Winter 12-4-2009

Modeling Medical Summary Sharing Service with Web Services

Yung-Hsiu Lin

Rong-Rong Chen

Su-Chien Chiang

Her-Kun Chang

MODELING MEDICAL SUMMARY SHARING SERVICE WITH WEB SERVICES

Yung-Hsiu Lin[1,2], Rong-Rong Chen[1], Su-Chien Chiang[3], and Her-Kun Chang[4,*]
[1]College of Management, Chang Gung University, Taiwan
[2] Department of Information Management, Ta-Hwa Institute of Technology, Taiwan
[3]Institute of Biomedical Informatics, National Yang-Ming University, Taiwan
[4]Department of Information Management, Chang Gung University, Taiwan
[4,*]Correspondence: hkchang@mail.cgu.edu.tw

Abstract

Enterprises are entering a new Internet era. The Web, initially designed for human use, will now evolve to better support automated use. In this new era, enterprises will have the capability to assemble large-scale systems out of network-bound software components within the reach of mass-market consumers. This study aims to depict the conversations between business processes and Web service technologies, explain what and how can Web services support message sharing between business partners. A Medical Summary Sharing process from IHE is implemented with Web services technologies in a Long-Term Care Management Center setting. In this scenario, one manager in Care Management Center uses a care plan creation application to evaluate care requirements for one patient. The conversations between the application and Web services are explained using Web Service Business Process Execution Language (WS-BPEL) in business process side and Web Services Description Language (WSDL) in technical side. We discovered that basic Web service technologies have matured enough to support enterprises in composition of Web services and further research should be made to identify novelty in using the technologies and to ensure operational quality while the services are consumed.

Keywords: Business Process, Care Management Center, Web Service

Introduction

Medical summary is a subset of patient data that contains essential information for the purpose of communication among healthcare or other service providers [1]. Other than the minimum patient identification data, this summary can be adapted into the forms that include the information suitable for different business processes such as, referral, discharge, emergency events, insurance claiming, and care planning [2-3]. These processes connect service providers in a loosely coupled manner that the connections will only be activated through the request from the occurrence of specific events. Nowadays, most of information requested in such connections would be prepared, packed, and delivered by the sharing party in human operations. These tradition operations open up enormous service innovation opportunities for sharing the information that is now either trapped in hospital proprietary systems or still in paper records.

Sharing of medical summary in an effective and reliable manner is challenging current healthcare delivery systems [4-5]. The challenge may partially be attributed into technical [6] and managerial issues. The technical side will be the concerns to the standards in terms of data elements included in the summary and the transmission mechanism to support the information sharing. The managerial end can be the perceptions from healthcare service providers related to the difficulties and the benefits incurred from the implementation. With the rise of internet technologies, web service [7] was born to facilitate the service oriented business process [8] and the processes that distributed in different organizations can be coordinated in a machine-readable level [9]. Moreover, the technical standards of the web service implementation have been accepted by major information technologies vendors [10] and the medical summary sharing service scenarios have been promoted by healthcare institutions such as Integrating the Healthcare Enterprise (IHE) [11].

This study models the medical summary sharing process with a scenario in a community health service center (HSC) that a senior citizen discharged from hospital and reported to HSC for applying follow up care plan. The care plan creation process in HSC incorporates the web services provided by hospital medical summary process, social welfare organization (SWO) benefit evaluation process, and family affair section (FAS) family status process in HSC. This study implements the care plan creation process based on the standards from both healthcare domain and information and communication technology (ICT) field with the off-the-shelf software. The implementation demonstrates the technical feasibility in cross organizational process cooperation and the benefit in streamline this service oriented business process.

The structure of this will follow by a brief literature reviews on nature of service oriented business process and the standards related to medical summary sharing form IHE and web service from W3C working group. Section 3 describes the modeling process and the software architecture used in implementing the service. Section 4 presents the results of the implementation with the details of how the processes interact with each other. Section 5 discusses the finding and implications of this study with a conclusion remark.

Literatures

Sharing patient information among healthcare or other service providers is a business process that different organizations such as insurance firms or social welfare organizations may need the information to evaluate or plan the follow on services [4]. The process is now a time consuming and labor intensive operation that policy makers and healthcare practitioners are trying to redesign or restructure the system to make the information more accessible by various parties [12-13]. However, the operation in hospital is a set of tightly control disease curing procedure that is very different from that outside hospitals [14]. The care services outside hospital focus more on the inter-organizational collaborative procedures [15]. These procedures are loosely coupled, service oriented business processes that each organization can operate autonomously and can have the choices to maintain or release the connections [16]. To facilitate this information sharing process between different types of institutions, two sets of developments should be in place for the participants to follow. One is a set of scenario that is developed in the service domain such as healthcare industries and accepted by those participants. Other is a set of technologies that is developed to support this loosely coupled operation and accepted not only by standard bodies but also by major venders in the domain of ICT [17-18].

IHE is an industrial initiative designed to stimulate the integration of the information systems that support healthcare organizations [11]. It defines medical information sharing standard as technical framework (TF) for various domains such as cardiology, radiology, or patient care coordination (PCC). Under each TF, integration profiles (IP) are defined as the sharing scenarios to include the actors, transactions and their content. Cross-Enterprise Sharing of Medical Summaries (XDS-MS) is an IP from PCC-TF that mirrors current manual sharing processes: operator in hospital gathers appropriate information from patient medical record, copies and packages them up and ships the packages with a cover letter explaining the intention of the information. This manual process has been defined by IHT with automotive sharing process between information requester and provider with the web service technologies.

Web service is a set of business-driven technologies [4] that integrates business tasks as loosely coupled business services [10]. As defined in W3C, a Web service is a software system designed to support interoperable machine-to-machine interaction over a network [11]. A typical Web service architecture consists of three entities: service providers who create Web services and publish them to outside world, service brokers who maintain a registry of published Web services; and service requesters who find Web service required and bind those services components within their applications [12]. Based on Extensible Markup Language (XML), three Web service technologies facilitate the interaction among the entities. They are Simple Object Access Protocol (SOAP): communication protocol among entities, Universal Description, Discovery and Integration (UDDI): registration and searching of web services, and Web Services Description Language (WSDL): the service description language. In deploying Web service as operational

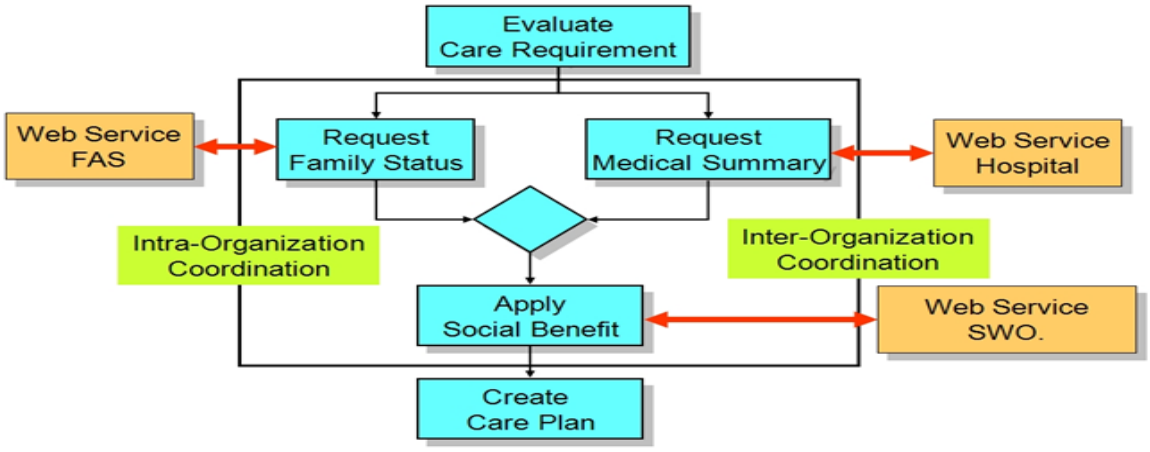

Figure 1 Operation Architecture of APP_CP

business process, extension standards are needed in coordination and composition of Web services from different providers. The technologies used for this deployment could be Web Service Business Process Execution Language (WS- BPEL) and Web Service Conversation Language (WS-WSCL) [13].

Methods

This study models the medical summary sharing service operated in a community HSC. The service scenario depicts the process that a manager in HSC processes a care plan creation service for a senior citizen discharged from hospital. After interviewing with the citizen, the manager requests medical summary from the hospital, checks the family status of the citizen from FAS in the HSC, and sends the initial care package with the medical summary to SWO for evaluating available social benefit. The care plan creation process needs information from various parties that many of the information collection procedure are now conducted by the care plan applicants.

This study model the care plan creation service with the standards from IHE's PCC-TF and implement the roles and information content from XDS-MS profile. Five roles are identified in the service and a care plan creation application is developed with the web services technologies to demonstrate the information sharing operation. The computer language used for developing the application is C# in Microsoft Visual Studio 2005, database is SQL 2005, and the process engine is BizTalk 2006. Figure 1 depicts the operational architecture of the application.

Use case method was used to describe the interactions among different roles in the care plan creation service. Table 1 depicts the use case description.

Results

This study develop an application with the web service technologies to models the care plan creation service in HSC. The development explains the information sharing interactions in terms of business process management level and technical communications level. Figure 2 is a sequence diagram that describes what business entities are involved in sharing the required information and how these entities are being incorporated into care plan creation service.

The sharing service is formed dynamically because each care plan may have different medical summary provider. Figure 3 demonstrate how the information from each provider be coordinated as a integrate service process by the process engine. In technical level, Figure 4 depicts how WS-BPEL uses <sequence> and <flow> to composite WS_MS and WS_FS in parallel and orchestrates WS_BP to form the integrated service process. Figure 5 describes how WSDL uses <operation> to describe input and output message and <binding> from detail implementation.

Discussion and Conclusion

The sharing service is formed dynamically because each care plan may have different medical summary provider. Figure 3 demonstrate how the information from each provider be coordinated as a

Table 1 Use case of APP_CP

Roles	**Mgr_HSC**: Manager in HSC who responsible for care plan creation service **APP_CP**: Application for creating patient care plan and coordinating different information sharing web services. **WS_MS**: Web service of Medical Summary published by one Hospital. **WS_FS**: Web service of Family Status published by FAS. **WS_SB**: Web service of Social Benefit Evaluation published by SWO.
Pre-Condition	**Mgr_HSC** interviews with applicant and collect his/her demographic profile
Process	1. **Mgr_HSC** inputs Patient ID to **APP_CP** 2. **APP_CP** requests Patient's Medical Summary from **WS_MS** 3. **APP_CP** requests Patient's Family Status from **WS_FS** 4. **APP_CP** integrates Patient's Medical Summary and Family Status as a Social Benefit application 5. **APP_CP** sends Social Benefit application to **WS_SB** 6. **WS_SB** sends the evaluation result to **APP_CP** 7. **APP_CP** presents the coordination result to **Mgr_HSC** 8. **Mgr_HSC** continues Care plan creation process
Exception	N/A
Post-Condition	**APP_CP** responses a Coordination result User Interface to **Mgr_HSC**

integrate service process by the process engine. In technical level, Figure 4 depicts how WS-BPEL uses <sequence> and <flow> to composite WS_MS and WS_FS in parallel and orchestrates WS_BP to form the integrated service process. Figure 5 describes how WSDL uses <operation> to describe input and output message and <binding> from detail implementation.

Web service is now the most popular paradigm for service oriented business process integration. It provides a framework of software technologies designed to support interoperable machine-to-machine interaction over a network. In this study, APP_CP integrates intra- or inter-organizational business processes to fulfill the care plan creation operation. Business designers can also create the new service out of the

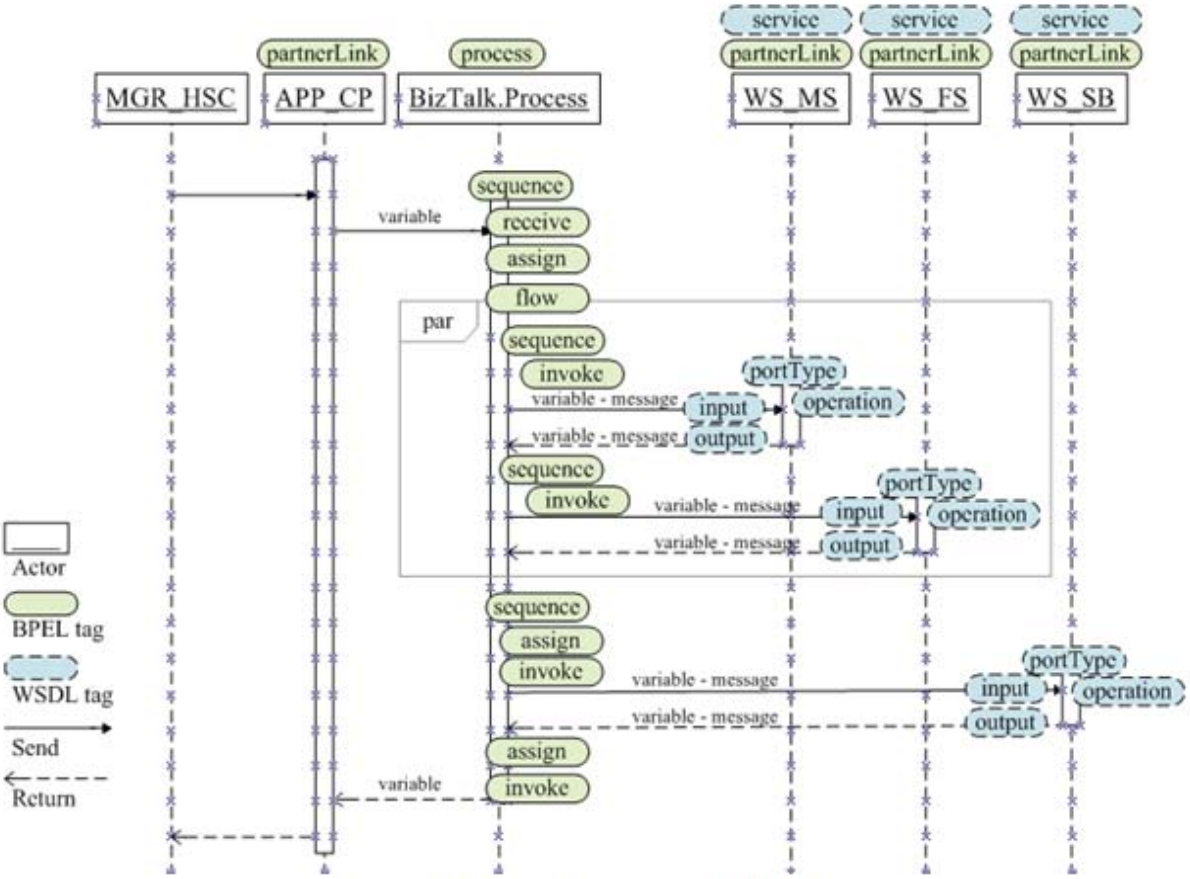

Figure 2 Sequence Diagram of APP_CP

Sharing medical summary is a business process that can be done in an effective and efficient way. This study adopts the industrial standards both in healthcare domain and ICT fields to model the sharing processes. The entities that provide the information need not to restructure their whole information processing procedures or systems. For instance, hospitals will create and store patient data during the caring processes. The data can be organized in the forms and published as a medical summary sharing web service to allow the requests from other service providers. The development of the summary sharing web services is not a hi-tech project that limited resources can contribute substantially on saving traditional labor operations.

integration of web services from other providers to respond to certain business needs. The capability of web service has opened up the opportunities for a new generation of e-commerce applications to emerge.

Current healthcare systems have been challenged by ever increasing aging population and prevalence of chronic disease. New healthcare models and service applications need to be developed to provide the care outside the boundaries of institutional care. This study develops a medical summary sharing application that can streamline the operation in community HSC. The web service technologies used in the application can facilitate the sharing processes among various participants. More healthcare

applications should be developed for decision makers to trust the web service technologies and for business designers to innovate adequate care services.

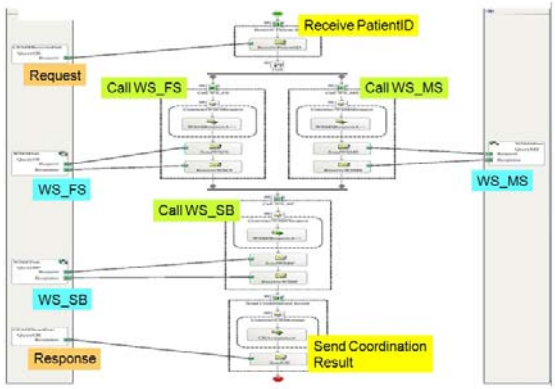

Figure 3 Business Processes Coordination of APP_CP

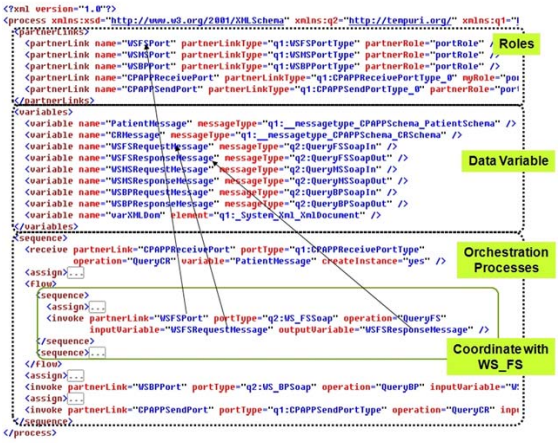

Figure 4 BPEL description of APP_CP

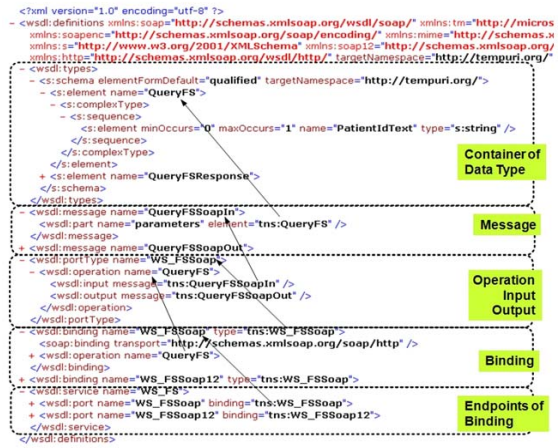

Figure 5 WSDL Implementation of APP_CP

Acknowledgements. This work was partly supported by the National Science Council, Taiwan, under grants NSC 95-2745-H-182-005【6, 7, and 8】-HPU.

References

[1] L. Ward and M. Innes, "Electronic medical summaries in general practice--considering the patient's contribution," The British Journal of General Practice, 53, 2003, p. 293.

[2] J. M. Corrigan, Crossing the Quality Chasm: Washington, DC, National Academy Press, 2001.

[3] M. Cabrera, et al., "eHealth in 2010: Realising a Knowledge-based Approach to Healthcare in the EU," European Commission Directorate-General Joint Research Centre Technical Report EUR, 21486, 2004.

[4] W. Pratt, et al., "Personal health information management," Communications of the ACM, 49, 2006, pp. 51-55.

[5] C. Ma, et al., "Empowering patients with essential information and communication support in the context of diabetes," International Journal of Medical Informatics, 75, 2006, pp. 577-596.

[6] A. Dogac, et al., "Key issues of technical interoperability solutions in ehealth," 2006.

[7] K. D. Gottschalk, et al., "Introduction to Web services architecture," IBM Systems Journal, 41, 2002, pp. 170-177.

[8] L. D. Paulson, "Services Science: A New Field for Today's Economy," IEEE Computer, 39, 2006, pp. 18-21.

[9] D. Booth, et al., "Web Services Architecture," W3C Working Group Note, 11, 2004, pp. 2005-1.

[10] M. P. Papazoglou and W. J. van den Heuvel, "Web Services Management: A Survey," IEEE Internet Computing, 2005, pp. 58-64.

[11] E. Siegel and D. Channin, "Integrating the healthcare enterprise: a primer," Radiographics, 21, 2001, p. 1339.

[12] I. Kohane, et al., "Sharing electronic medical records across multiple heterogeneous and competing institutions," 1996, p. 608.

[13] J. Jahnke-Weber, et al., "Making available Clinical Decision Support in Service-Oriented Architectures."

[14] M. M. Funnell and R. M. Anderson, "The Problem With Compliance in Diabetes," 284, ed: Am Med Assoc, 2000, pp. 1709-1709.

[15] M. M. Funnell, et al., "National Standards for Diabetes Self-Management Education," Diabetes Care, 31, 2008, pp. 97-104.

[16] C. P. Pires, et al., "Innovation in services? How different from manufacturing?," The Service Industries Journal,28, 2008, pp. 1339 - 1356.

[17] I. Foster, "Service-Oriented Science," 308, ed: American Association for the Advancement of Science, 2005, pp. 814-817.
[18] M. P. Papazoglou and W. J. Van Den Heuvel, "Service-oriented design and development methodology," International Journal of Web Engineering and Technology, 2, 2006, pp. 412-442.