Business Processes Modeling through Multi Level Activity Diagrams

Denis Del Villano[1], Gaetanino Paolone[2] and Paolino Di Felice[1]
[1] Department of Ingegneria Elettrica e dell'Informazione, University of L'Aquila, L'Aquila, Italy
[2] Gruppo SI S.c.a.r.l., Teramo, Italy

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Abstract: The usage of UML 2.0 activity diagrams at two different levels of abstraction is proposed to consolidate an already known business modeling approach for the development of large enterprise software applications. In this way a high continuity between the phases of business modeling and system modeling is obtained. Moreover, to keep a better control of the completeness of the business modeling artifacts, we recommend to fill out matrices that make explicit the link among business activities, business use cases and business objects involved in the automation of the information system.

1 INTRODUCTION

The RUP oriented and Use Case centred methodology described in (Paolone et al., 2008a; 2008b; 2009; 2010a; 2010b), currently under use within Gruppo S.I. (www.softwareindustriale.it), is appropriate for the modeling of enterprise information systems when the goal is to automate one of its subsystems. We borrowed such a modeling and development methodology to computerize workflows of a network of banks. The peculiarity of such a scenario is the existence, within the enterprise, of the underlying information system. This situation makes natural to carry out the business modeling phase (of subsystems) of the enterprise in terms of Business UCs and classes of Business Objects, as well as the description of the internal and external information flows.

The everyday experience teaches that, besides the automation of enterprise subsystems, often it arises the necessity of:

a) re-engineering (part of) the enterprise organization before proceeding to its automation in order, for instance, to either improve the information flows or to introduce process innovation;
b) designing from the beginning the information system of a new enterprise, before proceeding to its automation.

In both those situations, the just mentioned methodological approach presents shortcomings due to the fact that, being UC centred, it is not suitable for the representation of the processes. The goal of this paper is to suggest a way to strengthen such a modeling approach at the business level, so that it may become applicable with the same effectiveness also to the mentioned cases "a." and "b.".

Today, several notations for describing business processes are available: BPMN, Petri-nets, BPEL, UML Activity Diagrams, Data Flow Diagrams, etc. Among them, a leading position is held by BPMN (BPMN, 2012) to which, lately, came abreast UML (e.g., (UML, 2012; Johnston, 2004)).

Research has been done to formally compare the expressiveness of BPMN Business Process Diagrams against UML ADs with respect to their suitability to serve as a business processes modeling formalism (e.g., (Russel et al., 2006)). The final outcome was that those notations are basically equivalent. However, there is an important difference between them and it concerns the target users of the diagrams. BPMN Business Process Diagrams are more oriented to business stakeholders than to system ones, a category, this latter, equally important when the goal is to move from business modeling to system modeling. That's why, in this paper, we embrace the choice of UML as the common modeling language between business and technical stakeholders.

The present paper is organized as follows. Sec.2 recalls the basic elements of the methodology described in (Paolone et al., 2008a; 2008b; 2009; 2010a; 2010b) in order to provide the reader with the minimal background necessary to understand the present proposal. Sec.3 focuses on the proposal. Basic elements of the contribution concern the

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adoption of the UML 2.0 ADs to model, at two different levels of abstraction, the business processes of the system to be computerized, and what we call *correspondence* matrices, offering a global view of *all* the underlying business activities, BUCs, BUC realizations and BOs being part of the artifacts carried out during the business modeling. Sec.4 touches on an example helpful to instantiate the ideas sketched in Sec.3.

2 THE BACKGROUND

The final goal of the research described in (Paolone et al., 2008a; 2008b; 2009; 2010a; 2010b) is to define a UC centred methodology, together with a supporting developing tool, ensuring the continuity between business modeling, system modeling, design, and implementation according to the model-driven paradigm. Their method is structured into four distinct phases (Fig.1).

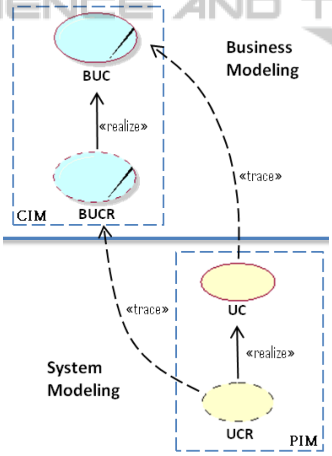

Figure 1: A sketch of the four methodological phases.

The first two phases concern business modeling, while the remaining two concern system modeling. The business modeling activity starts from the detection of the organization units involved in the IT project, then it proceeds to the discovery of their Business Systems. Inside every BS, we identify Business UCs and BUC Realizations.

During system analysis, a double trace operation is accomplished (Fig.1) to map to the system perspective BUCs and BUCRs, which become the SUCs and SUCRs, respectively. The logic behind the trace remains unaltered with respect to the classical RUP: in the system view, only the UCs that will be automated will be taken into consideration.

3 THE PROPOSAL

If the business analyst can rely on an existing and well designed information system, then he has to analyze the working context and proceed to the discovery of the BOs and the BUCs. But, if he has to either design or re-engineer the business (points “a.” and “b.” of Sec.1.), then he has to proceed differently. In fact, in those cases, it is necessary to make use of UML constructs suitable to represent the information flows, the business processes, and the relationships existing among them, as well. To extend the usability of the methodology by Paolone and his colleagues to those situations, we propose to model the business processes of the system to be computerized in terms of UML ADs used at two different levels of abstraction. Hereinafter, we discuss such two modeling levels, in sequence.

At the initial stage of the business modeling, by means of the ADs it is possible to define the business processes and, hence, the information flows of the system to be computerized, whether it exists, or it has to be re-engineered in some of its subsystems, or it has to be developed from scratch. Each business process can be modeled in terms of one or more ADs.

The business modeling of real systems brings to the construction of manifold artifacts collecting business activities, BUCs and BOs. As their number and complexity increase, it becomes difficult to keep a global view of the project progress. This increases the risk that the completeness in the identification of the "elements" composing them cannot be reached. We managed the complexity by collecting in a matrix of dimension nxm (hereinafter called BActivity-BUC correspondence matrix - C1) *all* the business activities, BUCs and BOs part of the artifacts carried out, as soon as they are accomplished.

Matrix C1 collects the business activities (the rows) and the BUCs (the columns): to carry out 1 business activity it may require from 1 to m BUCs, while 1 BUC concurs in the achievement of 1 to n activities. The generic element of C1 denotes the set of BOs involved in the BUC_j in connection with the $BActivity_i$, that is:

$$C1[BActivity_i, BUC_j]=\{BO_1, BO_2,\ldots, BO_k\}.$$

If BUC_j is not involved in the $BActivity_i$, then such a set is empty. A BO may be involved in several BUCs. Fig.2 shows an example.

C1=

	BUC_0	BUC_1	BUC_2
$BActivity_0$	$\{BO_1, BO_2\}$		
$BActivity_1$		$\{BO_1, BO_3\}$	$\{BO_2, BO_3\}$

Figure 2: An instance of matrix C1.

Real life projects emphasized the usefulness to complement the narrative specification of "complex" BUCs (i.e., those that give rise to at least three BUCRs) in order to formally detail the logic of the underlying process in terms of atomic actions. For each detailed process, it may be necessary up to n ADs.

For each BUC, we suggest to fill in a *DActivity-BUCR correspondence* matrix (C2) - same reasons as for C1 - (where DActivity stands for Detailed Activity, that is an activity that denotes elementary business operations. Examples are given in Sec.4) of dimension pxq among the detailed activities (the rows) and the BUCRs (the columns) that realize the selected BUC: to carry out 1 detailed activity it may require from 1 to q BUCRs, while 1 BUCR concurs in the achievement of 1 to p detailed activities. The generic element of C2 denotes the set of BOs involved in the $BUCR_j$ in connection with the $DActivity_i$, that is:

$C2[DActivity_i, BUCR_j]=\{BO_1, BO_2,\ldots, BO_h\}$.

If $BUCR_j$ is not involved in the $DActivity_i$, then such a set is empty. A BO may be involved in several BUCRs. Fig.3 shows an example.

C2 =

	$BUCR_0$	$BUCR_1$	$BUCR_2$
$DActivity_0$	$\{BO_2\}$		$\{BO_2, BO_3\}$
$DActivity_1$		$\{BO_1, BO_4\}$	

Figure 3: An instance of matrix C2 for a generic BUC.

Matrices C2, referring to an abstraction level lower than that of C1, may accommodate additional BOs with respect to those listed in C1. In the examples of Fig.2 and Fig.3, BO_4 is the extra BO that arises.

4 A REAL-LIFE EXAMPLE

The business and system modeling approach of Sec.2, and integrated with ADs (Sec.3), was applied to the design of a documentary management system for the BCC of Vomano bank, part of the Central Institute of Rural and Artisan Banks circuit.

At the initial stage of the business analysis, we carried out, in close collaboration with the bank top management, the definition of the corporate information system. 7 BSs were detected and analyzed: in the example discussed hereinafter, we focus on one of them: the BS `DocumentaryManagement`. The BCC bank adheres to the Green Economy vision. To design an information system oriented to the Green Banking it is mandatory to adopt a documentary management system allowing to reset the circulation of paper-based documents within the bank.

For each identified BS, the pertinent business processes were enucleated and modeled through high level of abstraction UML ADs (Sec.3). In this section, we will refer to the business process `DocumentDematerialization` of the `DocumentaryManagement` BS. Fig.4 shows the corresponding AD that describes the logic of such a business process in terms of a certain number of not-atomic actions. The `DocumentAcquisition` activity, for instance, denotes the set of atomic actions needed to file a document in the system.

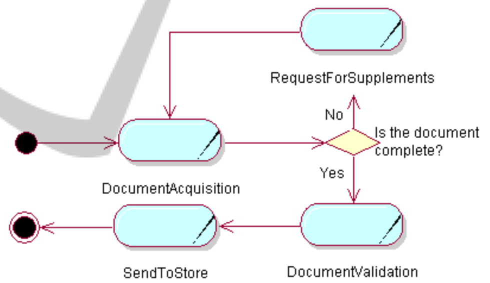

Figure 4: An AD at a high level of abstraction.

For the 7 BSs of the BCC of Vomano, 22 BUCs were detected and 15 high level of abstraction ADs were realized. Fig.5 shows the portion of matrix C1 concerning the 4 business activities of Fig.4 and the pertinent BUCs. Those BUCs are part of the business UC model (Johnston, 2004) not shown here because of space limits. Among the listed BUCs, the most complex is `DocumentAcquisition` realized by 5 BUCRs (Fig.6). The narrative specification of the `DocumentAcquisition` BUC was complemented by 4 detailed ADs, each modeling the detailed logic of the BUC in terms of atomic actions. Two of them are shown in Fig.7, where, for instance, the `Document'sTemplateSelection` represents an atomic action. Fig.8 shows the portion of C2 regarding the ADs of Fig.7.

C1=

	Document Acquisition	Document Visualization	Document Validation	Document Approval	Document Archiving
Document Acquisition	{Document}	{Document}			
Request For Supplements	{Document, Business Area}	{Document, Business Area}	{Document, Business Area}		
Document Validation	{Document, Business Area}	{Document, Business Area}	{Document, Business Area, Document'sType }	{Document, Business Area, Document'sType}	
SendToStore					{Document}

Figure 5: A partial instance of the BActivity-BUC correspondence matrix (C1).

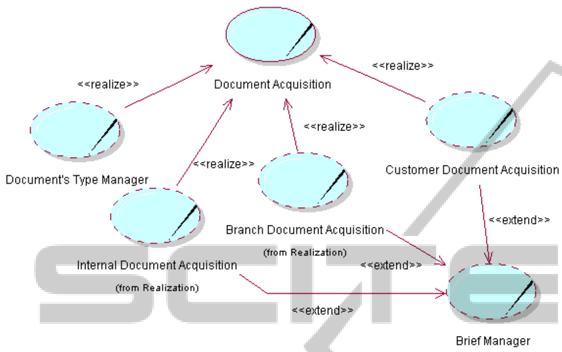

Figure 6: **`DocumentAcquisition`** realization diagram.

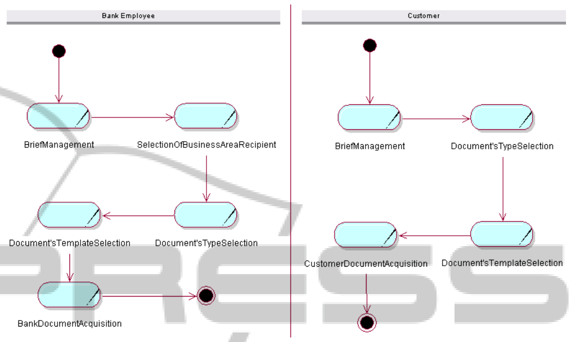

Figure 7: Two detailed ADs.

C2=

	Document's Type Manager	Customer Document Acquisition	Branch Document Acquisition	Internal Document Acquisition	Brief Manager
Customer Document Acquisition		{Document}			{Document, Attachment}
Bank Document Acquisition				{Document}	{Document, Attachment}
Brief Management					{Document, Attachment}
Selection Of Business Area Recipient			{BusinessArea}	{BusinessArea}	
Document's Type Selection	{Document'sType }				
Document's Template Selection	{Document'sType, Document'sTemplate, Product, Service, Rules}				

Figure 8: A partial instance of the DActivity-BUCR correspondence matrix (C2).

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