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# Data stakeholders interacting with patient data

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# DATA STAKEHOLDERS INTERACTING WITH PATIENT DATA

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## ABSTRACT

*How data stakeholders interact with data is considered in this paper by incorporating a socio-technical perspective. A data interaction enactment model is proposed to better understand how a logical structure is enacted when data stakeholders interact with data. The proposed model expands a technologies-in-practice view to also provide for the embodied structures of data objects. This extended technology-in-practice view provides designers with an approach that focuses on the interaction between data stakeholders and data objects. Although the proposed model is a generic model it is applied in the healthcare context for this study. An interpretive approach was used for a private healthcare centre as the case to investigate how healthcare professionals interact with patient records. The findings indicate the design of patient records based on the perceived anticipated use may not sufficiently provide for their actual use where different stakeholders need to interact with the patient records. An understanding of the relationships between designers, data stakeholders, the patient record structure enacted during interaction and its physical components is important. This may be one of the reasons why patient records are still mostly paper-based in spite of efforts to develop and adopt electronic patient record systems.*

## 1 INTRODUCTION

Organizations find it difficult to determine the value of their data, an important organization resource today and the abundance of data and increased sharing of it within and between organizations have amplified the problem (Bertolazzi & Scannapieco, 2001, Loshin, 2003). A practice related study has confirmed this problem (Eckerson, 2002). The objective for this study is to determine how data stakeholders interact with data by considering how they respond to each other during the period of interaction. This paper specifically deals with the interaction between the persons using data and the technology on which it is stored and which facilitates its processing. The focus of this paper is on a patient record representing the patient who is in need of a healthcare service.

This research is in the information systems field and the interpretive approach used provide for its socio-technical nature. The problem this paper addresses is that the perceived anticipated use of data objects is an inadequate means for designing data objects ultimately leading to data that does not sufficiently support the needs of the intended users. In order to address this perceived misalignment between designed anticipated versus actual use it is necessary to better understand the interaction between the designers, users and their perceived observations of real-world objects and data objects as the resulting presentations. The data object is the result of the interaction between the designer and user based on their perceived observation of the real-world object and the anticipated use of the data object. It is necessary to understand exactly what happens when the user interacts with a data object. A data interaction enactment model is proposed to extend Orlikowski's (2000) technology-in-practice model. This is an attempt to address the concerns of Hanseth et al. (2004) that her model does not sufficiently address how technology-in-practice is shaped by the technological artefact as well as the relationship between the two and her responding suggestion to better understand the problem of agency by also considering the status of the object. Data stakeholders are regarded as social actors and data objects as conceptual artefacts because it is not yet clear how these objects are instantiated from their design templates in practice every time data stakeholders interact with data.

The objectives of the paper is twofold, firstly to propose a data interaction enactment model based on the research findings of other similar studies that can be used as a theoretical lens to analyse the interaction of data stakeholders with data objects; and secondly to apply the proposed model to a healthcare case. The purpose of the empirical part of this paper is to illustrate how the proposed model can be used in practice. Its validation is at this stage outside the scope of the paper since a more extensive empirical study is required.

The layout of the paper is according to the two objectives and the first part represents the logic that guided the conceptualising of the thoughts, constructs, reasons and structures of the different concepts of the proposed model presented in Figure 1. The focus of the paper is on the enacted structure indicated by the circle in Figure 1. The literature review did not reveal any appropriate model that could be used and the literature findings were instead conceptualised as the proposed model. In the first part of this paper the different views of data is discussed in terms of data stakeholder as the person using it and the data object as the logical unit for a patient's data. Next the different views of technology in information systems are discussed with a specific focus on structure, agency and inscriptions to provide for the socio-technical nature of the study. This part is rather lengthy to give justice to the complexities around how humans interact with technology. It is concluded with a proposed model of how data objects are enacted during interaction. This model incorporates technologies-in-practice as the data object is constructed during interaction of data with the anticipated use inscribed during its design and the actual use inscribed in the actual data. The next part considers a healthcare case and in the discussion the proposed model is applied. In conclusion the usefulness of this model to investigate how data stakeholders interact with data objects is discussed.

# 2 INTERACTION IN SOCIAL AND TECHNICAL WORLDS

Persons using data have an interest in how it is defined and how they can use it. A data stakeholder is a person who has an interest in data and examples of data stakeholders are management using data for decision-making; a salesperson; a doctor, etc. Although stakeholders are usually humans, it is possible that a stakeholder is another organization, a department, a hospital, etc. The term data stakeholder is used as a generic term to describe any party interested in data regardless of the context. An external party is an outside person or organization that shares organizational data with an organization. All the data stakeholders interact with data in the roles of data producer, consumer or custodian (Strong et al. 1997). In the healthcare context data stakeholders are healthcare professionals and other persons and parties who need to interact with patient records.

A data object can be regarded as a logical record that is constituted of one or more physical records/parts. Data objects -data representations of real-world objects -are generic templates of the different organizational objects obtaining their values from data sources when instantiated through how they are used. Data objects are identified and defined during systems development by systems developers as they perceive the real-world object as well as the needs of the users (data consumers) of the data objects. The representation of real-world objects, such as for example a patient, is not limited to its representation as part of an information system, but also includes all data generated during the interactions of the organization with the real-world object, e.g., the patient. Not only is the healthcare organization interested in the best match of the data object with its corresponding real-world object, but it is also interested in the history of that data object, i.e., snap shots of all its states. This history is complete when it includes copies of all the different states as well as copies of all the interactions that lead to the changes in the states. Wand and Wang (1996) suggested the following states when considering the mapping of a real-world object, in this case the patient, to its IS data representation (patient record): proper, incomplete and ambiguous representations and meaningless state. These states will influence how the records are used in practice in terms of how well they were designed.

The healthcare sector is typically divided into a public and private sector and in some cases a mixture of the two. Although, for example, the primary goal of medical practices, hospitals and clinics is to provide a healthcare service to their communities, they also have to operate as businesses. Patient data

is used by healthcare professionals when providing a healthcare service for their patients whilst it is also used to manage the different healthcare enterprises.

The focus of this study is on patient data which to a large extent is still paper-based. There are different types of patient records but for the purpose of this study a patient health record is considered. An electronic health record (EHR) includes the patient's health profile, behavioural and environmental data over time to represent different episodes of care by various providers (WHO, 2006). Fitzpatrick (2000) emphasises that a health record does not only contain data about a patient and the care of patient but should rather be regarded as an integral part of the practical "*doing*" of healthcare and as a record "*at work*". She further argues that it is a working record evolving around a complex collection of related forms, papers, documents and records embedded in the social, spatial context of a healthcare enterprise

For the purpose of this study technology as an infrastructure is regarded as pervasive and present, but data objects as technological components need to be specifically considered. Although data objects are non-human objects, they are socially constructed by humans, namely, designers and data stakeholders and it is necessary to consider the position of data objects in terms of the technical and social worlds.

In much of information systems (IS) research the focus is unavoidably on the interaction between social and technical systems. An improved understanding of the phenomena that emerges when these systems interact will therefore enrich IS research (Rose *et al.,* 2004). The human-artefact relation is viewed by Widjaja and Balbo (2006) through a macro-level lens as human and artefacts are both social products as well as social makers in shaping and remaking each other. Technology is social in its origins as well as in its implications in that it does not influence human agency by imposing a single and mechanical functionality but by "*inviting specific courses of action*" (Kallinikos, 2002). Technology is not used within a vacuum but always involves social actors where technology shapes its users and at the same time responds to how it is used. Hosein (2002) responded to the concern of technology being "*pushed into the background*" by suggesting that researchers should, when relevant, attempt to understand the technological within their research.

While the IS researcher is neither in the social nor in the technical worlds, but rather where these two worlds overlap, it is possible to move beyond the properties of each world and to consider the relationship between them. It is then necessary to study how the human, from the social world, interacts with the technical components of the technical world when and how these two worlds become one. The definition of IS already provides for this boundary crossing between the two worlds.

## 2.1 Information Technology

Technology can be regarded as practical or useful, rather being an end in itself. It includes all the tools, techniques, materials, and sources of power that humans have developed to achieve their goals (Rose & Scheepers, 2001). Technology is not only objects or technical artefacts, but also ideas (object-oriented paradigm), practice (testing), etc., and is socially constructed and should not be investigated according to the laws of natural sciences (McMaster *et al.,* 1998). Information technology (IT) is the acquisition and processing of data to support human processes and can be regarded as a material resource that supports information practices and such information practices in turn support a wider set of social practices (Rose & Scheepers, 2001). Information technology is the product of human agency and will reflect the structures of the social system that designs and manages it as well as interpretations of its anticipated use. Information systems (IS) can be regarded as a social system of information practice that is supported by information technologies (a material resource) and representation the essence of IS according to Weber (2004).

When the emphasis is on the interpretation of technology use then this could lead to a detachment of the IT artefact (Widjaja & Balbo, 2006). They base their arguments on the practical knowledge in dissecting and constructing artefacts of human-computer interaction research (HCI) as opposed to the socio-technical research that views human-artefact relations with both human and artefact as social

products and social makers in shaping and remaking each other. Monteiro and Hanseth (1996) argued that it is necessary to move beyond the "*IT enables/constrains*" position and they base their arguments on the departure point of IT being the crucial factor, simultaneously enabling and amplifying the trends for restructuring organisations. They felt the necessity to focus more on the *interplay* between IT and organisations by reaching a deeper understanding of this interwoven relationship as to *how* IT shapes, enables and constrains organisational changes. It is necessary to explain why a group of diverse people, e.g., data stakeholders, reach a single accepted agreement, based on an interest resulting in an inscription into material form.

Technology artifacts are made up of multiple components and are not fixed or independent with their stability being conditional. Interrogating interests and actions provide moments within a discourse where the actors may take form. This may particularly be true for objections, resistance to interpretation or obduracy. Kallinikos (2002) suggests that "*an essential part of the conditions underlying human agency are given expression and shaped through the very organization of cognition-based artifacts and the procedural standardization of their construction, interpretation, and utilization*". He bases this understanding of the relationship between humans and their artifacts on the humans' ability to objectify and organize their experiences by means of various systems of notation and symbolic codification. A person may initially be constrained by a technological artifact such as, e.g., a mobile phone, but with repeated use may become more comfortable using it as the device's properties become more familiar. Although the user as an agent interprets the artifact's enabling capabilities each time it is used resulting in an improved understanding of how it can be used, the shaping effect of the technological artifact on the human cannot be denied. The human initiated interaction with the technological artifact and during this agency process displays intentions and has the ability to interpret whilst the technological artifact's "machine agency" has the capacity to make a difference.

## 2.2 Structures

The view of technology as structure with the ability to enable and/or constrain human actions was contradictory to Giddens concept of structure as "traces of the mind" and with no material existence. This created a debate about the agency ability of technological artifacts as well as different interpretations of structures (Akrich, 1992; De Vaujany, 2005; Hosein, 2002; Kallinikos, 2002; Orlikowski, 1992, 2000, 2005; Orlikowski & Iacono, 2001; Rose, 1999; Rose et al., 2004, 2005;Widjaja & Balbo, 2006). Agency for both humans and technological artifacts plus the concept of structures as these apply to this study are discussed next.

Technology-in-practice is proposed by Orlikowski (2000) to bring her original structurational perspective of technology in line with Gidden's view of structure as being only constituted when users interact with technology. Such a structure is enacted by humans only for the duration of that interaction, thus only fragments of the mind. Hanseth et al. (2004) argue that such an approach still does not address how the technology-in-practice is shaped by the technological artifact as well as the relationship between the two. Orlikowski (2005) responded to this criticism by agreeing that "*by privileging either the technology or the social, we lose sight of their intermingling*". She suggests that further research should help with a better understanding of the problem of agency and by specifically looking at the status of the object. Instead of referring to material agency they prefer to use the term "*material performativity*" as opposed to "*human agency*" and these terms may be more useful to recognize the power of both without equating them. Both terms are implicated in the other since human agency could be materially performed whilst material performances are always enacted by human agency.

When humans interact with technology, a technologies-in-practice structure is enacted for the duration of the interaction. Humans use facilities, norms and interpretive schemes in response to the technology's enabling/constraining properties to make sense of how to use the technology. This is

done by enacting a temporary structure based on rules and resources. This however does not provide for details about the relationship between the technologies-in-practice and actual technological artifact.

Action and structure cannot be separated and structure is both the means and the constraint for action (De Vaujany, 2005). Rose et al. (2004) refer to structure as "……..*to the common enduring pattern in social interactions and linguistic and semiotic discourse in which those interactions primarily take place*". They use Wand and Weber's (1995) three structure types, namely: physical as the technological implementation of the computer system; deep as reflecting the meaning or underlining rule set of how the computer system represents the real-world system; and surface as the way the system represents itself in the form of interface, inputs and outputs to the user. The deep and surface structures form the basis of the linguistic perspective.

They concluded their paper with the statement that by "*understanding how the deep and surface structures of social practice and discourse are consciously and unconsciously embedded in material computer systems, by the actions of designers, and subsequently interpreted by other stakeholders and reincorporated in the production and reproduction of linguistic and social structures continues to be one of the most challenging areas of inquiry in the discipline*" (Rose et al., 2004). They further quoted Mol (2002) who refers to the practices in which an object is manipulated as not a single passive thing in the middle "*waiting to be seen from the point of view of seemingly endless series of perspectives. Instead objects come into being – and disappear – with the practice in which they are manipulated*".

Burton-Jones and Grant (2008) adopt positivist assumptions for their study to investigate how IS can be used effectively and build their theory on representation theory. They propose constructs such as fit-in-use and transparent interactions, amongst others, as constructs in their model for effective system usage. They consider structures as the basis as to how IS provides its representations (deep structures) via surface and physical structures.

Inscriptions are discussed next to indicate how designers inscribe their understanding of how data stakeholders will interact with data and how data stakeholders inscribe their actual use of data objects in practice.

### 2.3 Inscriptions

Inscriptions are attempts to inscribe pattern of use or behavior in for example artifacts, work routines, legal documents, standards, procedures and other institutional or organizational arrangements (Monteiro & Hanseth, 1996). They further state that inscriptions may have different forms and it may increase understanding of how these artifacts, etc., are used when investigating how and where "*patterns of use*" are inscribed and the first step would be to study how the users' interests are translated and inscribed. Callon (1986) describes inscription as a "*process of creating technical artifacts that would ensure the protection of the actor's interest*". It is important to note that an artifact never begins as a blank slate and in fact the inscriptions of IT artifacts represent the design, construction and use of different stakeholders, all with their own interests, values and assumptions in variety of communities of designers, users, investors, etc.(Faraj et al., 2004). The technology artifact can be modified through use with patterns of use inscribed and such inscriptions can then be viewed as properties of the artifact.

Inscriptions as the "*way technical artifacts embody patterns of use*" do not imply that actions are "*inscribed, grafted or hard-wired into an artifact", but rather that artifacts are "interpreted and appropriated flexibly*". During software development the "*programs of action*" for the users are inscribed in the data object based on the perception of how the data object will be used and this then anticipates how the data stakeholders interact with the data object in their different roles. Assumptions about the required competencies and roles of the data stakeholders are made and these roles and competencies are delegated to the components of the socio-technical network. Technology, having programs of actions inscribed, is an actor imposing its inscribed program of action on the data stakeholders. It can for example "*resist*" responding in the way expected by the data stakeholder such

as when it does not allow a value to be entered based on its validation criteria. Data stakeholders may also use data objects in unanticipated ways by, for example, bypassing validation criteria (enter 1111111 for a telephone number) or finding creative ways to enter data values in other fields such as entering a comment in an address field, etc.

The designer inscribing the perceived anticipated use for technology and as a caution Kallinikos (2002) warns that this should never become the arbiter of technological malleability. He further states that the spectrum of embodied intentions that characterize a particular technology cannot represent all possible embodied intentions that the user can enact when interacting with technology. In fact it may be important for the designers to consider the assumed user versus the actual user, real-world object versus its representation as a data object. Orlikowski (2000) states that the use of technology is situated, but not totally open to any and all possibilities. There will always be boundary conditions when using technology artifacts because they have physical properties that may limit their use. This does not imply predictable responses of human action (Widjaja & Balbo, 2006). Data stakeholders inscribe their understanding of how data can be used during their daily activities. The problem could then be that these understandings may not be recorded and that the understanding is reflected by the outcome of the action that is then inscribed, e.g., by how they produce or consume data to compensate for quality problems. Understanding is the outcome of the internalization process where different data inputs are combined with the data stakeholders own knowledge that (s)he has gained through experience as to how a similar situation was handled before. The inscriptions are not only based on the data stakeholders' own competencies and assumptions, but may be influenced by factors of the environment in which the data stakeholder operates, as well as by other actors of the network. Data stakeholders may influence each other by convincing each other of their interests and how that may benefit them. All of these actions may be inscribed as patterns of use in the data object.

Next the design and use of data objects to provide for the data stakeholders technologies-in-practice is discussed.

### 2.4 Design and use of patient records as data objects

The designer, in this case the software developer, inscribes the beliefs, social and economic relations, previous patterns of use, legal limit and assumptions of what the artifact is about when defining the data object (Akrich, 1992) quoted in Faraj et al. (2004). Once the data object is created with its inscriptions its structure becomes material and these "*embodies*" structures represent various social rules (Orlikowski, 2000). Data in its different forms, e.g. records, database tables, reports, emails, etc., can be regarded as artifacts and as an artifact it has an embodied structure (refer to the physical structure) that includes the patterns, rules and resources that are embedded in the data object during its design as it may be used by data stakeholders (Widjaja & Balbo, 2006). Design is also regarded as the social construction of the data object's embodied structure that emerges from their perceived understanding of the real-world object and through communication with the data stakeholders. The embodied structure could also contain inscriptions providing for data quality such as "*rules*" that are coded as software programs doing data validation or the use of triggers on databases. The design output (technology artifact) of the data object is referred to as a data object template and has inscriptions of the data object's anticipated use. It is important to note that a data object does not refer to a single artifact as Jensen (2004) refers to an electronic patient record as "*a multiplicity of things which forms a whole only sometimes or for some purpose*".

It is important to note that an embodied structure, i.e., the data object as an artifact, is a passive object that at the most has the potential to enable or constrain action but only when it is used in practice. By itself the data object cannot initiate any action or displays agency and an embodied structure can therefore be regarded as potential structuring elements emerging through the recurrent use of the data objects by humans. This in-use structure that is constituted during the process of agency, when data stakeholders interact with data though the data object structure, refers to the enacted structure of data objects. The same data object may be enacted differently by different data stakeholders and therefore

the appropriation of the data object can be viewed as "*a weave of embodiment in-design and enactment in-use*" (Widjaja & Balbo, 2006).

Data objects represent not only its physical structure, the template(s) defined by software developers during design, but when a data object is instantiated for each customer it is populated with the data representing the details of that customer. This is when data stakeholders capture or modify data. One data object template is instantiated by several data object instantiations when populated with data values to represent, for example, different customers and this multiplicity aspect requires a different view of structures and inscriptions as opposed to other technological artifacts. The result of this is that there are multiple instances of the data object, no longer necessarily being processed together but each could be enacted separately during its use. The data values can also be regarded as inscriptions because such values are captured or modified according to the data stakeholders' perceived understanding of the data values during interaction with the data object.

The logical data object is constituted from the different physical parts during the process of agency and is, in that form, only available during the duration of that process.

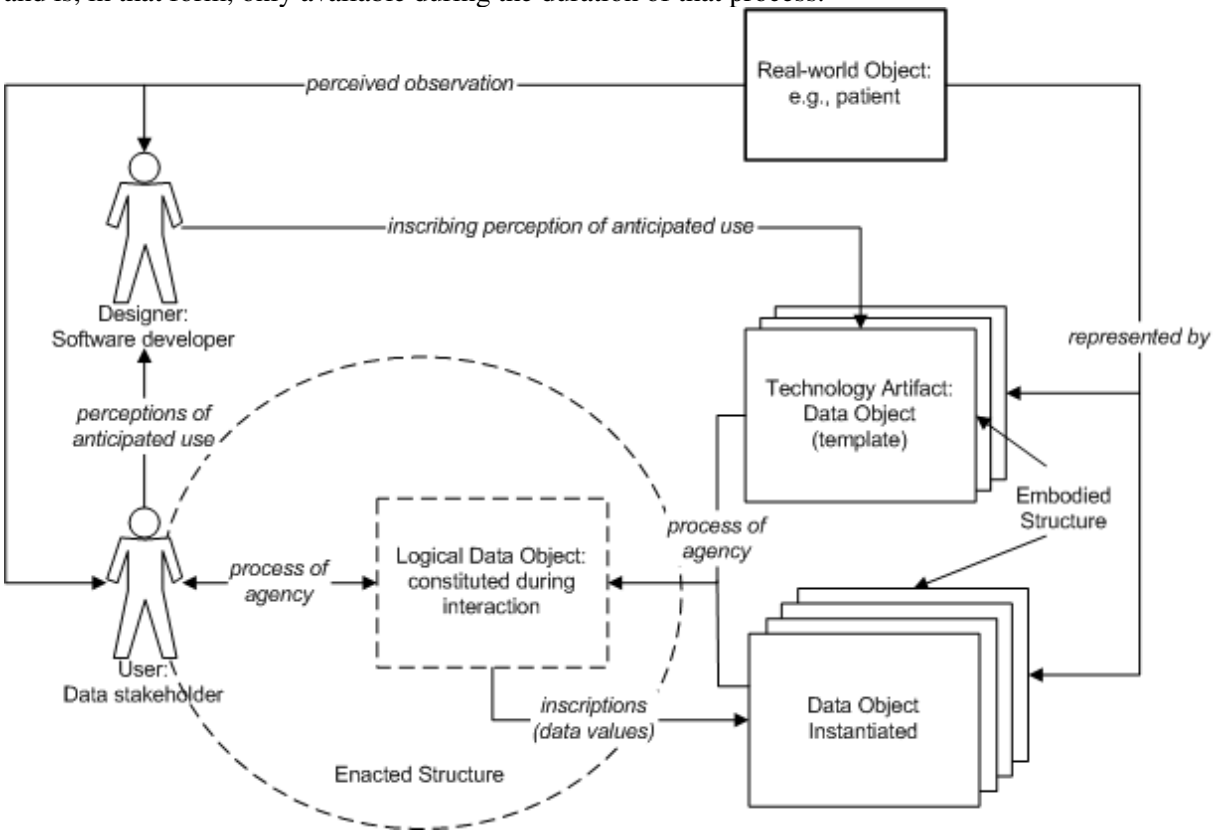


*Figure 1. Data interaction enactment model*

The above discussion is illustrated next by considering patient records as data objects.

## 2.5 Patient records in practice

Patient records are used in healthcare for coordination and cooperation of a large collection of healthcare stakeholders as large and complex networks (Berg & Bowker, 1997; Hanseth & Monteiro, 1997; Fitzpatrick, 2000). Healthcare records, in this case patient records, are configured according to the needs and practices of the organisations they serve. The patient health record evolves into different views that are both independent and interdependent as the details about the patient's care are recorded. In a medical practice the patient record is used by individuals rather than large groups as in hospitals.

Government regulations and Industry standards (e.g., code systems) are incorporated in how these records are used. The nature of what and how data is captured and used in patient records reflects the highly subjective judgments of their users, e.g., medical doctors, nurses, etc.

There is an interaction between the patient and the healthcare professional at the different points of healthcare therefore representing a network between the patient, healthcare professional and the corresponding data object of the patient. This interaction results in the exchange of data and information between the different data stakeholders.

The healthcare professional interacts with both the patient and patient record, contributing values to the patient data record based on his/her perception of the patient's condition. This means that the medical practitioner is engaging with the patient's data, integrating data from both the patient and patient data object, internalising these facts together with his/her observations, perceptions and professional knowledge. Data obtained from the patient are the facts provided by the patient and observation of the patient's condition. Data from the patient data object are the facts previously recorded and stored, i.e., inscribed. This information is internalised and communicated by the medical practitioner to the patient and captured and stored, i.e. inscribed, in the patient data object in the form of clinical data. The patient receives the information which has to be processed and internalised by the patient in order to understand its meaning. Once the consultation is over the link between the patient and medical practitioner network is broken with the healthcare practitioner, patient and patient data object becoming inactive nodes of the network in terms of caring for that patient.

The logical patient record refers to the enacted structure temporarily constructed by the healthcare professional when interacting with both the patient and physical patient record at the point of care. The outcome of this interaction is inscribed in the actual patient record as the data recorded by the healthcare practitioner to represent the observations, diagnosis, treatment and other details. The physical patient record can be the patient file, notes, results, etc. One example is the prescription with the medication details that the patient takes to the pharmacy for dispensing of the medicine. All these physical components constitute the patient record even though it is possible that the individual parts may be physically in different places. This combination of components represents the real-world object – the patient. The temporary structure, the logical record, contains only the data necessary for the interaction between the healthcare professional and the patient's data. This can be constrained by what data is available as the result of insufficient design where the anticipated use was not sufficiently perceived and or translated. It is also possible that the healthcare professional does not record all the interpreted data, such as diagnosis, observations, treatment, etc., resulting in incomplete inscription of data values. As a shared data object this means that other healthcare data stakeholders may have insufficient data to treat the patient and this can be regarded as a data quality problem.

Designers have a smaller role in the case of paper-based patient records because the structure and layout of the record evolves through its use rather than being designed first in terms of its anticipated use. Paper-based records usually provides for some structure combined with free text and are typically already in the format required for the type of document, e.g., X-rays, ultra-sound pictures, EEG, etc. The situation is different for electronic patient records because the systems supporting electronic patient records require a proper investigation, planning and design in terms of its anticipated use before such records can be used successfully. This is a complex task and research dealing with issues around electronic patient records should not only concentrate on identifying obstacles and barriers but also on exactly how such a record will be used in practice. In the case of electronic patient records the patient record has a pre-defined template to provide for all the possible data required to constitute the required patient record. This template can and probably will have more than one template components to provide for all the different parts of a patient record. This requires the designer sufficiently to understand the anticipated use of different healthcare data stakeholders to integrate it with the mapping of the real-world object. These templates guide the healthcare practitioner during the interaction to capture and use the data according to the specifications.

Even though patient records should not be regarded as passive repositories of data, it is true that the record is only active during the interaction between the healthcare practitioners and patient and then only for the duration of the interaction. Thereafter it is passive and cannot contribute anything to the patient's care unless it is used by a healthcare practitioner. It is possible that the arrival of another part of the patient record, e.g., lab results, could result in the patient record becoming active again, but then only if a human attends to the arrival of such data. The patient record cannot alert the healthcare practitioner to something that may be unnoticed by the healthcare professional when it could in fact be significant for the patient's care, e.g., unrelated observations on different parts that could in fact point to a specific condition or development. The patient data is as good as it is interpreted and used by the healthcare professionals.

Although the different parts of the patient's record can be used independently, the significance of the interdependencies on each other has to rely on the healthcare professional's ability to notice these interdependencies – the more experienced they are, the better they are equipped to interpret the patient's data sufficiently to provide effective care. The data at this stage does not actively contribute to these interdependencies because it does not have the ability to initiate an action unless a procedure has been incorporated to process the interdependencies of data from time to time.

# 3 HEALTHCARE CASE

HealthCenter[1] is a healthcare enterprise located in Cape Town, one of the fifteen such centres planned to operate in the private healthcare sector in South Africa by the end of 2008. They believe that an informed society is a healthy society and aim their services at accessibility and convenience. It provides a number of healthcare services under the same roof that cover the whole spectrum from sickness to wellness and primarily targets upper class citizens. Their patients either belong to a medical aid or can afford to pay for their healthcare services. The sub-acute hospital bridges the gap between hospital services and home-care for those patients who still require medical care on their way to recovery and who can no longer be treated in hospitals.

In the sub-acute and rehabilitation hospital a separate patient record is used where additional information is captured. This information supports the care period during the time that the patient has been admitted to this hospital until the patient is discharged. Most of these forms were designed by the current sister in charge based on her previous experiences at other hospitals. The main components of the ward patient record, also kept in a patient folder, are: discharge planning ward round; the FIMS (functional independence mobility score) form; admission form; medical admission record; nursing progress report; referral letter; medication administration chart; and vital signs chart.

## 3.1 Research methodology

This is an interpretive study in the information systems field with a relativist ontological stance and a subjectivist understanding of the research objects' behaviour. A literature study was conducted to establish the different issues, themes etc. of the research topics. An exploratory case study was conducted with the group of data stakeholders and data objects as the units of analysis. Empirical data was collected through unstructured interviews where probing questions were asked and documentation and forms studied. Representatives of the following stakeholder groups were consulted: patient; management (centre manager, patient care manager and financial manager); administration (reception); healthcare professionals (doctors, nurses); and developers. Patient records were considered as the data objects. The approach was not to unpack all the possible uses of the different stakeholders but to rather understand how the different groups interact with patient records. The

[1] Pseudonym used for the healthcare case

empirical data was analysed using the proposed data interaction enactment model as the theoretical lens as well as by identifying common themes and categorising data. Questions were derived from the proposed model and translated into suitable questions that were used during the interviews. Responses and observations were recorded and organised according to identified themes. The findings were further interpreted by establishing the meaning of the findings based on hermeneutics. The size limitation of this paper restricts the reporting of the case study in extensive detail and only the parts relevant to the interaction between data stakeholders and data objects are discussed. The data interaction enactment model is part of a more comprehensive research framework that also consider details about the influence of the context, profiling of the data stakeholders and the approaches they use during the interaction, roles, available resources and attributes. These details were considered but are not reported in this paper due to size limitations.

### 3.2 Analysis

HealthCenter's patient data is still mostly paper-based and although electronic options could be made available the practice doctors and nurses in the sub-acute hospital the healthcare professionals still prefer paper records. This is in spite of patient folders that are often miss-placed. The business side of HealthCenter uses an electronic IS with effective appointment booking, medical aid claims, financial and other systems that support their business processes. Management has access to summary reports that they can use for decision-making but need easier access to be able to manipulate data for improved decision-making. The doctors indicated that their relationships with their patients are more important and their knowledge of their patients or family dynamics (not captured in patient records) may influence their diagnosis and treatment plans. The case notes based on the consultations are used differently by different doctors, e.g., for one doctor comprehensive and detailed notes are very important whereas another doctor feels that a template could deal with most of the standard observations. Data stakeholders adapted their use of patient records by inventing communication mechanisms, e.g., adding a red dot to folders of patients with outstanding accounts; blue message slip with phone messages to folders for a doctor's attention; and using pink A4 paper sheets for female patients. There is limited sharing of patient data and this is even the case between the different care facilities of HealthCenter and doctors use referral letters to refer patients to other doctors or facilities. A new record, for example, is created for a patient admitted to the sub-acute hospital where all the patient details are again captured even though the patient is an existing patient of HealthCenter with a patient file at the doctors' practices. There is still much duplication and disparate data sources at the different facilities.

When a patient is admitted in the sub-acute and rehabilitation hospital the nurse's observations become important to manage the care of the patient. The nurse is the primary care giver and has direct contact with patients over a period of time. Patient records are stored and updated and then kept for a period of five years. Only the following patient details are captured on the computer: medical aid; payment; and medical condition.

The difference between patient records used by doctors and nurses reflects the purpose for which these records are used. The doctor interacts with the patient and/or patient record only for a short period during the visit in order to observe the patient's condition and/or progress. The doctor may then decide to intervene by describing or changing medication, treatment; request for tests, e.g., blood, x-rays, etc. Nurses interact with both the patient and patient record over a longer period while the nurse cares for the patient. Nurses are therefore in a better position to become more familiar with the patient and the data that reflects their observations during the care period, in terms of the patient record, should be a more realistic representation of the patient. Typically, nurses data is not captured electronically and the value "hidden" in the data could become lost in the treatment unless the nurse and doctor specifically respond to observations recorded that may be relevant to the patient's condition and treatment.

Following are the findings derived from the empirical data collected from Healthcenter:

- Different data instances of the same patient are located at different healthcare centres resulting in a lot of duplication and disparate sources of patient data.
- Patient data is important to all data stakeholders and although business data stakeholders interact with patient data to support an effective healthcare service from a business perspective, healthcare professionals still have the final say over how they will interact with patient data which at this stage is still secondary to their person-to-person interactions with their patients.
- Patient data used by healthcare professionals is still mostly paper-based and they are not specifically concerned about data quality except to provide for a comprehensive medical history for each patient in order to provide an appropriate healthcare service according to the legal requirements of their profession. Sharing of patient records is currently limited with referral letters the only mechanism to share patient data.
- Data inscriptions depend on how the data stakeholders interpret the use of patient data and although standard formats are used, e.g., patient observation cards, the actual values may be recorded and/or captured differently.
- Data is designed and used for two separate purposes, namely, business and healthcare. The data stakeholders are interested in using patient data for their purpose and may not recognise the benefit that they can derive from a design and use of patient data for a single purpose that supports both healthcare and business activities.

### 3.3 Discussion

When designing patient records, paper-based or electronic, designers need to consider how data stakeholders interact with patient data. This cannot simply consist of a list of the perceived user requirements but rather should be based on a sufficient understanding of the complexities associated with how the data stakeholders interact with data. The user interfaces to aid data stakeholders with interacting with patient records should be flexible enough to provide for a range of activities; for the different levels of expertise of the different data stakeholders; for the different purposes and ways that healthcare professionals interact with patients; to accommodate new, different requirements or enhancements. It is essential for designers and developers to understand how the different logical patient records are enacted for the different healthcare purposes according to the different healthcare professionals' needs. Only then can the different patient record components be designed to support the different enacted logical patient records in practice. At this stage it seems as if most effort is spent on designing for anticipated use by defining the physical patient record (template) rather than focusing on the different enacted structures (logical patient record) to better provide for the different uses in practice.

The importance of the HealthCenter findings indicates that patient data is designed for two different purposes, namely to operate HealthCenter as a business and to provide a healthcare service but not for different uses in practice. Data stakeholders are only interested in using data for their own purpose and may not recognise the benefit they can derive from a design that can support more diverse activities. Design for use in practice should take into account the complexities of human interacting with technological artefacts by providing how different stakeholders interact with data at different times, at different locations and for different purposes. This cannot simply consist of a list of the perceived user requirements but rather should be based on sufficient understanding of the complexities associated with how data stakeholders interact with data. User interfaces, templates, records, reports, are all mechanisms designed for data stakeholders to interact with data and these should be flexible enough to provide for a range of activities; different level of expertise; and different purposes.

The socio-technical nature of IS should specifically be considered when designing for actual use based on representing the real-world in a way that effective facilitate actual use in practice – specifically its human-agency and Orlikowski's (2005) machine-performativity as well as how data objects are enacted as "moments-of-interest" (Hosein, 2002). Patient records are shared between different data stakeholders, but in different ways as large and complex networks (Berg & Bowker, 1997; Hanseth &

Monteiro, 1997; Fitzpatrick, 2000). This is confirmed by the empirical study that emphasized the complexities around the interaction between data stakeholders and data objects where the actual use differs from the anticipated use. The reason why this is still the case could be the lack of understanding of how logical data objects are enacted as logical data objects and how these differ from the design templates (physical data objects). The empirical results of the healthcare case confirmed that a patient record currently still constitutes of many different physical components that are stored in different places and the concept of a logical record is not clear since users enact the required temporary logical structure with those components that they can locate with different levels of success and frustration. This enacted structure is also only available during the moment of interaction and needs to be enacted from scratch each time it is needed. Since these are still mostly paper-based careful consideration is required to provide for the same facility in any electronic patient record systems.

There is an important difference between the physical and logical structures of a record. Different temporary logical records are enacted to support different needs, i.e., it is necessary to provide for flexible logical records to enact the logical structures from the different physical parts as and when needed. In order for HealthCenter to compete as a business in an ever-changing global environment, they need to consider external factors that have an impact on the environment in which they operate. Better utilisation of their patient data will enable HealthCenter to protect themselves against legal actions and to improve their Healthcare service delivery. HealthCenter will be in a better position to interact with their partners, both internal and external, by recognising the importance of sharing patient data and this can be best achieved when their systems and patient record designs provide for their stakeholders to operate in a global world.

# 4 CONCLUSION

The purpose if this paper was to consider the complexities associated with humans using technology and to propose a model to consider how data stakeholders interact with data objects. This model illustrates the temporary enactment of the logical data object during the interaction with data objects. The problem seems to be the difference between the design for anticipated use and the actual use of these data objects. Data stakeholders inscribe their understanding of how the data object is used and these understandings are then inscribed into the actual data objects. The proposed data interaction enactment model can be used to investigate how logical patient records are enacted during interaction by considering which components are required to constitute the logical patient record for the different purposes. The proposed model indicates the extension of the technologies-in-practice model to provide for the embodied structures. The usefulness of the proposed data interaction enactment model still needs to be validated in practice to establish if this extended view sufficiently provide for improved design of the patient record components. Only once the data interaction enactment model is operantionalized will it be possible to evaluate its usefulness as a practical model to support better design for actual use in practice.

The model built by Burton-Jones and Grange (2008) for effective usage provides for several constructs to consider for effective system usage, e.g., fit-in-use, transparent interaction, etc. Although their model also considers the three structures of Wand and Weber (1995), they focus more on to what extend the structures in terms of representing the users' world, support effective usage as opposed to the data interaction enactment model that may provide more insights on the actual interaction between users and data as part of an IS. On the other hand it may be necessary to specifically consider representation theory for the proposed model to focus more on the representation aspect of the model, i.e., how the designer inscribe the perceived observations of the real-world object and anticipated use as the data object template and how that is instantiated to represent the real-world object (refer to the parts outside the circle in Figure 1). In this paper the focus is on the enacted structure indicated by the circle in Figure 1. It may be possible to combine some aspects of both models in which case further

research is required. Both models are at a formative stage and need to be operationalized and validated.

At this stage the contribution is more theoretical where the data interaction enactment model provides an explanation of the difference between a temporary enacted structure (logical data object) versus an embodied structure (data object template). The conceptual model was derived from the different explanations and descriptions to present a generic representation of the concepts on an abstract level. It is an attempt to visually represent the thoughts, constraints, events, reasons, behaviour or structures of the specific concepts. The interpretive research approach used contributes towards the improved understanding of the interaction between social actors and technological artefacts as the latter are designed to represent real-world objects.

The findings confirmed the notion that patient records are complex and that a consideration of both social and technical considerations are necessary, especially when these overlap when data stakeholders interact with data objects. Designers should focus more on the use of patient records in practice rather than only on their anticipated use. The contribution of this paper is more conceptual although the empirical results confirmed the issues identified by the literature review. Further research is required to translate these findings into practice design recommendations

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