Preface of the 3rd International Workshop on (Meta)Modelling for Healthcare Systems (MMHS 2018)

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Abstract. MMHS 2018 was arranged as a joint workshop with the HealthTech seminar at Western Norway University of Applied Sciences, Bergen, Norway, June 13-15. It was the third workshop in the MMHS workshop series focusing on modeling and metamodeling for healthcare systems. E-health is one of the fastest growing ICT markets. According to Mordor Intelligence the market share for e-health was estimated as USD 124 billion in 2016 and is projected to reach USD 244 billion by 2021, growing at a compound annual growth rate of 14.56% during the forecast period. Major software and ICT infrastructure companies are currently investing for this growth. Several modelling approaches have been successfully implemented in the healthcare domain, such as business process modelling, domain specific languages for representation of health resources (HL7 FHIR), and conceptual modelling with archetypes (OPEN EHR), However, there is still a huge potential for metamodelling and model based software engineering to tackle problems such as software interoperability, formalization and simulation of work processes and clinical guidelines, domain specific abstractions, etc. The goal of this workshop was to create a forum for healthcare system developers and researchers on the one side and modeling researchers and the modeling community on the other.

Keywords: modeling in healthcare, metamodeling in healthcare, interoperability, integration, clinical guidelines, domain-specific modeling

1 Objectives and scope

Rising costs, ageing populations and increased expectations are making the current healthcare systems in the developed world unsustainable. Information technology has the potential to support healthcare but its application has not nearly reached its full potential. Barriers include the distributed nature of the services and local variations in policies; continuous changes due to updates in the rules

and guidelines; the complexity of the information; and the many and varied of requirements placed on the systems by a network of stakeholders. Model-based software engineering (MBSE) is an emerging and promising methodology for software systems, targeting challenges in software engineering relating to productivity, flexibility and reliability. MDSE is especially useful as a methodology for the development of healthcare systems having the above mentioned barriers in mind. Modelling and metamodelling is fundamental for MDSE techniques, especially when new tools and modelling languages are created for the domain-experts.

The objectives of this years MMHS was to provide a forum for scientists and practitioners in both the modelling and the healthcare systems communities to identify and investigate problems related to the applicability of current modelling techniques to healthcare systems design. MMHS 2108 also aimed to build new collaborations between the different communities, facilitating the creation of new approaches, and supporting future healthcare systems modelers through the use of better domain-specific modelling languages, tools, methods and guidelines. The workshop also targeted researchers in related communities, including ontological and knowledge representation, domain-specific modeling, human-computer interaction, language design, process modeling, workflow modeling, and conceptual modelling.

The workshop accepted presentations of case studies and tool demonstrations. Submissions were invited dealing with model based and software language design techniques in general and modelling and metamodelling in particular, focusing on their applicability to healthcare, and could range from theoretical aspects to more applied case studies or prototype systems targeting applications. Suggested topics included, but were not limited to:

- Modelling and simulation of care processes
- (Meta)modelling of different aspects of the health care domain e.g., security, privacy, process monitoring, user interaction, data representation, clinical guidelines etc.
- Knowledge representation in the form of metamodeling, archetypes and ontologies
- (Meta)modelling techniques for patients' self-management of diseases
- (Meta)modelling techniques for integration and coordination of health data systems
- Techniques for interoperability of healthcare systems
- Modelling of care processes that crosses institutional boarders (e.g., hospital-care, home-care, home-family doctor, paramedic-hospital etc.)
- Success stories of application of (meta)modelling techniques in healthcare
- Domain specific languages and software language design for healthcare applications
- Modelling, communicating and presenting the various users' (e.g. patients and healthcare professionals) interaction with the health care system
- Formal techniques for software development and verification of healthcare processes

The previous versions of the MMHS workshop, MMHS 2014 (Halifax, Canada) and MMHS 2015 (Berlin, Germany), were organized as a satellite event of the ICTH conference.

2   The Workshop

The 2018 version of the MMHS workshop was arranged at Western Norway University of Applied Sciences, Bergen, Norway as part of a 3 days seminar on health technology 13-15 June, 2018. We had invited three types of submissions: Full papers, Tool presentations and Posters:

- Full papers and Tool presentations (max. 15 pages) were requested to be submitted using Springer LNCS template; the papers were refereed.
- Tool presentations could alternatively be submitted as a short abstract explaining how the MMHS community could benefit from using the tool.
- Poster announcements of previously published work or of works in progress, including tool development were also invited. This was meant to provide an opportunity for authors who are interested in discussing their published research with the MMHS community and giving a talk.

Submissions were reviewed by program committee members. The evaluation of submitted papers was based on originality, scientific quality and relevance to the workshop. Each submission received at least two reviews during the first round of evaluation. We arranged a second round of reviews for submissions that received conflicting reviews in the first round.

2.1   Workshop proceedings

5 papers, which were accepted by the program committee of the workshop, are included in this CEUR Workshop proceedings. The proceedings also include 1 invited paper.

- The invited paper *10 Years with the e-Health System in Estonia* presents a short history, general business and technical architecture and generalize the lessons learned from the past 10 years of operating the Estonian Nation-wide Health Information System (EHIS). The authors gives us a historical overview of the establishment of the EHIS. Moreover, they identify its success factors such as clear governance, legal clarity, mature ecosystem, agreement about access rights and standardization of medical data and data exchange rules. The authors shows us how the experiences from operating EHIS could serve as an overall overview of the requirement for success and the pitfalls to be avoided in developing and maintaining nationwide e-Health systems.
- The paper *Smart Space System Interoperability* provides an overview focusing on ontology-based knowledge representation and its use in resource-bounded multi-agent reasoning systems. The basic idea of this paper is to formalize and capture the agreed domain knowledge, to describe the shared

environment, to define shared vocabulary for facilitating knowledge communication between the agents, to reason and process the shared information, and eventually to provide a solution to informed decision-making in eHealth systems.

– The paper *Scanning the Medical Terrain: An aid to quicker adoption of guidelines* presents a study which examine a means to ensure quicker adoption of clinical guidelines in the health sector. Guidelines exist in order to ensure both quality of care, as well as efficient, effective and consistent provision of healthcare services. The paper argues that existing guidelines are often not adopted in a timely manner, even to the point of being outdated at the time of adoption. It also argues that in clinical practice many of the Electronic Health Record systems are expensive and provide limited support for work flow, limited user involvement during implementation, and limited potential for adaptation to changes of the program. Consequently, the authors believe that there is a need for more flexible systems tailored to and influenced by users' targeted needs. In addition, they have identified how well current management strategies align with the clinical guidelines, and have identified areas for improvement where scientific knowledge can be used to improve practice. Using domain-specific modeling languages would empower the users and remove or reduce the limitation of their influence on their functionalities.

– The paper *Integration and Coordination of Health Data Systems: State-of-the-Art and Open Problems* gives an overview of recent and current research activities in global consistency management, from which the development and maintenance of heterogeneous e-Health systems may benefit. The authors outline a possible workflow in a multi-user environment, which aims to keep all artifacts consistent, and sketch some of the biggest challenges in this area. The workflow is intended to both detect inconsistencies and restore consistency; in addition an overview of various state-of-the-art approaches which tackle these activities is given.

– The paper *Innovation in Digital Health and Care in Scotland* describes a design-led innovation initiative in Scotland with the goal of delivering the Specialty Sub-Group program, in which a range of experts in clinical specialties undertake a cycle of design-led workshops. These workshops aim to produce a high level mapping of each clinical area and to identify clinically led and patient centered sustainable improvements. The findings from these workshops are planned to form the basis of a specialty-led Access Collaborative Program delivering solutions to help scheduled care services to sustainably meet the challenges of the future. Modelling the intention of the patients and the clinical personnel is at the core of the improved solutions.

– The paper *Development of an E-mental Health Infrastructure for Supporting Interoperability and Data Analysis* presents an e-Health infrastructure for E-mental health which is designed to provide internet-based interventions and data analysis. To support interoperability between different devices, apps and the underlying healthcare systems the infrastructure built on established standards such as HL7 FHIR and ICD 10. A FHIR interceptor is

incorporated in the system architecture to handle user authorization to access FHIR resources. Further the authors shows how ontologies, dimensional modelling and process mining techniques can be combined to tailor visualization of clinical process at different abstraction levels to the needs of the specific users.

2.2   Workshop format

The workshop was 1 full day including 1 keynote, 5 presentations and one plenary discussion. The number of participants was approximately 30, including the participants of the health technology seminar.

3   Organization details

The workshop was organized at the Western Norway University of Applied Sciences[4] by Ludovico Iovino, Wendy MacCaull, Yngve Lamo and Adrian Rutle.

The workshop program committee consisted of:

– Andrew Fish, UK
– Rogardt Heldal, Sweden
– Ludovico Iovino, Italy
– Harald König, Germany
– Yngve Lamo, Norway
– Wendy MacCaull, Canada
– Salvador Martines Perez, France
– Gunnar Phio, Estonia
– Roberto Rodriguez, Spain
– Alessandro Rossini, Norway
– Adrian Rutle, Norway

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[4] https://cs.gssi.it/mmhs/