. At the same time, Rauffet et al. (2009) argue for organizational interoperability managing and designing, as a way to transform heterogeneous organizations into interoperable systems. According to Boland and Collopy (2004) agents who combine design and management approaches to improve their status quo, are said to adopt a 'managing as designing' (MaD) approach.

Consequently, to improve understanding of the emergent MaD approach and its applicability in transforming digital healthcare interoperability, this study posed the following question. How can HIS implementers manage and design HIS' interoperability? This was addressed through an investigation of a successful HIS interoperability project as recommended by Rauffet et al. (2009). Whereby the author explored MaD key aspects in order to create practical knowledge on how to transform digital healthcare

through managing as designing HIS' interoperability. The paper thus presents the research background in the second section and proceeds to discuss the managing as designing (MaD) approach in the third section. The research approach is presented in the fourth section, and the findings in the fifth section. Thereafter, the study implications are discussed in the six section, followed by the conclusion and future research prospects.

Research Background

Existing approaches to interoperability include interoperability standards (Fenton et al. 2007; Harsh et al. 2012), interoperability strategies/principles (Chen and Daclin 2006; Hugoson et al. 2008; Solotruk and Krištofič 1980) interoperability frameworks, and models (Chen and Daclin 2006; Jardim-Goncalves et al. 2013), and information, service-oriented & enterprise architectures (Chen et al. 2008; Hjort-Madsen 2006; Rosen et al. 2012; Öhlund 2017). Despites concerted efforts, interoperability remains a great challenge (Juzwishin 2009; Weber-Jahnke et al. 2012). Yet to benefit from existing interoperability approaches organizations must mutually agree to interact (European Commission 2017) according to prescribed interoperability methods (ISO 2004). As interoperability will not just happen (Agostinho and Jardim-Goncalves 2009; Kobusinge 2020) unless it is collaboratively (horizontally) pursued (Adenuga et al. 2015; eHealth Network 2015) and designed across entities (Rothenberg 2008). A common myth is for the HIS intervention to be left to the information technology department (Berg 2001), however, Berg (2001) believes in its consideration as a management activity integrated with the overall institutions' goals. This would bring healthcare managers and HIS designers to collaboratively transform digital healthcare interoperability as recommended by Hjort-Madsen (2006).

Expediently Barbarito et al. (2012), Kobusinge et al. (2018b), Mu-Hsing Kuo et al. (2011), Rozenblum et al. (2011) and Öhlund (2017) give accounts of successful HIS interoperability interventions where healthcare managers have worked with HIS designers. At the same time Kiberu et al. (2017) and Kobusinge et al. (2018a) refer to cases where HIS designers worked independent of healthcare authorities and the country ended up with countless non-interoperable HIS. The author believes this to be a common global problem, where interoperability is desired at the national level through creation of guidelines and policies, but is rarely coordinated and enforced at actual HIS implementations. Therefore, collaborations of healthcare managers and HIS designers cannot be underestimated. Henceforth, just as Hjort-Madsen (2006) this study calls on healthcare managers and HIS designers to improve interoperability status quo through 'managing as designing' (MaD) HIS' interoperability. As an approach, MaD brings together managers and designers to solve human problems through a design attitude that applies sense making and decision-making lenses (Boland 2008). Since it is an emergent approach, Kalle Lyytinen recommends its use in the information systems' field as a way of assessing the varied design attitude (Boland and Collopy 2004). At the same time, it is an appropriate approach to bring together healthcare managers and HIS designers to collaboratively pursue digital healthcare interoperability. Yet again, through MaD' sense making lens a thorough 'institutional context analysis' can be assured (Kobusinge 2020), which according to Lau et al. (2015) is crucial for the information systems' interventions success. Therefore, applying a MaD approach to HIS' interoperability interventions might be fruitful, as it would bring together healthcare managers and HIS designers and enable institutional context analysis.

Contextual analysis and understanding during interoperability interventions is very important as it leads to clear identification of interoperability issues within a given context (Rauffet et al. 2009), clear prescriptions of interoperability requirements (Chen et al. 2008), and identification of an appropriate interoperability principle (Hugoson et al. 2008; Solotruk and Krištofič 1980). In addition, Pettigrew (2012) and Ullberg et al. (2008) contend that understanding contextual factors is one way of managing the design process by controlling all factors, that could either hinder or enable the implementation process (Gichoya 2005; Ogrinc et al. 2015). Despite their impact on the information system implementation process (Axelsson and Melin 2014), contextual factors are very often not given much attention as they deserve (Dopson et al. 2008). This study therefore, pays particular attention to the aspects of 'context analysis' and 'managing' and 'designing' during HIS' interoperability designing in digital healthcare transformations.

Managing as Designing (MaD)

Managing as Designing (MaD) as an approach combines both managerial and design skills in order to solve a problem at hand and improve the situation (Boland and Collopy 2004). Precisely, the concept of 'managing as designing' (MaD) is a design attitude that brings together the fields of sense-making and decision-making in order to study human actions (Boland 2008). Boland (2008) noted that these two fields are always in constant play in our everyday human actions as we try to 'make sense' of the situation and at the same time 'decide' activities that improve that situation. Fundamentally, sense-making relies on institutional context (Weber and Glynn 2006; Weick 1995) as antecedents for making sense through action formulation into future transformations (Weber and Glynn 2006). Practically, the actors are able to analyse their institutional context by moving through the past and present interoperability situations, identifying gaps, muddles and questions, and brainstorming on how to bridge these gaps through agreed upon strategies and outcomes that transform the situation (Dervin and Frenette 2003). Boland thinks of 'sense-making' as a field that tends to always go further in surfacing new possibilities, but believes that this unending search can be closed off by decision-making. Incidentally, both sense making and decision-making are kept alive in organizations through the underlying design belief that things can always get better than they are now (Boland 2008). Therefore, this study, explores a MaD approach that applies both sense-making and the decision-making perspectives (Boland 2008), to make sense of past competencies, build them into new decision-possibilities that can be adopted to improve future design implementations (Boland and Collopy 2004) as illustrated in figure 1. Figure 1 was inspired by Boland (2008), it shows that managing as designing relies on moments of sense making and moments of decision making, whereby the former draws on past histories and experiences and the latter envisions the desired future.
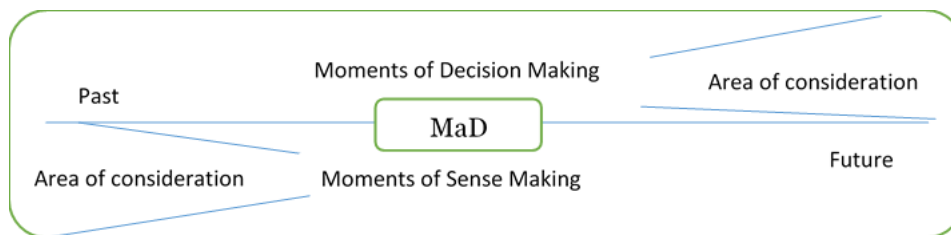
Figure 1. Moments of Sense-Making and Decision-Making in Managing as Designing (following Boland 2008)

Research Approach

Through a case study approach (Walsham 1995), the researcher conceptualizing participants' responses in accordance to the study objectives (Rowlands 2003). The case study approach was chosen in order to investigate and illustrate the 'managing as designing' phenomena in action (Creswell 2009; Thomas 2006). Data was collected and analysed through qualitative research approaches. Data collection was mainly carried out through semi-structured interviews and supplemented by document reviews (Cibangu 2012; Creswell 2009). The collected data was initially analysed through the inductive analysis method by Thomas (2006), then the MaD analytical framing (see figure 1) was fitted to the data. During data collection, focus was paid to the different core activities and core decisions that paved way for the implementation process.

Description of BFR Case Study

This is a case study of Västra Götaland Region in West Sweden that had implemented a virtual central imaging repository referred to as 'Västra Götaland Region radiology information infrastructure' termed as BFR (Bild- och funktionsregistret) in Swedish, henceforth referred to as BFR. Västra Götaland Region is the second largest region in Sweden with an average of 1.5 million residents, and at the time of BFR implementation, the region was operating 121 healthcare centers and 17 radiology departments. By that time Sahlgrenska University Teaching Hospital in Göteborg that provides highly specialized radiology services in the region had realised patient data exchange challenges in the region. Thus the decision to

implement BFR - a virtual central imaging repository to increase efficiency, harmonize patient medical information and improve information transparency throughout Västra Götaland Region (GE 2012). At the time of this study, BFR project had been in operation for an average of twelve years and was considered as a successful 'HIS interoperability project' by its implementers. It was considered successful because it brought about seamless information sharing between various heterogeneous radiology information systems within the region, and thus, qualified as an investigation case in line with this study objectives. Originally, the BFR implementation team was made of few core personnel who were very instrumental in coordinating and managing the entire BFR project. Therefore, the study participants consisted of these key people; the BFR project administrator, Regional-Chief medical information officer, Chief information officer-CIO, two information technology specialists and two radiologists at Sahlgrenska hospital.

Data Collection

The data collection exercise began in the year 2016 and ended in 2018, it involved interviews, formal and informal meetings, and document reviews (Cibangu 2012). The interview questions were semi-structured in order to stimulate engaging interactions between the interviewer and interviewees and generate deep knowledge. The interviews focused on extracting participants' responses regarding interoperability concerns taken during the BFR implementation process. Therefore, the interview protocol was structured around the different BFR implementation phases, core activities carried out, critical interoperability decisions taken and the interoperability principle adopted, and the different stakeholders involved with their roles per say. Interview sessions lasted approximately 60 minutes and were recorded with permission. However, to gain a deeper understanding of BFR implementation process, key documents were reviewed, and regular meetings were conducted. These extra activities were key qualitative validity checks for credibility, transferability, dependability and confirmability (Rowlands 2003). Thus, key BFR documents reviewed included 'General Electric' BFR company documents and BFR implementation status reports. Additionally, there was consensus towards integrity, anonymity and confidentiality between the researcher and participants (Walsham 2006).

Data Analysis

Data analysis was performed through four stages with the first being verbatim transcription (Hennink et al. 2010). The second phase involved intensive reading of the interview transcripts in order to make sense of the Managing as Designing phenomena under study (Thomas 2006). This exercise consisted of identification of core BFR activities, interoperability thoughts and decisions as initial categories. For instance, the initial identified categories in this phase included; *acknowledging and identifying past data sharing and exchange challenges, deciding to design for interoperability, installing a team, securing funding, analysing all existing HIS, and deciding not to discard them but rather harmonize and standardize.* The third analysis phase involved re-examination of the data against identified activities, thoughts and decisions, and grouping them under the fundamental MaD concepts of sense-making and decision making (MaD working categories). All BFR thoughts and activities were categorized under sense-making moments and all BFR decisions were categorized under decision making moments. For example, the first BFR thoughts about 'data exchange challenges' were grouped under moments of sense-making and the conscious decision to 'design for interoperability' was grouped under moments of decision-making. Hence, all other core BFR activities, thoughts and decisions were grouped under the MaD categories accordingly. The last analysis phase involved refining the MaD working categories into precise MaD HIS interoperability concepts as shown in table 1, which were finally formulated into a conceptual framework as shown in figure 2.
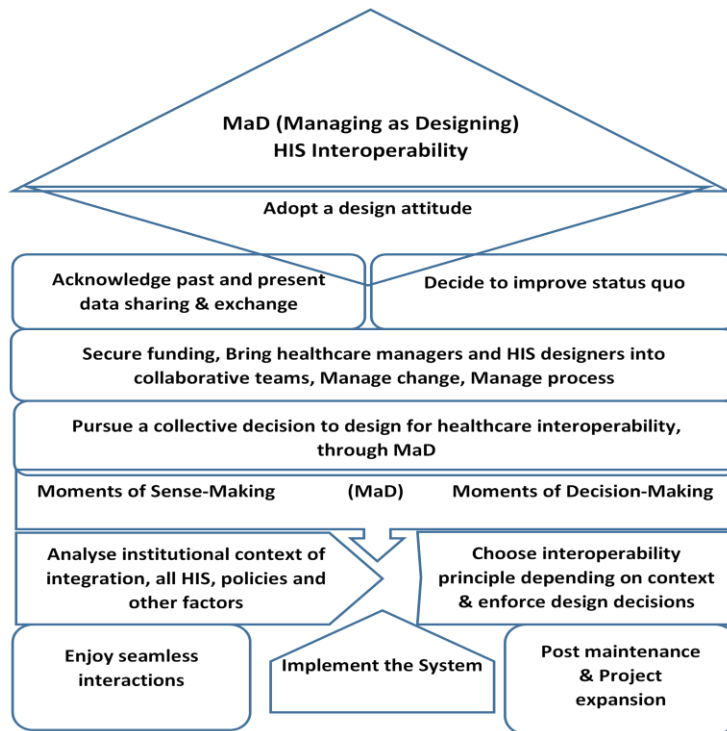
Findings

In order to address the stated research question of how to manage and design HIS interoperability, a managing as designing approach was investigated. Thus, the study results are presented according to the MaD aspects of *moments of sense making and moments of decision making* through the past, present and future phases as shown in table 1 below.

BFR Thoughts, Activities and Decisions - through moments of sense making and moments of decision making	MaD HIS Interoperability Concepts
Moments of Sense-Making: Current interoperability thoughts: acknowledgement of past and present actualities. Realization of data sharing and exchange challenges within radiology departments in Västra Götaland Region, these included; lack of patient data at the point of care, delays in accessing patient data, inconsistent patient ID format, sharing patient information through compact disks, post, phone calls, fax etc. Respondent quotes: *"So at Sahlgrenska we needed to access their data and we had had lots of problems getting data from the small hospitals". "…it was impossible to share, when we wanted to see something we had to phone … and send it by some ordinary transport". "It was tough to communicate data."*	Acknowledgement of past and present data sharing and exchange challenges
Moments of Decision-Making: Decision to improve status quo. A collective decision to design for interoperability among all radiology departments within Västra Götaland Region was central. Respondent quotes: *"So at Sahlgrenska we decided to install, to buy and install a common central archive that was vendor neutral". "smartest thing is to share the archive"*	Conscious collective decision to design for healthcare interoperability
Moments of Sense-Making: Thoughts about funding, Regional Top managers had secured funds for the entire BFR project. Thoughts about personnel, Managers and HIS designers were brought into collaborative teams. Thoughts about change; BFR team had to convince all stakeholders that BFR would promote seamless data exchanges in order to minimize resistance to changes. Respondent quotes: *"Upper management decided that all images should be digital" "… the region decided to put money for digital modalities… they also invested money in the systems and started a working group to achieve this." "…you have to do change management." "You have to explain in a good way, to have people…"*	Secure funding. Bring healthcare managers and HIS designers into collaborative teams. Manage change
Moments of Sense-Making: Thoughts about existing systems, analysis of all radiology HIS within Västra Götaland Region. Realisation of; existence of non-interoperable systems, inconsistent data formats & exchange standards, inconsistent 'digital imaging and communications in medicine' standard, different vendors and stakeholders, lack of a uniform patient record to be shared, inconsistence Patient ID format, etc. Thoughts and insights about pressing factors, analysis of security, privacy, policies, legal requirements, HIS implementation guidelines and standards in regards to interoperability. Respondent quotes: *"vendors had different formats" "we had information silos" "support existing vendors develop HL7", "digital imaging and communications in medicine - standard was partially immature." "…hospitals had other rules how to write the patient ID"*	Analysis of all HIS in existence alongside other contextual factors like policies in regards to HIS interoperability designing.
Moments of Sense-Making: Thoughts about new system: Adherence to strict 'digital imaging and communications in medicine' - standard format and other agreed upon relevant standards e.g HL7. Enforcement of strict patient ID format. Creation of minimum data record to be shared, Definition of mandatory and optional fields. Respondent quotes: *"We allowed hospitals to have different systems but we said you have to store in a standardized way." "… Follow these guidelines" "you need to accept* 'digital imaging and communications in medicine - standard" *"don't get rid of old investment…no one system …we focus mainly on information and data sharing." "made an agreement on*	Enforce strict adherence to 'agreed' upon formats, standards, requirements and methods in regards to interoperability. (enforce adherence to design-decisions)

how to store the personal ID"	
Moments of Decision-Making: Determined by the institutional context of integration, a decision to harmonize the data was reached, thus an intersection interoperability principle adopted. A decision to design a 'central repository' system was reached. All other systems would post the required patient radiology data for archiving into the central repository. BFR designing commenced. Respondent quotes: *"Use of standards it is mandatory". "... set the rules of specified amounts of information with common terms and concepts that is what we did we built a model together."*	Choose an appropriate interoperability principle depending on the institutional context of integration Implement system, deploy it and maintain it
Moments of Sense-Making: Thoughts about BFR: a functional BFR, patient data sharing and exchanges within the region are possible by anyone, anywhere and anytime. Updated patient imaging record within the region. Respondent quote: *"The interesting thing when we connected BFR ... we connected 32 departments, that was good".* After BFR, *do* prospective reviews and improvement plans (Post BFR project) Respondent quotes, *"We need to mature..." "after BFR start focusing on the quality, how can we create value." "the new BFR will store a lot more data"*	Enjoy interoperability benefits of the developed system. Post maintenance and improvement horizons

Table 1. Major BFR Sense-Making and Decision-Making Activities and MaD Concepts

Consequently, through a thorough analysis the study implications were formulated into a MaD HIS interoperability conceptual framework (see figure 2) that can guide future HIS interoperability digital healthcare interventions. According to Adom et al. (2016) conceptual frameworks offer a good way to illustrate fundamental concepts of the phenomena under study.

Figure 2. MaD HIS Interoperability Conceptual Framework

Discussion of Findings

Hjort-Madsen (2006) affirms that healthcare managers and HIS designers ought to work together to transform digital healthcare interoperability. To this end, this, study proposes a MaD approach as a way to manage and design future HIS' interoperability in order to transform digital healthcare. Fundamentally, a MaD approach facilitates collaboration between institutional managers and system designers, who together adopt a design attitude where moments of sense-making and moments of decision-making are prioritized. The design attitude constantly seeks to improve the situation through new possibilities that transform the future (Boland 2008). Ideally, the design field offers alternative design methods (Plattner et al. 2009; Simon 1969), from which agents can choose to enhance their sense making and decision making processes. At the same time, the MaD approach is not an end in itself it is an umbrella through which agents can use existing interoperability approaches to mutually pursue seamless interactions.

Therefore, following the BFR example, there was an intent to make things better from past and present data sharing/exchange challenges to seamless patient information exchanges. Moments of sense making were noticed during contemplations about interoperability challenges, gaps, questions, strategies and activities, and moments of decision-making were noticed whenever interoperability design-decisions were taken and pursed. Which ultimately led to adoption of an appropriate interoperability strategy in regards to the BFR context, and the successful implementation of the central imaging infrastructure. Inspired by the BFR implementation approach, this study presents a MaD HIS interoperability conceptual framework (see figure 2) that points to major MaD activities. These include adopting a design attitude, securing funding, instituting collaborative teams of healthcare managers and HIS designers, managing change and the entire process, analyzing the institutional context and identifying contextual factors through the sense-making lens, adopting and enforcing major interoperability design decisions through the decision-making lens, and finally implementing a sustainable system.

This study highlights the importance of analyzing the 'institutional context of integration' in order to align the context to an appropriate interoperability principle, as noted by (Hugoson et al. 2008; Solotruk and Krištofič 1980). The study also demonstrates the importance of analyzing the existing HIS (Berre et al. 2007; Kobusinge 2019; Mu-Hsing Kuo et al. 2011) and other pressing internal and external contextual factors including policy and required resources (Kobusinge 2019). Consequently, through constant analysis of existing HIS, factors concerning system diversity/heterogeneity, automaticity, homogeneity (Berre et al. 2007) have to be scrutinized, as well as assessing system interoperability capabilities (Chen et al. 2008). Subsequently, the context analysis exercise leads to a set of interoperability design requirements that can guide the HIS implementation process (Kobusinge 2020). Thus, through continuous institutional context analysis, decisions to unify existing systems, design an intersection between them, discard the systems or leave systems as they are might be reached. As discussed by Mu-Hsing Kuo et al. (2011) that when there are several systems in existence a standard-oriented model can be adopted, else a common interface can be adopted. Alternatively, interoperability can be achieved on the fly (Tu et al. 2016) through open data exchange approaches like APIs- application protocol interfaces (Groth et al. 2014) and messaging tools like HL7 (Berler et al. 2004; Orgun and Vu 2006).

Specifically, in the BFR case there were many existing radiology information systems that could not be discarded, so an appropriate 'intersection' principle, which is a data harmonization and standardization strategy was chosen (Fenton et al. 2007; Lindsköld 2012). By and large, there are higher chances of assured interoperability once the adopted principle is matched to the institutional context of integration (Hugoson et al. 2008) just like in the BFR case (Kobusinge et al. 2018b). Thus, transforming healthcare interoperability through a MaD approach could lead to mutual interoperability collaborations that could eventually lead to seamless data exchanges, coordinated and continued patient care and overall improved quality healthcare.

Conclusion and Future Works

This study offers a managing as designing (MaD) approach as a way to manage and design future HIS' interoperability. The basis for proposing a MaD approach, is a threefold i. Its' approach of bringing managers and designers to work together. ii. Its' potential to analyze the institutional context of integration and iii. Its' ability to enable actors make conscious design decisions for further improvements.

In practice, this would lead to identification and adoption of an appropriate interoperability principle that is in line with the institutional context of integration. In addition, core MaD activities that can be adopted to manage and design future HIS' interoperability have been presented in a MaD HIS interoperability conceptual framework in figure 2. However, the study considered a single case thus, future studies can investigate the proposed conceptual framework and MaD's potential for example through action research and other case studies across domains.

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