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Supporting process execution by interdisciplinary healthcare teams: Middleware design for IBM BPM

Nihan Çatal[a], Daniel Amyot[a,b,*], Wojtek Michalowski[b,c], Mounira Kezadri-Hamiaz[d], Malak Baslyman[a], Szymon Wilk[c,e], Randy Giffen[f]

[a]*School of Electrical Engineering and Computer Science, University of Ottawa, 800 King Edward Ave., Ottawa, ON, K1N 6N5, Canada*
[b]*Institut du savoir Montfort, 202-745A Montreal Road, Ottawa, ON, K1K 0T1, Canada*
[c]*Telfer School of Management, University of Ottawa, 55 Laurier Ave. East, Ottawa, ON, K1N 6N5, Canada*
[d]*College of Computer Science and Engineering (CCSE), Taibah University, PoBox 344, 41477, Al Madinah, Kingdom of Saudi Arabia*
[e]*Institute of Computing Science, Poznan University of Technology, oPiotrowo 2, 60-965 Poznan, Poland*
[f]*IBM Canada, 3755 Riverside Dr, Ottawa, ON, K1V 1B8, Canada*

Abstract

Interdisciplinary healthcare teams (IHTs) are involved in clinical processes composed of tasks requiring specific capabilities from different disciplines, often executed at different times. Although some hospitals use Business Process Management (BPM) suites to support their clinical activities, these tools are often unable to support the dynamic and capability-based allocation of tasks to the most suitable practitioner during the execution of a given process. Extensions, such as our previous work on ontological frameworks, exist that enable reasoning about IHT dynamics and allocate tasks to practitioners on the fly, but they are either unable to interact with commercial BPM suites or they are tightly integrated to one specific BPM suite. This paper contributes an innovative BPM-oriented middleware that enables existing BPM suites to interact with a semantic layer, hence offering more opportunities for deploying such advanced functionality in healthcare organizations. As a proof of concept, the middleware implementation is connected to a specific semantic layer and a specific commercial BPM suite (from IBM). The resulting system is illustrated with an acute stroke management process, hence demonstrating the feasibility of the proposed middleware-based approach. This solution compares advantageously against related work.

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Keywords: Business process management; generic interface; IBM BPM; interdisciplinary healthcare teams; middleware; team dynamics

* Corresponding author. Tel.: +1 613-562-5800 ext. 6947; fax: +1 613-562-5664.
E-mail address: damyot@uottawa.ca

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1. Introduction

Interdisciplinary healthcare teams (IHTs) are composed of practitioners from different disciplines who collaborate in order to provide optimal care to patients. IHTs enable collaborative and coordinated services in the healthcare system[1] and, in areas such as chronic pain management, raise the effectiveness of patient treatment[5]. However, as care processes (or workflows) can easily span many hours, days, or even months, the composition of IHTs usually changes over time. Another source of change is the real-time availability of practitioners (physicians, nurses, etc.) with specific capabilities required by the tasks of a care process, as these tasks are about to get executed.

The continuous selection of appropriate team leaders and members, and their allocation to tasks in a patient's care process, represent challenges for the automated support of IHT dynamics. This is particularly true in a context where *Business Process Management* (BPM) suites are used to model healthcare clinical processes and manage their execution. Commercial off-the-shelf and open-source BPM suites provide many process definition and execution features useful in a healthcare environment, as well as collaborative features such as mobility support and instant communication. For instance, The Ottawa Hospital (in Ontario, Canada) automated some of their traditional clinical processes with IBM's Business Process Manager suite (IBM BPM)[10] and also added support for mobility and collaboration with its integrated platform[9]. Yet, BPM suites do not necessarily have the functionalities needed to describe and reason about *team dynamics*, where team members and leaders change over time. The problem is that such tools need to be supplemented with additional functionalities to associate and dismiss, dynamically, suitable practitioners with the tasks being part of these clinical processes. Such functionalities can be modelled in many ways, including with a *semantic layer*[17] that defines concepts for dynamic team management while supporting the real-time allocation of process tasks to available and relevant practitioners.

An intermediate middleware, with a well-defined interface, is a potential way to integrate such a semantic layer with a BPM suite in order to capture complex healthcare processes and support dynamic IHT collaboration. This paper contributes such a middleware layer, including a *Generic Engine and Semantics Interface* (GESI), which decouples the semantic layer from underlying BPM suites while enabling the addition of dynamic IHT management features to existing BPM suites (commercial or open source), hence adding value to tools already used in healthcare. We have used Hevner et al.'s Design Science Research approach[8] to develop and assess this middleware artefact[3].

In this paper, Section 2 provides related work on IHT and BPM. Section 3 presents the design of the middleware, including GESI. The middleware's implementation and its interaction with a commercial BPM suite (IBM BPM[10]) are discussed in Section 4. Section 5 demonstrates how the middleware helps support typical IHT scenarios related to an acute stroke management process, and compares our approach to related work. Section 6 presents conclusions.

2. Related Work

IHTs are needed in healthcare to follow patients in a continuous way (e.g., as for chronic diseases) and often to treat an increasing aging population with complex care needs. Many problems occur in relation to a lack of a) sufficient collaborative work of healthcare teams towards common goals such as incomplete specifications of responsibilities, b) continuity in teams working in shifts, c) information about practitioners' capabilities, and d) clarity about work assigned[6]. To address such problems, real-time capability-based assignments can be achieved with an ontological framework combined with BPM[7]. An ontology for supporting teams is useful since team members' capabilities and responsibilities need to be clear in order to optimize the team's efficiency.

In her literature review, Çatal collected many goals and requirements for solutions in that context[3]. The language used to define clinical processes needs to be standard and well supported, with sufficient expressiveness. A common choice here is the *Business Process Model and Notation* (BPMN)[12]. The ontology must support healthcare concepts (patients, practitioner, capabilities, etc.) and team dynamics with role variability and user/patient preferences (especially in a patient-centric context). The team leader, also called *most responsible physician* (MRP), needs to be identified, with possible updates. The solution must allow the assignments of tasks to the most appropriate members based on their availability and capabilities. Both task-level and process-level assignments are needed, and some tasks/processes might be urgent. As healthcare teams care for patients who have a wide diversity of issues not always foreseen by clinical processes, the handling of process exceptions is another important feature. Finally, a BPM solution must integrate user interfaces and collaborative work support.