A Lightweight Approach for Designing Enterprise Architectures Using BPMN: an Application in Hospitals

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Summary

An Enterprise Architecture (EA) comprises different models at different levels of abstraction. Since existing EA design approaches, e.g. MDA, use UML for modeling, the design of the architecture becomes complex and time consuming. In this Article, we present an integrated and lightweight design approach for EA that uses a generic architecture and patterns, expressed in BPMN. The approach facilitates the modeling between the different levels. This has been applied in real cases in hospitals and other domains, demonstrating its feasibility and usability, reducing complexity and time for modeling.

Introduction

Companies using EA as a management method have found that different representations of processes are needed according to the level of detail that managers want to know. Based on the reported experience of many companies [12, 18] and our own experience with hundreds of redesign projects through the collaboration with industry [3, 4], the following levels of detail can be identified:

  I.   Process Architecture, which is a high-level representation for communicating to executives.

  II.   Business Design, which is based on the process representation of value chains for its presentation to process managers and business executives.

  III. Process Logic, which is a detailed representation of the process models for simulation and implementation for communicating to process specialists.

  IV.   IT Process Support which is the representation of the system supporting the execution of the processes for process and IT specialists.

Different modeling schemes and tools can be used for each of these levels for process analysis and design. For example, for Level I, we can use simple diagrams as the one that is part of the first level of SCOR [7] or eTOM [9]. Next, for Level II we can draw informal Porter Value Chain diagrams [15] or more formal IDEF0 models [8]. Then, for Level III, we can use BPMN [19] or EPC [16] for more detailed models. For Level IV, depending on the type of implementation, we can use alternatives such as UML, Workflow diagrams or BPMN for implementing the supporting software application into a process-aware information system. Therefore, differences and inconsistencies appear as the models are designed by using different modeling languages at the different levels. In this Article, we propose an integrative approach in which all the models are designed with BPMN and the process models are implemented in a BPMN-based system. We use a real case that is being developed in a hospital to exemplify our ideas.

Existing frameworks for designing Enterprise Architecture [14] use a similar approach to the one we propose. MDA [13] is based on UML for modeling the complete architecture, from business

requirements to software architecture for implementing the supporting system. Since UML is not broadly used at the business level, the modeling becomes complex for non UML experts and is hard to communicate to business executives. An analysis of a complex architecture, using MDA in combination with the Zachman Framework [20] has been developed to investigate this gap and to define a mapping between them with a three dimensional approach [17]. TOGAF is a comprehensive framework for designing an EA, based on a iterative life-cycle which architecture modeling method (ADM) using the Archimate language [12]. Although TOGAF does not force the use of Archimate, other modeling languages can be used, such as UML or possibly even combining ADM with MDA [5]. In practice, TOGAF is generic and it can be used for any company in any industry. Since TOGAF does not have any design pattern [6] for developing an architecture in a given domain, this process becomes complex and slow. In previous research [1, 3, 4], we have developed patterns for designing an Enterprise Architecture and processes in different industries such as healthcare. By using the patterns, the design process becomes faster than simply using a generic framework like TOGAF or MDA. In this Article, we present an EA design approach, which uses BPMN to model designs based on our patterns at the four levels in an integrative way. We concentrate on the Process Architecture, but other architectures such as the application, data and technical architectures are present in design levels Levels III and IV defined above. The remainder of this Article is as follows. Section 2 explains the problem solving approach. Section 3 describes the approach for designing an EA with BPMN in a hospital. Finally, Section 4 describes the conclusions to be drawn from this experience and future work.

Problem Solving Approach

In this Article, we propose a scheme that uses BPMN as a unique technique for designing and modeling all the four levels (I-IV) defined above. For this, we take the best of the different methods in which we have experience: Business Process Patterns (BPP) [1, 3] that are in line with the purpose of SCOR [7] or eTOM [9] but valid for different industries; BPMN modeling language, and process-aware information systems for implementing BPMN models. The key ideas of our approach are:

1. In order to drive modeling at all levels of detail, predefined general process patterns are used. The patterns, which are based on what we call macroprocesses, provide templates or general structures of activities and flows about how a process should be performed. Each macroprocess is itself, a layered normative structure of processes. A macroprocess gives, in several levels of detail, the processes, sub processes and activities plus the relationships that should be executed in order to produce a desired result.

2. Using these patterns, ad-hoc for different industries, the design or re-design process is accelerated.

3. We adopt a simple information flow representation and hierarchical decomposition of activities for gradually giving details of the process for Levels I and II, using some of the simplest BPMN constructs to represent levels I and II, for flow type models.

4. We maintain consistency and traceability with hierarchical decomposition: all the elements of any level should be details of an element at a higher level.

Other authors such as Freund and Rücker[10] have proposed the use of BPMN for process modeling; however,they concentrate only on Levels III and IV of our approach. They neithr consider the process architecture design of Level I by using frameworks as SCOR [7] or eTOM [9], nor do they address the business design of Level II by using Porter Value Chain or IDEF0 diagrams. Therefore, their approach lacks the strategic and business alignment for designing processes. According to the design guidelines of Hevner et al. [11], we propose an approach that produces an artifact that can be used by practitioners to provide solutions in a given domain. Our design domain is stated above and goes from strategy based process architectures to information

systems that support such processes. This problem is very relevant since most organizations deal with process and information system design on a piecemeal basis, without considering the integration that we propose.

Designing the EA with BPMN

We now explain how each level defined above is modeled for a hospital. To maintain a reasonable length for this Article, we have provided more details in [2].

Process Architecture Modeling (Level I)

We base the modeling of this level on general process architecture patterns reported in our previous research [1, 3, 4]. The patterns are based on the thesis that the architecture of any enterprise can be modeled by means of four general Business Process Patterns, which we call macroprocesses. In Figure 1, we show the resulting architecture for the domain of hospitals we are working with. From the architecture we select the macroprocess that is to be designed in detail, which is Service Lines to Patients, since the business goal in this case is to improve the service to patients and make better use of resources, which can be accomplished by designing this macroprocess. Such services lines or value chains are then detailed, by hierarchical decomposition.
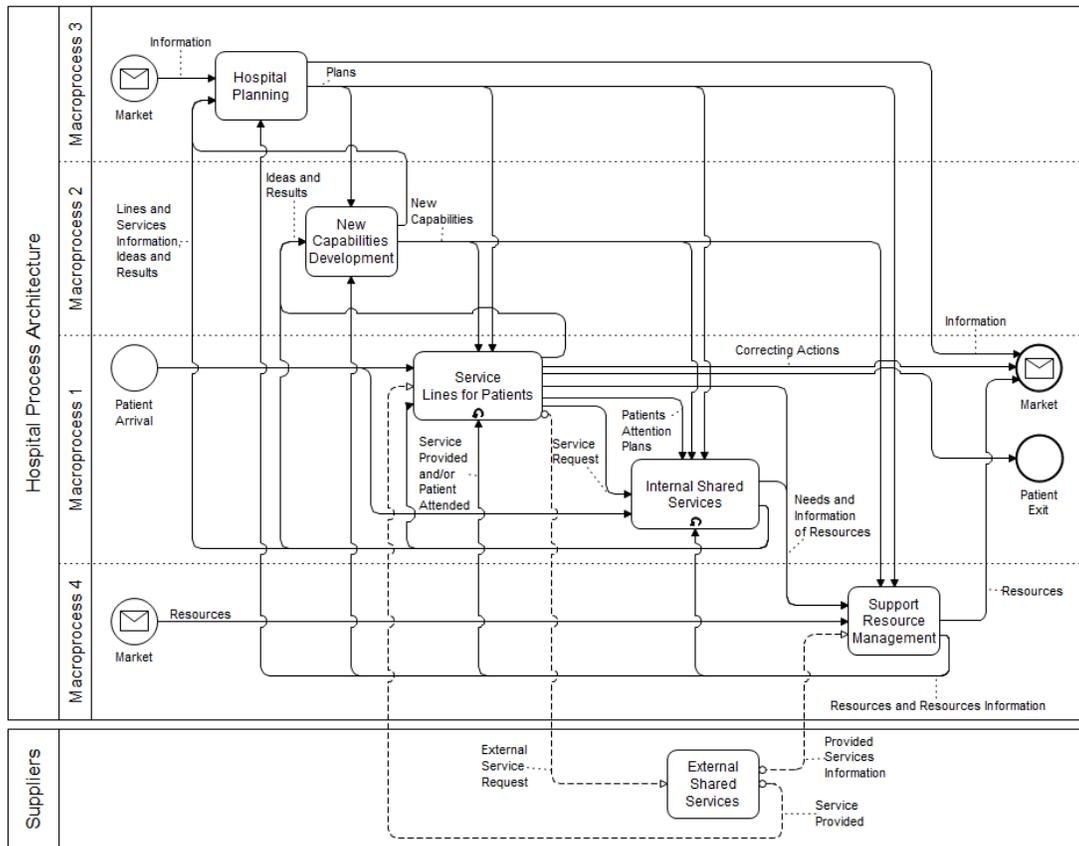

Figure 1: Process Architecture for Hospitals (Level I)

Business Design using Patterns (Level II)

The basic rule that we apply for designing at this level is to take the structure of processes provided by the architecture of the previous level and design each of its components by using the process pattern corresponding to the value chain. This provides a set of sub processes that are require execution.. Then, the components are specialized to accommodate the particular case; i.e. to establish how every sub process of the pattern is currently executed, if at all, and then evaluating technically and economically the feasibility of performing it according to what the pattern prescribes.

Process Logic Design (Level III)

The basic rule is that each of the sub processes designed at the previous level should be detailed in terms of who is responsible for each activity of the sub process, the business logic that will be executed by people or the information system and the workflow that establishes the relationships among activities. This should be consistent with the previous level in that all the functionality that a sub process provides at such level and the relationships it supports must be accommodated by the design. For our running example, we detail the BPMN model for the sub process Attendance Control shown in Figure 2. This tries to solve one important problem currently observed at a given hospital, which is that *20% of medical visits fail* because of patient absenteeism. Our goal is to improve the performance of the medical booking service to reduce the patient waiting list. This is done by introducing a logic that detects patients who are not likely not to show up and calling them in advance to find out if they plan to keep their appointment. This allows the staff to reassign liberated appointments to patients on the waiting list who otherwise would not receive attention.
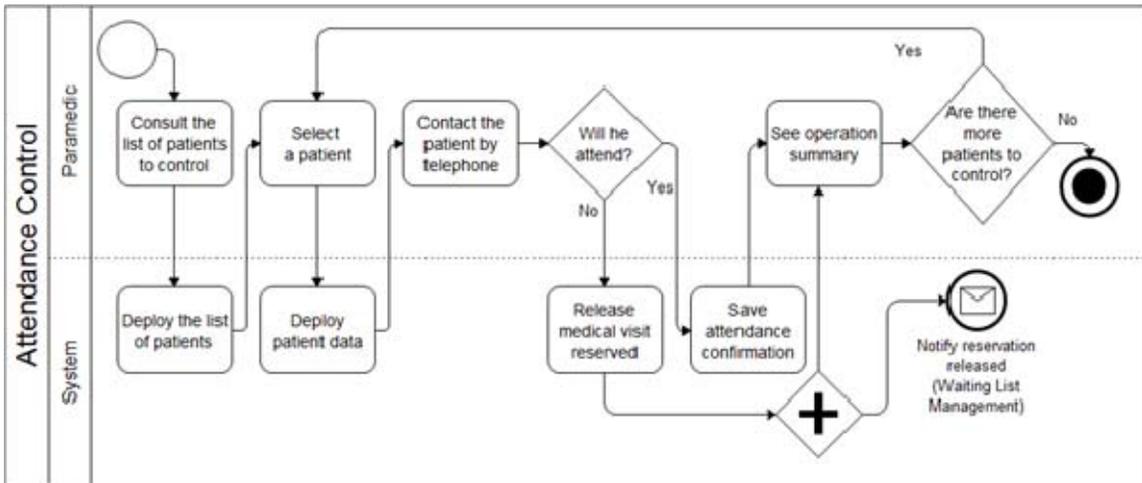

Figure 2: BPMN diagram for Attendance Control (Level III)

IT Process Support (Level IV)

We illustrate this level with the case in which we want to automatically generate the supporting system for the processes models in BPMN. The BonitaSoft system is used to demonstrate the easy implementation of the processes from the models designed in Level III.

Conclusions

All the steps performed from Level I through Level IV have taken just 4 weeks for implementing the processes in the prototype for our running example. This means that in this period we have designed the architecture of the hospital, developed the redesign of the critical processes, implemented the redesigned processes in the supporting system and communicated all the changes to the different stakeholders at every level (I-IV). Compared to other EA design approaches as Zachman [20], MDA [13] and TOGAF [12] that take longer and become complex due to the generic guidelines, our approach accelerates the design process of the EA by using process patterns and BPMN as the only modeling language. So, our approach represents an integrated and lightweight design process for an Enterprise Architecture. Although this is a preliminary result and may more success cases will be carried out, we have shown in a real case that indeed our approach is less complex, much easier to use and faster than existing approaches.

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