Mother Theresa Group of Hospitals – HealthCare System SOA Project Plan: Approach for SOA-based Patient Care Information System

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Creation Date: 11/13/08
Last Revised: 12/04/08
Version: 2

CPET 545 SOA and Enterprise Applications
Fall, 2008

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EXECUTIVE SUMMARY

Problem:
- Mother Theresa Hospitals current system is mainly paper based, thus expensive, and time-consuming to maintain necessary quality of data standards imposed by HIPPA regulations.

Solution:
- The EJM Service Oriented Architecture (SOA) design team will design a SOA-based patient care automation system offering efficiency and interoperability across multiple departments and locations.

Deliverables:
- Analysis of project cost and expected ROI
- Recommended implementation of patient care process based on BPMN and SOA technologies such as XSD, WSDL, and BPEL

INTRODUCTION

The SOA-based patient care information system will:
- Provide interoperability, loose coupling, dynamic discovery, reusability, compositionality, and federation among its components.
- Organize and utilize distributed capabilities that may be under different ownership domains.
- Provide a uniform means to offer, discover, interact with and use capabilities to produce desired effects consistent with measurable preconditions and expectations.
- Allow different applications to exchange data with one another as they participate in business process.

Outline of Project Sections:
- EJM SOA team previous experiences rely on Microsoft Corporation products
- The team will highlight the project scope, estimated cost, project schedule, and risks assessment and management
- Implementation will be based on business process modeling notation (BPMN) and unified modeling language (UML)
- Appendix may include minimum system requirements, software inventory and vendors, and terms and keywords as deemed necessary.
INTRODUCTION

The EJM team's portfolio of experience demonstrates excellence in engineering enterprise applications as demonstrated in figure 2 below.

SOA PROJECT EXPERIENCE

EJM SOA team design automation system for a well-known manufacturing company, as shown below:

Figure 2: Cutit Supply Chain Business Process

Figure 1: IT infrastructure for a well-know company
SOA PROJECT EXPERIENCE

EJM team examined and designed a pilot lab business process project as displayed in Figure 3 below.

Conclusion:

Through considerable effort of the EJM team, the following SOA requirements were met and the platform served the original user needs while adapting to growth.

- A componentized platform
- Distributed platform
- Loosely coupled platform
- Reusable platform
- Minimally state-full platform that served the original user needs while adapting to growth

The adaptability of the SOA-based lab project process allowed further automation additions and an incredible ROI in only 1.6 years.
Project Scope and Deliverables

◆ The Project will introduce a SOA-based patient care information system with the following features:
  – Flexibility to communicate among Mother Theresa Hospitals and other healthcare providers
  – Communication with existing SAP (System Application & Products) systems for data processing
  – Security around the modules based on roles and constraints (Active Directory based authentication)
  – Automated reporting module
  – Communication between Insurance carrier and hospital management system

◆ Proposed platform for integration and interoperability:
  – .NET Framework as the key infrastructure
  – Microsoft BizTalk Server as the key integration technology utilizing HL7 and HIPPA accelerators
  – Microsoft SQL Server as the clinical data repository

◆ Final project deliverables
  – Analysis of project cost and expected ROI
  – Recommended implementation of patient care process based on BPMN and SOA technologies such as XSD, WSDL, and BPEL

Constraints and Limitations

◆ Implementation limited to Microsoft platforms, although the methods discussed may still apply to various software environments.
◆ Implementation does not cover patient tracking or details with RFID (Radio-Frequency Identification) software
◆ Does not provide DSS (Decision Support System) for doctors
◆ Other programming languages such as Java, C#, C++, or any other programming language rather than XML will not be employed to conduct this project.
Technology and Standards:

- BPM and SOA methods and technologies.
- Workflow execution logic for the patient care process will be represented by the Business Process Execution Language (BPEL) using an XML-based (eXtensible Markup Language) vocabulary.
- BPEL relies on WSDL (Web Service Description Language) for the description of the messages exchanged between the different participants (Web services).

Figure 4 illustrates the layering of standards [4].

Figure 5 [6, 7] shows the proposed client server architecture emphasizing needed hardware and software components.
**Project Cost Estimation**

**Hardware Platform**

- The EJM team recommends 3 Dell PowerEdge M90 Servers at a cost of $30,000. The servers are recommended due to the following reasons.
  - Use of four socket processors and high memory capacity (up to 192 GB 667/800 MHz DDR2 w/ 8 GB DIMMS) for high performance
  - Ensured high availability due to fully redundant connectivity on all three fabrics
  - High density virtualization environments for consolidating server roles and minimizing physical inventory
- Other hardware will need to be purchased such as tablet pcs for doctors and network access controllers to allow for VPN connections in the event of outsourced healthcare providers. The estimate cost for this is $10,000.

**Software Tools [6,7]**

- Microsoft BizTalk Server
- Microsoft SharePoint Server
- Microsoft SQL Server
- Microsoft Windows Server with IIS
- Microsoft Exchange Server
- Microsoft InfoPath

**Table 1, Total Costs**

The total costs below reflect estimated hardware and software costs, as well as staffing (3 new hires) and expected ROI information. It has been carried out to three years as requested by Mother Theresa Hospitals.

- **NOTE:** Consulting fees are billed at $150/hour and it is expected to take 10-40 hours weeks of consulting to build, test, and implement the project.
- **Annual ROI is 61%**, **payback period is 1.65 years**, and **average yearly cost is $177,400**

<table>
<thead>
<tr>
<th>Cost</th>
<th>Pre-start</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software</td>
<td>86,000</td>
<td>12,000</td>
<td>12,000</td>
<td>12,000</td>
</tr>
<tr>
<td>Hardware</td>
<td>40,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Consulting</td>
<td>60,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Personnel</td>
<td>0</td>
<td>160,000</td>
<td>160,000</td>
<td>160,000</td>
</tr>
<tr>
<td>Training</td>
<td>7,600</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Per Period</td>
<td>193,600</td>
<td>172,000</td>
<td>172,000</td>
<td>172,000</td>
</tr>
</tbody>
</table>
## Project Roles and Responsibilities

<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibilities</th>
<th>Participant(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Sponsor</td>
<td>• Ultimate decision-maker and tie-breaker&lt;br&gt;• Provide project oversight and guidance&lt;br&gt;• Review/approve some project elements</td>
<td>Mr. Paul Lin</td>
</tr>
<tr>
<td>Steering Committee</td>
<td>• Commits department resources&lt;br&gt;• Approves major funding and resources allocation&lt;br&gt;• Resolves conflicts and issues&lt;br&gt;• Provides direction to the Project Manager&lt;br&gt;• Review project deliverables</td>
<td>Mr. Paul Lin &amp; MOTHER&lt;br&gt;THeresa HOSPITAL MANAGEMENT</td>
</tr>
<tr>
<td>Project Manager</td>
<td>• Manages project in accordance to the project plan&lt;br&gt;• Supervise vendor(s)&lt;br&gt;• Provide overall project direction&lt;br&gt;• Direct/lead team members toward project objectives&lt;br&gt;• Handle problem resolution</td>
<td>Elhadi Elomda</td>
</tr>
<tr>
<td>Project Participants</td>
<td>• Communicate project goals&lt;br&gt;• Provide knowledge and recommendations&lt;br&gt;• Helps identify and remove project barriers&lt;br&gt;• Assure quality of products that will meet the project goals and objectives&lt;br&gt;• Identify risks and issues and help in resolutions</td>
<td>Murali Trikona, Josh and Elhadi</td>
</tr>
<tr>
<td>Subject Matter Experts</td>
<td>• Lend expertise and guidance as needed</td>
<td></td>
</tr>
</tbody>
</table>
IMPLEMENTATION RISK MANAGEMENT

Table 4: SOA Implementation Risks [8]

<table>
<thead>
<tr>
<th>Implementation Risks</th>
<th>Mitigation Strategy</th>
</tr>
</thead>
</table>
| Business Architecture Risks   | • Improper SOA implementation due to inflexibility of other IT policies  
                                • Business process inefficiency to QoS expectation mismatch |
| Application Architecture Risks | • Improper identification of business services               
                                • Improper implementation of business services               
                                • Inefficient handling of error scenarios                   |
| Information Architecture Risks | • Improper mapping of business object model to the physical data store |
| Technical Architecture Risks  | • Improper choice of ESB solution                            
                                • Improper implementation/configuration of ESB solution      
                                • Inefficient product/custom-built application integration   
                                • Risk related to inappropriate deployment strategy        |

Risks Management

- The Project Manager will ensure that team members are available as needed to complete project tasks and objectives
- The Project Plan will be executed in a timely manner (i.e., timely approval cycles and meeting when required)
- Changes to draft deliverables will be communicated effectively with respect to the project timeline to avoid delays
- Mother Theresa Hospitals will foster support and "buy-in" of project goals and objectives
- Management will support the existence of a technological infrastructure that can support the new SOA implementation project for patient care information system
- The EJM team will clearly define business goals and the scope of the SOA project to avoid SOA implementation risks [9]
### Table 5: Popular SOA Standards [10]

<table>
<thead>
<tr>
<th>Standard, Specification, API</th>
<th>Organization</th>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSRP (Web Services for Remote Portlets)</td>
<td>OASIS</td>
<td>Integration</td>
<td>Interfaces and semantics which standardize interactions with components.</td>
</tr>
<tr>
<td>WS-BPEL (Web services Business Process Execution Language)</td>
<td>OASIS</td>
<td>Orchestration</td>
<td>Enabling users to describe business process activities as Web services and define how they can be connected to accomplish specific tasks.</td>
</tr>
<tr>
<td>UDDI (Universal Description, Discovery, and Integration)</td>
<td>OASIS</td>
<td>Discovery</td>
<td>A platform-independent, XML-based registry for automated services to be discovered and defined.</td>
</tr>
<tr>
<td>SOAP (Simple Object Access Protocol)</td>
<td>W3C</td>
<td>Protocol</td>
<td>A protocol for exchanging XML-based messages over a computer network, normally using HTTP.</td>
</tr>
<tr>
<td>WS-I RSP (Reliable Secure Profile)</td>
<td>WS-I</td>
<td>Transactions</td>
<td>An interoperability profile dealing with secure, reliable messaging capabilities for Web services.</td>
</tr>
<tr>
<td>WSDL (Web services Definition Language)</td>
<td>W3C</td>
<td>Discovery</td>
<td>An XML format for describing network services as a set of endpoints operating on messages containing either document-oriented or procedure-oriented information.</td>
</tr>
<tr>
<td>XML (eXtensible Markup Language)</td>
<td>Protocol</td>
<td>A remote procedure call protocol which uses XML to encode its calls and HTTP as a transport mechanism.</td>
<td></td>
</tr>
<tr>
<td>WS-SEC (Web services Security)</td>
<td>OASIS</td>
<td>Security</td>
<td>Provides a means for applying security to Web services.</td>
</tr>
<tr>
<td>WS-TX (Web services Transaction)</td>
<td>OASIS</td>
<td>Transactions</td>
<td>Defining protocols for coordinating the outcome of distributed application actions.</td>
</tr>
</tbody>
</table>

**Acronyms:**
- **API** = Application Programming Interface and
- **OASIS** = Organization for the Advancement of Structured Information Systems

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**Figure 6**

**SOA Reference Architecture**

**Abbreviations:**
- **HIS** stands for Hospital Information System,
- **RIS** stands for Radiology Information System, and
- **PACS** is the abbreviation for Picture Archiving and Communication System.
SOA Disaster Recovery in case of a system failure, unplanned downtime, or natural disaster.

- SOA design will consider storage costs, network bandwidth, and hardware requirements.
- Hardware infrastructure design will include redundant Dell Servers with virtualization capabilities to store backups of critical patient, system, and service data.
- Offsite storage facility will be used to upload backups of system changes and data for additional redundancy and backup capabilities in the event of disaster. The offsite partner storage facility offers fast recovery from disaster and is monitored 24-7-365 by professionals to ensure constant uptime.

SOA Governance

- SOA governance focuses on the methods and processes around service identification, funding, ownership, design, implementation, deployment, reuse, discovery, access, monitoring, management, and retirement [13].
- The SOA governance life cycle is commonly referred to in four different phases include [14]:
  - **Design time**: refers to the defining and controlling of enterprise services to be created in the enterprise, and the creation of policies used to direct and control the implementation of the enterprise service life cycle.
  - **Deploy time**: involves the process of testing and controlling compliance to enterprise policies in order for services to be deployed in an SOA.
  - **Run time**: refers to the process of enforcing the adherence to run-time service policies at run time
  - **Change time**: involves managing services through the cycle of change. In a service life cycle, interfaces, service Policies, and agreements may be modified many times.
**IMPLEMETATION PHASES**

- **SOA Security**
  - Security for the patient care process and related services will be provided in 2 levels: hardware and software. Level 1 will include firewall security configured by the network experts at EJM SOA. Level 2 will include security provided by the Windows platform [6].
  - The SharePoint security context will be used to access components, services, and databases.
  - The user credentials are established via LDAP (Lightweight Directory Access Protocol) directories to serve data on individuals, system users, network devices, and systems over the network for e-mail clients, applications, and applications requiring authentication or information user impersonation.
  - Role-based security controls access to detailed patient information and enables more accurate treatment and faster response times, while at the same time protecting the patient's privacy and enforcing hospital and regulatory policies. This will be provided by Active Directory/Windows-based authentication.
  - InfoPath will provide form security allowing access to system resources and other components on a user's computer.
  - PKI (Public Key Infrastructure) mechanisms are employed to protect data during transmission.

**SOA Service Inventory**

- **SOA Service Modeling**
  - Service-orientation in the patient care system is achieved via Web services, BPEL processes, adapters, handlers, and lookups.
  - Web services are extensively used in the patient care system to send and receive XML messages (clinical forms), thereby enabling enterprise servers and components to interoperate with each other.
  - Patient data that is available elsewhere at the hospital is automatically accessible via web services that obtain data from databases. For example, extracting patient examination results is implemented using implicit online research.

- **SOA Business Process Modeling**
  - Set of graphical tools to create orchestrations by connecting a series of graphical shapes in a logical way.
  - Mapping component can be used to transform the source XML message to the new one.
  - Data from messages as well as the whole XML documents can be written in a database.
  - When all actions from orchestration finish, a message is sent to corresponding destination.
  - BizTalk Server will be used to drive business processes via its BPEL-based orchestrations.
ADDITIONAL INFORMATION

♦ Additions since last progress report
  – Reworking of deliverables and previous project conclusions
  – Project cost estimation (technology and standards, hardware/software, total costs)
  – Specific SOA implementation risks and strategy identified
  – Planning Phase
    • Reworking of reference architecture section with standards discussion
    • DR, Governance, Hardware and Server Configuration
  – Modeling and Design Phase
    • Security, Service Modeling, Business Process Modeling information

Thank You!

Any questions?
REFERENCES