

Chapter 24

Modeling and Automated Examination of Communication Processes in Integrated Health Information Systems: A Systematic Approach

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ABSTRACT

Modern, integrated information and communication systems (ICT) help improve the communication along processes in hospitals. The goal of this paper is to present a reusable and holistic concept which allows the detailed and systematic description of arbitrary communication processes, as well as the detection of communication errors. This is realized by mapping attributes of communication processes to an entity relationship model respectively database and applying specific, predefined queries on the stored process attributes and their relationships, resulting in the detection of potential communication errors. To develop the authors' concept, they used a methodological approach which was inspired by the concept of Rapid Application Development and adapted in order to develop their model. Furthermore, techniques of qualitative content analysis, as well as expert interviews, were used to develop the authors' approach. The components of their approach have been successfully evaluated with different communication processes and they were able to detect major potential communication errors. To fully proof the authors' concept, further tests with complex communication processes are indicated. Tool-support is on a prototype-level and needs further improvement towards standardization and usability. To transfer their concept from scientific use to daily operation, it is also necessary to further analyze and coordinate the concept with existing approaches from the domain such as business process modeling etc.

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INTRODUCTION

In recent years, the electronic acquisition and transmission of information objects, e.g., order forms or examination reports, gained importance in the health care domain (Haux, 2006). The correct transmission of information objects between the involved computer-based application systems (e.g., order entry system) has become vital for processes in health care institutions (Coiera, 2000). In this context, terms such as “seamless integration” are used quite commonly (e.g., Brazhnik & Jones, 2007; Giuse & Kuhn, 2003) and underline the necessity that all communication partners must share conventions that enable them to effectively operate together (Kun, 2007). These conventions pertain to the structure of information objects (e.g., as sets of identifier-attributes pairs), the meaning of each attribute and consequently each application system’s communication interfaces. In the health care domain, the two most important communication standards are Digital Imaging and Communications in Medicine (DICOM) (ACR/NEMA, 2007) and Health Level 7 (HL7, 2007). Nevertheless, communication within heterogeneous information systems is still error-prone (Hammond, Helbig, Benson, & Brathwaite-Sketoe, 2003; Khorasani, 2003). Even the use of just one of the standards requires additional implementation efforts (Gross-Fengels et al., 2002; Matthews & Bosch, 2006). Among others, this situation is caused because standard definitions still allow the misuse of objects and services. Therefore, the international initiative Integrating the Healthcare Enterprise (IHE) provides a framework for the coordinated use of established standards (HIMMS/RSNA, 2008; Mildenerberger, Wein, Bursig, & Eichelberg, 2005). In accordance to the process-oriented paradigm that has been increasingly propagated for the healthcare domain in the last years (Reichert & Dadam, 1998), the IHE defines transactions in its technical framework. These transactions are organized in distinct integration profiles that represent all common

use cases. Each profile defines those transactions wherein the application systems are regarded as actors that exchange specific information objects while acting in a certain way. The IHE helped to improve the integration within heterogeneous health care information systems. This is important because fully interoperable communication interfaces between all involved application systems are crucial prerequisites for correct information logistics i.e., the right information at the right time and place in the right form to the right people, so that these can decide correctly (e.g., Augustin, 1990), or rather process-oriented information systems, i.e., the deployment of Workflow Management Systems (e.g., Dadam, Reichert, & Kuhn, 2000). However, correct information exchange on a broad scale still cannot be taken for granted (Boochever, 2004; Carr & Moore, 2003). Communications that appear successful can still have mistakes in the exchanged content while the underlying reasons are difficult to identify. Even changes in properly working infrastructures may cause bad side-effects that are hardly predictable (e.g., Mildenerberger et al., 2005) – also having in mind that process-oriented information systems must adapt to any organizational changes. Problems related to communication infrastructure and processes must be examined carefully because they affect the quality of patient treatment. It is, therefore, important to detect any possible communication errors. However, the current methods seem to be not optimal for the assessment of computer-based communication processes (Brigl, Strübing, Wendt, & Winter, 2006) - they either perform e.g., time measurements, e.g., MOSAIK-M (Hoffmann, Bergmann, Bott, & Pretschner, 2005) or reachability analyses on Petri-net based models in order to detect bottlenecks and the best performing variations (Blake, Carter, O’Brien-Pallas, & McGillis-Hall, 1995). Others, such as the method of Alexopoulos et al. (2001), were developed to analyze those processes that show significant variations in their executions. While some of these methods do not include information

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