Technology Representation in *i** Modules

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Abstract. In current business practice an integrated approach to represent at the design level the technological infrastructure that gives support to business processes is needed. We argue that it is highly complex considering technology in terms of specific functionalities from the beginning because these functionalities depend on new business requirements produced continually by internal and external changes. However, business-technology integration has been largely neglected in the modeling of business processes, including *i** models, considering the technological components as highly abstract entities that do not require further description. In this paper, an overview of our approach to deal with technology representation in *i** business process models is presented, which focuses on the identification of quality attributes that are offered by specific technologies and the representation of these technologies using a particular class of *i** module. This approach has been explored in a previous work developing an example of a library in which an automatic identification technology is required to support some specific business processes.

Keywords: *i** framework, iStar, *i** modules, technology modeling, business processes, business services

1 Introduction

Nowadays, the use of technology is an important aspect for the implementation of efficient business processes, being the indispensable infrastructure for exchanging and persisting information among business actors. In this context, technology can improve the performance of business processes insofar as it is correctly adapted to the organizational context. However, the integration of business and technology at the design level is a current issue that applies both to general software solutions (like ERP systems) and technological infrastructures, such as Radio Frequency IDentification (RFID) or mobile technologies.

We consider that modeling business-technology integration is needed in software and business process design, because embedding technology in the organization can modify the workflow of business processes, and thus the manner in which the analysts should design the software system. However, one issue we found at developing such an integrated modeling technique, is the high complexity of considering technologies in terms of specific functionalities from the beginning. This is mainly because the number of functionalities and characteristics of technology to be handled can be very high, and the business requirements to which technology should provide support are continually modified by internal and external factors. A natural approach for overcoming this complexity is to rely on goals in the early stages of business and technology infrastructure design, rather than on detailed requirements, functionalities or quality models. We argue that because of its intentional nature, the *i** framework is suitable to be used as a basis for such approach, enabling the analysts to incorporate technological components in the definition of business processes, in order to better consider the possibilities to incorporate the technology at design level. Therefore, we propose a new business model that extends the capabilities of the service-oriented approach for the *i** framework defined in [1], considering technologies as a key element for effective operation of the organization and representing them within *i** modules [2], in order to provide a framework for analysis and design of strategies for integrating business and technology.

The proposed business model deals with technology in a more natural and convenient manner considering technology directly in relation to business requirements independently of their functional capabilities, by means of specifying its quality attributes. We applied this approach in a previous work to a library example [3], in which technology for the automatic identification of items (e.g., books) was required to support specific business processes.

2 Objective of the Research

The goal of this paper is to present an *i**-based approach for analysis and design of business processes, considering technology representation as a key modeling aspect of business process models. To achieve it, on one hand our work applies a service-oriented approach as a strategy for managing the complexity and size of *i** business process models [1], the intention for doing this is only to isolate each business process in order to focus on how a given technology may be applied to it, and to analyze contributions and dependencies that are generated when integrating the technology within a business process. On the other hand, our work uses a modular approach for describing technological entities in *i** modules [2], in terms of quality attributes offered, and conditions of operational environment required by technology functioning.

3 Scientific Contribution

The main contributions of our approach are: First, the definition of a framework for technology integration analysis and design based on its quality attributes. This framework describes how to model differentiation, compositional, refinement, and integration features of technology. And second, the integration of two approaches (services and modules) for incorporating modularity capabilities into *i** business process models at architectural and detailed modeling levels. In brief, we utilize an *i** service-oriented approach for modeling the global business architecture, and low level *i** modules for encapsulating the technology specification. Due to space limitations, in this paper we only focus on the first contribution, particularly on the specification of technologies using *i** modules; the reader is referred to our previous works to know the details of this approach.

Our approach include four types of information to specify technology to be included in business process models: a) *differentiation features*, which include information that makes a technology different from others and may serve to assess the usefulness of the technology in the organizational context; b) *compositional features*, which refer to the several components that a particular technology may be composed of; c) *refinement features*, which enable us to deal with the varieties of a given technology, derived from features of specific components of that technology; and d) *integration features*, which enable us to be aware of the requirements that technology is claiming and satisfying in regard to specific business processes. It is important to point out that this paper only focuses on the representation of technological aspects at the design level, and it does not present details about the development method associated to the framework.

The information describing a particular technology is modeled in a technology module. This allows us to create a portfolio of technologies which could be reused in several organizations according to their necessity. Therefore, our approach consists of defining which elements of the *i** metamodel are to be included in this type of modules to consider the features stated above. We use the *i** metamodel proposed in [2], which includes some classes for representing modules in a separate package from the *i** core metamodel (those classes represent the elements to be considered in the module definition), as described in [3]: a) a set of *properties* for representing quality attributes associated to quality characteristics of technology (e. g., efficiency, usability), covering differentiation features; b) a network of *actors* (named technology actors) connected by means of *is-part-of* and *is-a* links, which represents a technology and its basic internal components, covering compositional and refinement features; c) a set of *one-side incoming dependencies*, or *dependencies without depender*, entering into technology actors, which specify the functionalities, resources and behavior that the organization could obtain when using this technology (in particular, for those dependencies whose dependum is a softgoal, there must be a relationship among the softgoal and the quality attributes and their values, e.g. , a softgoal "information be encrypted" may correspond to the quality attribute "encryption algorithm" with value "MD5"); and d) a set of *one-side outgoing dependencies*, or *dependencies without dependee*, stemming from technology actors, which represent relevant external conditions required for the proper functioning of technology. Dimensions c) and d) of technology representation together are for covering integration features.

To sistematize the process of identifying the information to be included in a technology module with regard to *differentiation* and *composition*, the first step is to build a quality model as proposed in [4], which specify a hierarchy of technology characteristics, subcharacteristics, attributes and metrics. Some of this information wont be shown graphically, but will remain as the source of a technology module representation. Fig. 1 shows an example of a technology module for a RFID system,

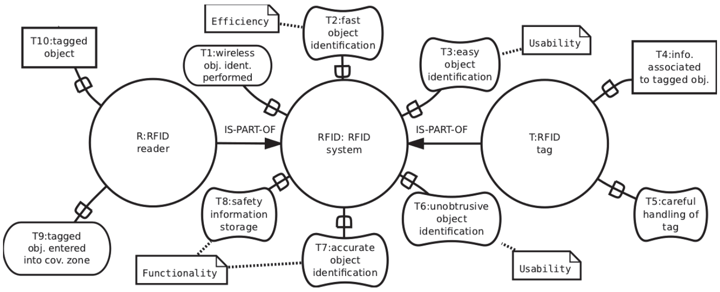

Fig. 1. Technology module of a generic RFID system.

annotated with the main quality characteristics specified in the quality model (not shown here) of this technology (functionality, usability, and efficiency) and specifying its quality attributes (`T1-T3`, `T6-T8`) and main components (`R` and `T`). Although in the graphical model is only shown limited information, in the quality model we specified more detailed information, such as the metrics upon which rests the statement of quality attributes. For example, for the attribute stated in softgoal `T2` we idenfied two metrics on which it depends: "speed of the tag response" and "maximum write/read distance of reader." It is convenient that the information to be specified in a technology module and in its underlying quality model is defined with the assistance of an expert, in order to identify the relevant general features and components of a technology, avoid to fail in excessive details or in the lack of meaningful information, and reduce the time required for the description of technology.

In relation to *refinement*, the second step is to define concrete types of technology to be effectively used in organizations. This is done by extending the base technology module into new modules that include new components and dependencies. For example, to specify a passive RFID, we can refine the general RFID technology module by adding it more specific features of passive tags. Fig. 2 depicts the technology module of a passive RFID system, to which we have added two new features: "efficient coverage in short area range" (`A1`), and "reliable functioning in interference environment" (`A2`). Elements (actors and links) from the base module within the refined ones appear in dotted lines as proposed in [5]. It is important to point out that defining more concrete types of technology involves the refinement of the initial quality model into new quality models, by adding new attributes or discarding some of the existent ones; for example, to the attribute `C2` of the active RFID system (Fig. 2) corresponds the addition of the new metrics "sensor integration," "real time location," and "processing capability."

Finally, concerning the *integration* features, the last step is to determine the correspondence among the offering features (incoming dependencies) of technology and its claiming requirements (outgoing dependencies) on one hand, and the business process requirements on the other, in order to obtain an integration model such as the one shown in [3]. Starting with the analysis of technology contributions to each business process, we can explore the way in which the technology features might correspond into business requirements captured in the business process model. Fig. 3 shows the analysis of some contributions of a passive RFID system to a checking-out

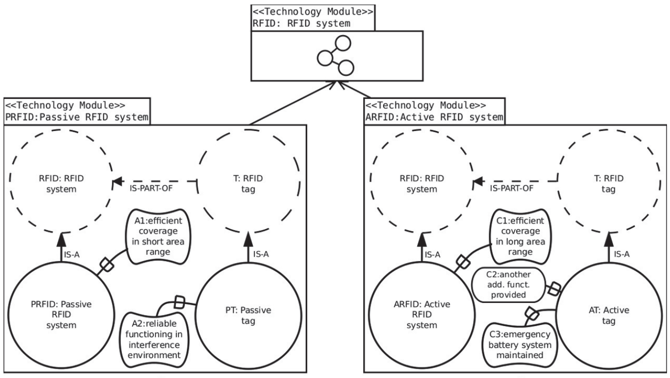

Fig. 2. Extending the base RFID module into passive and active RFID modules.

process of a library (an integration model obtained from this analysis has been presented in [3]). Thus, for example, we have that the attribute "fast object identification" (`T2`) of the passive RFID system (in fact, inherited from the general RFID module) has a correspondence with both "fast checking-out" (`D1.1`), required by library patrons, and "fast checking-out management," required by the library, at contributing positively to both of them. Continuing in this way the technology module application to each business process can enable us to think in a passive RFID system for a library.

4 Conclusions

In this paper we have presented an approach for modeling technology available for supporting business process. Our approach is based on the concept of module which allows us to create technology modules, i. e. , specifications of technological entities

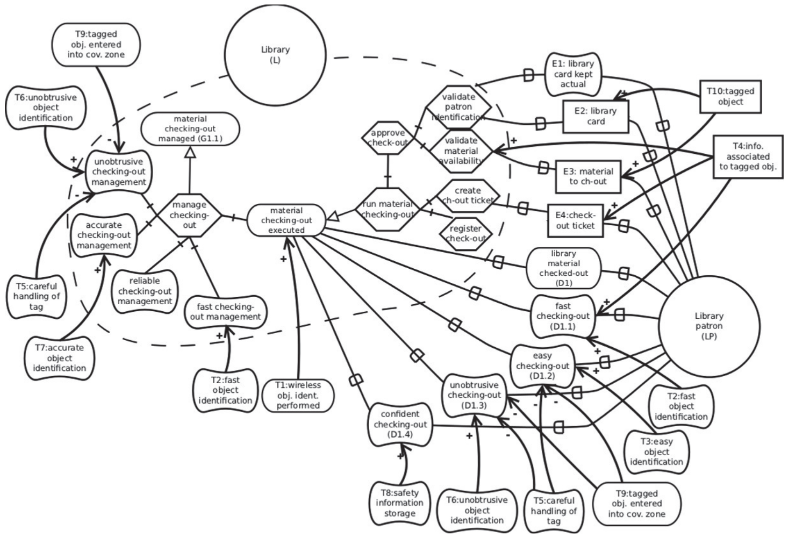

Fig. 3. Business-technology correspondence between passive RFID and checking-out process

that can be then integrated into several business processes by means of a correspondence analysis of technology features and business requirements. We have considered four types of information required to specify technology modules (differentiation, composition, refinement, and integration features). For the sake of brevity, we have described just an overview of the approach focusing on technology modeling and suggested the business-technology integration process allowed from this approach.

5 Ongoing and Future Work

Other relevant aspects of our current work are: to formalize the notion of integration using the concept of matching as introduced in [6]; to explore the possibility of adding adaptation strategies depending on the results of technology evaluation as done in [7]; to define a portfolio of patterns which describe the impact of technologies using some predefined roles (e.g. , technology provider, technology manager, etc.); to implement a support tool for concepts adopted (module, service, process, etc.); and to evaluate the approach developing a real case study.

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