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Towards a Repository for Managing Archetypes for Electronic Health Records

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ABSTRACT

Background: *With the advent of openEHR Version 1.0 a common Electronic Health Records (EHR) architecture has been defined to pursue the aim of having ubiquitous information available when and where it is needed.* ***Objectives:*** *To analyse the functional requirements for supporting Domain Knowledge Governance with Information Technology (like authoring or updating archetypes) and present a prototype implementation.* ***Methods:*** *Requirements analysis using the Unified Modeling Language (UML) and incremental prototyping; also a series of archetype workshops were conducted.* ***Results:*** *For a web-based archetype repository, a total of four top-level use cases, 23 refining use cases for 5 different actors, are found to be essential. A prototype implementing some of these use cases has been developed.* ***Discussion and conclusions:*** *We believe that Domain Knowledge Governance is necessary independent of the actual approach and methodology chosen for EHR systems. Appropriate information technological support is required to support a clear process for authoring, updating, managing, disseminating knowledge in archetypes as well as archetype version control.*

Keywords:

Electronic Health Records, *open*EHR, Archetypes, Semantic Interoperability, Computerized Medical Record Systems

INTRODUCTION

With the recent advent of *open*EHR Version 1.0 ([1], http://www.*open*EHR.org) there is a common information and knowledge model for Electronic Health Records available that is believed to be able to solve some of the still prevailing problems of ubiquitous information and knowledge by improving semantic interoperability and also providing a common basis for decision support, data mining and other requirements in the health sector. Standardising knowledge is essential for achieving semantic interoperability between systems, and in general standardizing documentation systems means standardizing the underlying terminology system [2]. This in turn means standardizing concepts, relations between concepts and the linguistic designations for these concepts [3]. This is usually done by creating Clinical Data Sets - and is a tedious task: Simply put, the bigger the scope or the applicable region, the bigger the effort [4]. More and more stakeholders in Australia and internationally choose archetypes as an means to define clinical knowledge [5]. In 2005, we defined 'Domain Knowledge Governance' as comprising "…all tasks related to establishing or influencing formal and informal organizational mechanisms and structures in order to systematically influence the building, dissemination, and maintaining of knowledge within and

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between domains" [4]. We argued that systematic Domain Knowledge Governance is essential to achieve semantic interoperability. This has recently been backed up by NEHTA stating that 'undisciplined creation and application of archetypes threatens the goal of semantic interoperability' [6]. To adequately support Domain Knowledge Governance, Information Technology support is required. In this context, the aim of this paper is to analyse the functional requirements for supporting Domain Knowledge Governance with Information Technology on the basis of archetypes. This paper will present requirements and a prototype implementation for a web-based Archetype Repository to manage the authoring and updating of archetypes.

METHODS

In order to gather the requirements for the development of an archetype repository which provides comprehensive support for archetype development cycles, we carried out a comprehensive requirements analysis. A series of workshops on archetype development for clinicians were conducted by two of the authors (SG, EH) and among many other activities an archetype road show was conducted by SH. Based on this, as well as face-to-face and telephone discussion with members of ISO/TC 215, EHR Taskforce of the European Committee for Standardization (CEN), Standards Australia Electronic Health Record Committee, and founding members of the *open*EHR Foundation, we were able to work out a set of requirements for an archetype repository. To document our results of requirement analyses and prototype specification we applied the Unified Modelling Language (UML) to create an initial model capturing the requirements.
Several versions of a prototype Archetype Finder (which implements a subset of the required functionality) were developed to facilitate further refinement of the requirements for an archetype repository. The Archetype Finder was developed using the Web Ontology Language (OWL, [7]) and the Protégé OWL Plug-In [8] to develop and maintain an Archetype Ontology which provides the necessary meta-information on archetypes. In addition, we used Borland JBuilder 2006®, Java™ Servlet 2.3 Technology, and Apache Tomcat 4.1.31 as servlet container.

RESULTS

Actors

During our requirements analysis for the development of an archetype repository, we identified five primary roles (actors): Lead Developer, Reviewer, Unprivileged User, Archetype Admin and System Admin. These actors are presented in the following Table 1.

Actor	Description
Lead Developer	A lead developer is responsible for the coordination of the development/update of specific archetypes. The Lead Developer usually is the one to develop the initial draft for an archetype.
Reviewer	Reviewers are assigned to individual archetypes and review these archetypes, discuss them, and eventually approve them together with the archetypes.
Unprivileged User	Unprivileged user can usually only view or otherwise access published archetypes (archetype versions).
Archetype Admin	The Archetype Admin is responsible for identifying archetypes that are due for review or for other reasons need to be reviewed and assign appropriate Lead Developers and Reviewers to archetypes. An Archetype Admin can be Archetype Admin for all archetypes or a selection of archetypes.
System Admin	The System Admin is mainly responsible for appropriate user administration.

Table 1: Overview of the Actors of the system.

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Use Cases

For these, we further identified 4 top-level use cases as presented in Figure 1.

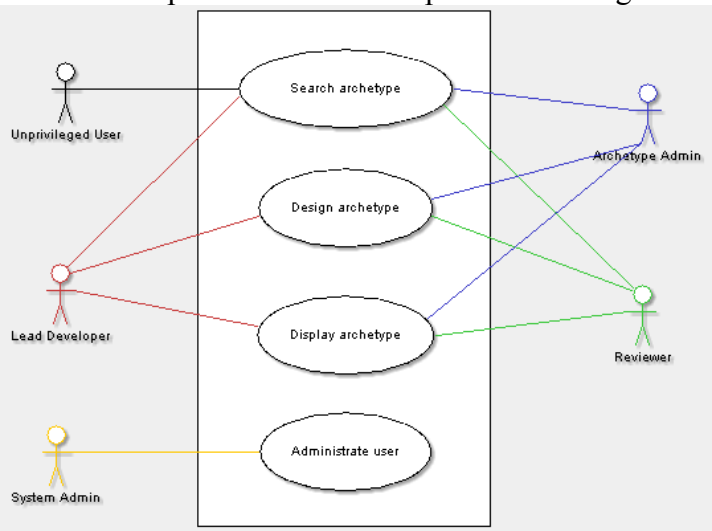

Figure 1: Top-level UML Use Case Diagram for the Archetype Repository.

It is not possible to discuss all uses cases in more detail in this paper, or present other diagrams (e.g. sequence diagrams specifying the exact order of activities) but as one key exemplar, we present the comprehensive use case diagram for an integrated archetype design process (Use case: *Design archetype*) in Figure 2.

Figure 2: UML Use Case Diagram that details the *Design archetype* use case.

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Prototype Implementation

So far, considerable amounts of the functionality of the 4 top-level use cases are prototypically implemented:

- Use Case *Search archetype*: The Archetype Finder[1] (see Figure 3) currently implements most of the required functionality in this use case. However, currently archetypes are not being marked with a next review date and consequently archetypes due for review can currently not be automatically identified. The Archetype Finder is based on an Archetype Ontology developed and maintained using the Ontology Web Ontology Language (OWL, [7]) and the Protégé OWL Plug-In [8]. The user interface is generically built based on this ontology, i.e. changes in structure and content of the Archetype Ontology are immediately reflected in the Archetype Finder.
- Use Case *Design archetype*: The editing functionality is implemented by the Archetype Editor. The Ocean Archetype Editor is a tool to support the authoring of archetypes as part of the *open*EHR initiative and the CEN EHR standardisations. Also, Thomas Beale's Archetype Workbench provides support for this. However many design aspects apart from editing and translating archetypes, e.g. comprehensive review functions, approval and publishing mechanism, are so far not supported by these tools. A tight integration with the repository is being strived for. Both Editor and Workbench are available at http://www.openEHR.org or precompiled at http://oceaninformatics.biz.
- Use Case *Display archetype*: This use case is basically fulfilled by Archetype Finder, Archetype Editor and Archetype Workbench for slightly different purposes. The Archetype Finder uses resources from the Archetype Editor for HTML-rendition of archetypes.
- Use Case *Administrate user:* This use case is not supported by any of the tools so far as this only becomes relevant for an integrated archetype repository.

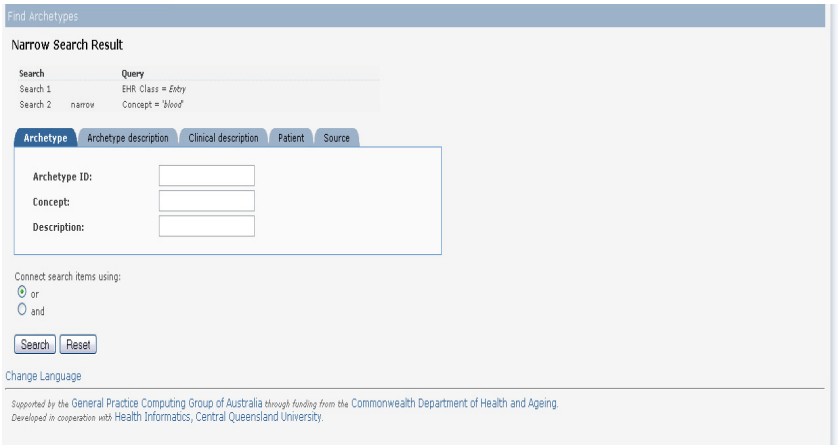

Figure 3: Screenshot of the Archetype Finder to narrow search results.

DISCUSSION

A framework for managing archetypes, identifying which archetypes need standardisation, which are domain specific and establish and train multidisciplinary teams for archetype development and coordination will enable comprehensive systematic domain knowledge governance. Much of this framework can be supported by information technology as analysed in this paper. A formal OWL Archetype Ontology can provide the necessary meta-information on archetypes for Domain Knowledge Governance and also support reasoning to automatically find similar archetypes.

[1] http://healthinformatics.cqu.edu.au/archetypefinder

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Drawing the right line between long and tedious but essential standardisation processes and flexibility and innovation is important for archetype authoring. One good example is the specialisation of a sector-wide archetype to suit a specific field – this will maximise interoperability while 'standardising diversity'.
The recent recommendation of NEHTA to "[a]dopt the European EN13606 standard on EHR Communication (parts 1 to 3) as the basis of an Australian Shared EHR Architecture Standard for specifying Australian Shared EHR Content" [6] shows the importance of setting up such an archetype repository as the CEN EN13606 standard is closely related to the openEHR approach. Until the development of international standards which has been proposed for managing international sharing of archetypes, a central Australian repository will be needed for local management of archetypes.

CONCLUSION

A comprehensive Archetype Repository will provide mechanisms to support Domain Knowledge Governance with a clear process for authoring, updating, managing, disseminating knowledge in archetypes as well as archetype version control. In conclusion, we believe that archetypes and adequate Information Technology tools render comprehensive Domain Knowledge Governance feasible and efficient - leading to high-quality clinical content that is semantically interchangeable between systems.

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