Applying Business Process Modeling Notation (BPMN) in Healthcare

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Content

- In this tutorial the concepts of business processes are explained and business process modeling using the global standard notation BPMN (Business Process Modeling Notation) is introduced.
- The approach on how to identify services and design business processes based on Service Oriented Architecture (SOA) is explained.
- Concepts of data modeling related to business process and service modeling are introduced.
- A practical case study related to health care processes and integration of hospital information systems is given.
What is a Business Process?

Our organization produces products and services for our customers.

The products and services are results of our core business processes.

Support processes give support to the core processes.

Management processes govern the operation of the system.

The processes need information which can be processed by our applications which run on our infrastructure.
A definition of a Business Process

A business process or business method is a collection of related, structured activities or tasks that produce a specific service or product (serve a particular goal) for a particular customer or customers. It often can be visualized with a flowchart as a sequence of activities. (Wikipedia)
Types of processes and flows

- **Real process**
  - Flow of material, people, products, services etc.

- **Financial process**
  - Flow of money

- **Information flow**
  - Flow of data

- **Business process**
  - Flow of tasks and messages
Business processes within healthcare

- Clinical process
  - How the patient is treated
  - Diagnosis – treatment
  - Observations, tests, operations, medication
  - Executed by doctors: Give orders

- Nursing process
  - How the patient is taken care
  - Executed by nurses: Carry out orders

- Financial process
  - Collection of payments
  - The cashiers

- Scheduling process
  - Scheduling appointments
  - The assistants

- Patient record process
  - Doctors, Patients, other staff
A Model and an Instance of a Business Process

A Model of a business process describes how product and services are produced.

An Instance of a business process produces an uniquely identifiable product or service to an uniquely identifiable customer.

Business process modeling and information modeling go hand-in-hand.
Why model business processes?

If we want to improve how we do things we must first understand how we do things today!

- First we model as-is
- Then we look at the problems or opportunities for improvement
- Then we choose the most important improvements
- Then we model the to-be
Modeling business processes

How to model and represent business processes?

- Verbal, textual descriptions
- Visual diagrams
- Execution instructions

1. Starting with a customer placing an order
2. Send IT-based information to the warehouse
3. Stock picking
4. Packing and recording
5. Sending the appropriate IT-based information to the distribution hub
6. Sending IT-based information to the accounts department
7. Generation of an invoice
8. Allocation and organisation of shipment for the vehicle drivers
9. Delivery of the item and invoicing (the customer need fulfilled)
Business Process Modeling Notation (BPMN)

- BPMN is a graphical representation for specifying business processes in a workflow
- BPMN was developed by Business Process Management Initiative (BPMI)
- BPMN is currently maintained by the Object Management Group (OMG) since 2005
- BPMN 2.0 published recently
- Tool support: (62 listed)
  - Drawing tools
  - Repository based modeling tools
Level of Detail?

Level 1: Conceptual, Descriptive
Level 2: Logical, Analytical
Level 3: Physical, Executable

Business Process Redesign
- Effectiveness
  - To do the right things
- Efficiency
  - To do things right

![Zachman Framework](http://apps.adcom.uci.edu/EnterpriseArch/Zachman/zachman.jpg)

Zachman Institute for Framework Advancement - (810) 231-0531

http://apps.adcom.uci.edu/EnterpriseArch/Zachman/zachman.jpg
BPMN Elements

Business Process Modelling Notation

Gateways
- Data-based Exclusive Gateway
- Parallel Gateway
- Inclusive Gateway
- Event-based Exclusive Gateway
- Complex Gateway

Activities
- Task
- Multiple Instances
- Collapsed Subprocess
- Loop
- Ad-hoc Subprocesses
- Pool
- Sequence Flow
- Conditional Flow
- Default Flow
- Message Flow

Data
- Data Object
- Undirected Association
- Directed Association
- Bidirected Association

Events
- Start
- Intermediate
- End
- Catching
- Throwing
- Plain
- Message
- Timer
- Error
- Cancel
- Compensation
- Conditional
- Signal
- Multiple
- Link
- Terminate

Transaction
- Transaction

Documentation
- Group
- Text Annotation

Author: Christoph Hartmann
Web: http://www.acidum.de
Example: The Patient in the “Happy Hospital”

Business Process Steps
- Pay for the book, if you don’t have one
- Pay for the visit
- Choose the department
- Wait in the line
- Meet the doctor
- Go to the lab
- Pay for the test
- Give the sample
- Get the results form
- Wait in the line
- Meet the doctor again
- The doctor writes the observations and the medication in the book
- Pay for the medicine
- Get the medicine
Example: Hospital visit as a BPMN diagram

- Flow objects: Events, Tasks, Gateways
- Connecting Objects: Sequence Flow, Annotation
- Data Objects: Data and Documents in the Process
- Hiding details: Sub-Process
Hiding details: Sub-Process

Sub-Processes are used to hide and show necessary level of detail.
Participants in the processes

Participants

- Organizations or departments
  - The Hospital
  - The Pharmacy

- Roles of persons
  - The Patient
  - The Doctor
  - The Nurse
  - The Receptionist

How do we represent participants in the processes?
Participants: Swimlanes, Pools and Lanes

- A Pool represents a process of one participant
- A Pool can contain sub-partitions to show different roles within a participant

Correction: Assistant!
Processes within Pools

- A Business Process is always within one Pool
- The Patient Pool: White-Box pool
- The Hospital Pool: Black-Box Pool
- Participants and their processes can collaborate with each other. How?
Collaboration with messages between processes

- The participant’s processes can collaborate using messages
- Message flow always between pools
- Sequence flow always within a pool
The Core Process of an organization

Core Process characteristics
- The doctor’s process gives a service to the patient
- Volumes in Happy Hospital
  - 1000 visits/day
  - 600 beds
  - 10 000 employees
Business Process Modeling Method steps

1. Define Process Scope
2. Create the Top Level diagram for the Happy Path
3. Add top-level exception paths
4. Expand sub-processes to show detail at child level
5. Add intermediate message flows to external pools
Discovering the processes

- What are the core processes?
- What are the support processes?

- Service orientation
  - Support processes give services to the core processes
What to improve? Process Orientation

- Clinical Process?
- Scheduling Process?
- Financial Process?
- Pharmacy Process?
- Other Processes?
- Health Record Management Process?
  - As-Is: Health Records are written in the book owned by the patient
  - Problems: A book can be in one place only. Other problems...
How to improve? Service Orientation

- Business Processes are composed of business services
  - Examples: Payment service, Patient record service
- Business Services are reusable components which can be used in many business processes
- Business Services can be implemented using software components, often web services
- The Benefits of using reusable components
  - Cost savings: Build once, use many times
  - Time savings: Use ready components instead of building from scratch
  - Risk management: Using ready components helps to control the risks
A service can be a task, a sub-process or a process
From As-Is to To-Be process

- Discussion about services
  - How to identify services
  - SOA Principles

- How the processes and services could be identified
  - Data oriented services (patient record)
  - Function oriented services (laboratory)
  - Process oriented services (the doctors workstation)
  - Notification oriented services (do we have any?..)
The Patient Record and the Doctor

- The patient owns the book
Laboratory included as a business service

- The Laboratory orders and results are on a separate paper form
- The doctor receives the results
- The patient pays for the laboratory and receives the results
Ideas for improvement regarding Patient Health Record

- Electronic Health Record?
- Discussion and collection of improvement ideas
  - What problems it could solve?
    - The patient could forget the paper book at home or lose it
    - The doctor has a bad handwriting
    - The laboratory results and other documents are on separate papers
  - What other opportunities EHR would give
    - The hospitals could share the patient records
- Other requirements
  - Privacy, Confidentiality, Authenticity and other security aspects
  - Support to other processes: Scheduling, Financial, etc...
  - Availability, Usability, Performance
Electronic Health Record as a service

- EHR could store all the doctors' notes in a similar way as the patient record book.
- It could store also the lab results and other information.
- It could be accessible for the doctor and other professionals when needed.
- It could also be accessible within the hospital and also outside the hospital like regional level.

- It must guarantee the privacy, confidentiality and authenticity of the notes.

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How EHR service could be used?

- The doctor would start looking at the patient’s EHR
- The lab results would be collected into the EHR
- The doctor would write all notes into the EHR
- The patient would get a paper copy or could also look at the EHR
How EHR could be implemented?

Option 1
Stand alone system
How EHR could be implemented?

Option 2
An application service which would offer services to other applications.
Identifying Application Services

- EHR
  - Patient record management
- LIS
  - Laboratory order entry and results delivery
- Pharmacy system
  - Delivery of the medicine
- Doctor’s systems
  - Coordination of the collaboration
- The Patient
  - Collaboration with the professionals
Implementing services as web services

- **A service** consists of one or multiple operations
  - A Message Exchange Pattern (MEP) is related to an operation
  - **Request-Response** operation
    - A service receives a request message and sends a reply message
  - **Solicit-Response** operation
    - A service sends a request message and waits for a reply message
  - **One-way** operation
    - A service receives a message
  - **Notification** operation
    - A service sends a message
  - A fault message can be replied (Fault)

- Applies to any programming language
- Services are **synchronous** or **asynchronous**
Implementing services as web services

Service: Electronic Patient Record

- Operations and messages
  - EPRQuery
    - In: EPR-QueryMessage
    - Out: EPR-ReplyMessage
  - EPRStore
    - In: EPR-StoreMessage

- Web services are defined using web services definition language (WSDL)
The data model for the messages

- How do we define the messages in WSDL documents?
- We need a data model
- Transactional data
  - What happened
  - Encounter and Notes...
- Master Data
  - The “static data” that is referenced from the transactional data that describes business events
- Hospital, Department, Doctor, Patient, Encounter Type...
RIM (Reference Information Model) is a generic health care data model.

HL7 CDA (Clinical Document Architecture) is a RIM based standard for exchange of clinical records.

- **Who**
- **Where**
- **What**
A standard for clinical documents

- HL7 CDA (Clinical Document Architecture) is a RIM based standard for exchange of clinical records
- EHR service can have the CDA documents as the payload in the messages
Extending the local EHR into regional EHR

A Regional EHR service could help in data exchange between hospitals
Summary: How BPMN helps in improving the processes

- Modeling the As-Is business processes
- Identifying areas of improvement
- Discovering reusable business services
- Modeling the To-Be business processes
- Discovering web services
- Helping in implementation of the web services
Questions?

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