The Value of Roles in Modeling Business Processes

Pavel Balabko[1], Alain Wegmann[1] Alain Ruppen[2], Nicolas Clément[2]

[1]Systemic Modeling Laboratory (LAMS), IC-EPFL, Lausanne, Switzerland
pavel.balabko@epfl.ch; alain.wegmann@epfl.ch

[2] alain.ruppen@bluewin.ch; nicolas@famille-clement.ch

Abstract. Rapid business changes require companies to make rapid changes in business processes and ultimately in BPS systems. These changes can be done rapidly if business modelers understand the base roles of business processes and relationships between these roles. In this paper we present an alternative to the traditional business processes modeling approaches. In our approach we make explicit roles present in business processes. This facilitates business process reengineering and improves the alignment between business and supporting systems.

1 Introduction

Today the business environment of modern companies rapidly changes due to the regulatory, technical or social changes. To understand and correctly react to these changes business process modeling is used. However, building models for complex business processes is difficult. It is difficult to collect and understand the information about all business processes in a company. It is difficult to discover relations between the processes. Some important processes may be missing and or misinterpreted. This results in incorrect models.

Modeling a complex business process is difficult because the model usually mix the knowledge that belongs to different participants of the business process: it represents the synthetic view of a super-observer that observes interactions of different participants. Frequently, explaining why the business process is modeled in a certain way is done with goals. However, the overall goal of the business process can be difficult to understand because the business process may include many different roles played by different participants with their own goals. Therefore, we propose to represent the business process as the composition of roles. This helps a modeler to understand the objectives (they can be modeled with Actor Dependency diagrams, see [9]) of each participant and helps to explain why the business process is modeled in a certain way. Furthermore, modeling with roles makes easier the modifications of business process models when changes happen in roles as results of regulatory, technical, or social changes in the business environment of a company.

In our modeling approach we represent a business process as the collaboration of roles (a dashed oval), see Figure 1. In this work we understand roles as the crafts of business process participants, i.e. we consider roles as the knowledge of the specialists that participate in the business process. We represent a role with a rectangle that includes a set of actions, sequential constraints between them, tools and materials that a specialist needs in his craft to perform the actions. We represent physical objects with cubes. Physical objects can be: a company, facilities, tools or materials.

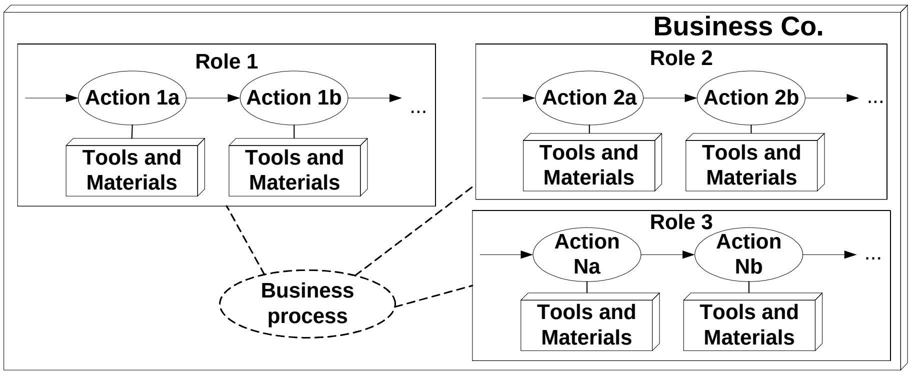

Fig. 1. Business process representation in our approach

There are several process modeling techniques based on role modeling. Three of them seem to be the most important: RIN – Role Interaction Networks [6], RAD – Role Activity Diagram [5] and OORAM – the Object-Oriented Role Analysis Method [7]. These three techniques are quite similar. Roles are considered as sets of sequentially ordered actions and/or interactions. The main difference of these three mentioned modeling techniques with our approach is that we represent explicitly physical objects that a role needs to execute its actions [8], [2]. The other modeling techniques represent only the information about roles in the form of attributes or concepts.

The main contribution of this paper is practical rather than theoretical. We claim that our approach improves the understandability of business process models. Thinking in terms of roles helps a modeler to understand crafts of business process participants and to see how these crafts are related in the business process.

To illustrate the practical impact of our approach we based or paper on the existing example of a manufacturing process in Pharma Co., a pharmaceutical company. This company needed to introduce MES (Manufacturing Execution System) to ensure the order of the manufacturing process. The goal of the “MES” project was to formalize the manufacturing process that will be controlled by MES. In this project our method was used for ensure the correct understanding of the manufacturing process by a modeler and to ensure that the model of the manufacturing process correctly reflects the viewpoint of all participants in this process.

In Section 2.1 we give an overview of the manufacturing process of Pharma Co. In Section 2.2 we present base roles of this process and explain the composition of these roles in section 2.3. Section 3 is the conclusion.

2 Pharma Co. Manufacturing Process Modeling with Roles

The manufacturing process of Pharma Co. consists of two parts. First, bulks of medicines are manufactured. Second, these bulks are filled in bottles or tubes and then packed. In our paper we take an example of a manufacturing process from the first part.

2.1 Example of a Manufacturing Process

Figure 2 shows the model of a process that specifies the manufacturing a bulk of medicine (or products). This model is used by the operator of the manufacturing process who is responsible for the execution of all actions in this process. This model is based on the internal notation developed in Pharma Co. and inspired by IDEF [3] and UML Activity Diagrams [4]. It consists of blocks representing actions of a manufacturing process.

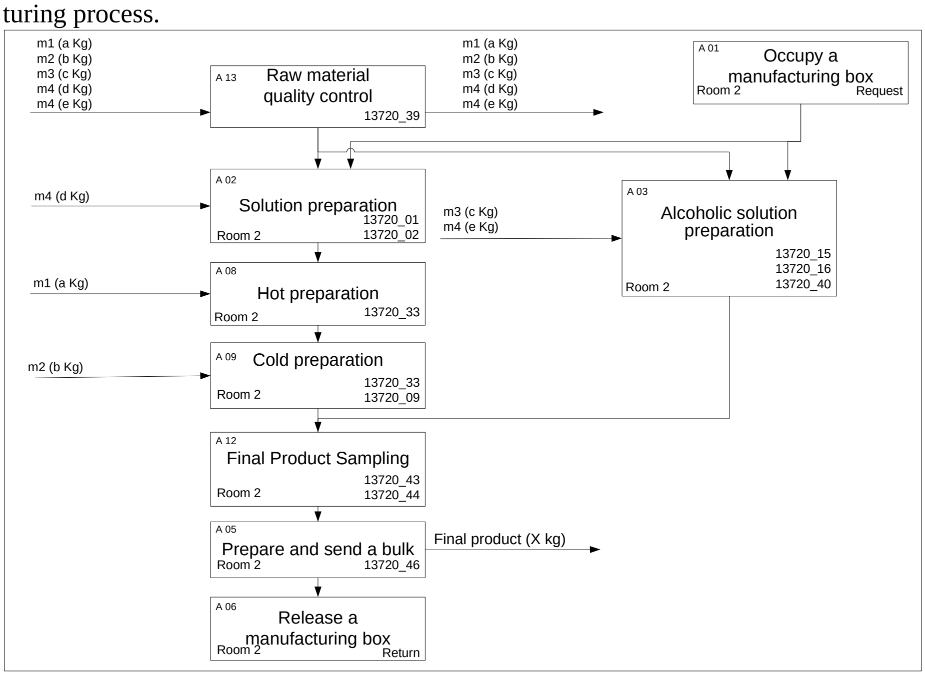

Fig. 2. The model of the manufacturing process in Pharma Co

Each block contains the following information about the corresponding action:

- Action name and description (in the center of the block);
- Identifier of the action (upper-left corner);
- A manufacturing room in which the action is executed (lower-left corner);
- Identifiers of sub-processes: these identifiers link each block to more detailed sub-processes specified in a similar way.

Blocks have also incoming and outgoing arrows that represent:

- Horizontal incoming: consumed products (names and quantities of products are given above arrows);
- Horizontal outgoing: created products (names and quantities of products are given above arrows);
- Vertical incoming and outgoing: sequential constraints between actions that specify the sequence of actions. Note that actions can be executed in parallel, for example, the “Solution preparation” and “Alcoholic solution preparation” actions are executed in parallel after the “Raw material control” action.

Based on this notation we can see that the operator of the manufacturing process has to occupy a manufacturing room, get raw materials, complete the quality control of these materials and then manufacture a final product. To finalize the manufacturing process, the operator has to complete the quality control by sampling the product (then samples would be analyzed by the quality control department).

In the following section we explain how this manufacturing process can be specified as the composition of roles (we call them “base roles”), where each base role represents a view of a certain engineer of the Pharma Co. company.

2.2 Base Roles of a Manufacturing Process

The manufacturing process from the previous section can be decomposed in four base roles: raw material provider, product manufacturing, bulk preparation and QC roles (see Figure 3). These four roles are performed by a manufacturing operator who manufactures a final product from raw materials using tools from a manufacturing floor.

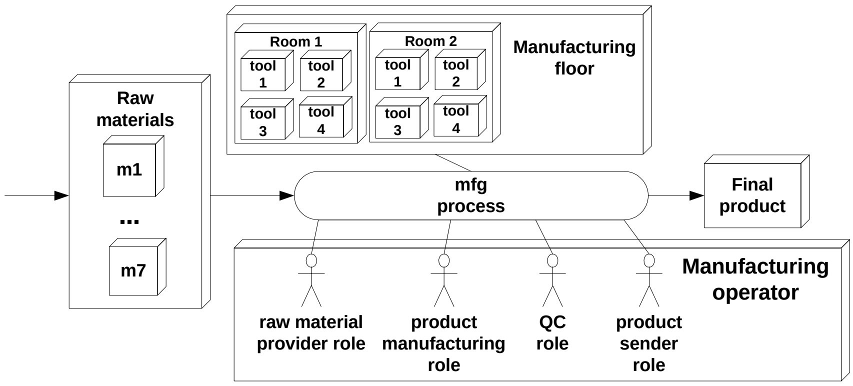

Fig. 3. Manufacturing process

In the following sections we present each role and explain how the composition of these roles can be done.

Product Manufacturing Role. The Product Manufacturing Role is the core role of the manufacturing process that specifies how a Final Product is created from raw materials (see figure 4). In this role four actions consume raw materials. We indicate this by changing the multiplicity of raw materials (mX objects) from one to zero ($1 \rightarrow 0$)

and with arrows that comes from consumed materials to the corresponding actions. The "Mix" action results in the creation of the Final Product. We indicate this by changing the multiplicity of the Final Product from zero to one (0→1) and with the arrow that comes from this action to the Final Product. The model from Figure 4 also specifies tools that are used in the manufacturing process. For example, Tool 2 is used in the "Alcoholic solution preparation". Tool 1 is used in all other actions.

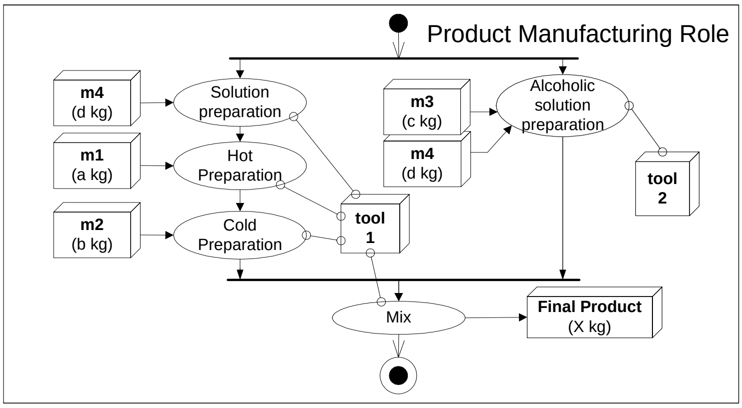

Fig. 4. Product Manufacturing Role

Process Interface Roles. The *raw material provider* role defines the action of receiving raw materials from a warehouse. The result of this action is that multiple raw materials become available. We indicate this in Figure 5.a by changing the multiplicity of materials (m*X*) from zero to multiple (0→*) and with the arrow that comes from the "mX" object to the "Get raw materials" action. The *product sender* role defines the "Prepare and send a final product" action. We indicate that the product was send by changing its multiplicity (1→0).

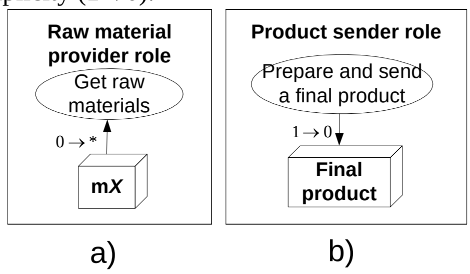

Fig. 5. Roles of a Manufacturing Process: a) Raw material provider; b) Product sender role

Quality Control Role. The *QC* (quality control) *role* specifies two quality control actions. First one is used for the control of raw materials before the manufacturing process (raw materials change state from unchecked to checked, see Figure 6). Second one is used for the control of the manufactured product after the manufacturing process (sampling the manufactured product).

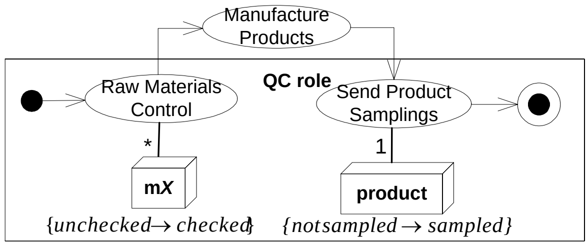

Fig. 6. Quality control roles

Manufacturing Floor Role. The main idea of the manufacturing floor role (see Figure 6) is to specify states of the manufacturing floor rooms. The manufacturing floor role changes its state from "clean" to "occupied" in the Occupy action and from "occupied" to "dirty" in the Release action.

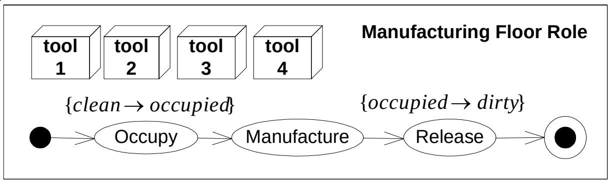

Fig. 7. Manufacturing floor role

2.3 Composition

In this section we explain how the upper mentioned roles are composed together. The composition is done by means of *composition constraints:* constraints implied on the behavior of roles to be composed. Composition constraints show how the composed roles are related to each other. There are different types of composition constraints [1]. In our work we use only two types:

- **Constraints of sequentiality:** define the sequence of actions of roles to be composed. For example, in Figure 8 the "Get raw materials" action (Raw material provider role) precedes the "Raw materials control" action (QC role).
- **Identity constraints**: two model elements are identical if they represent the same entity in the reality perceived by modelers (see [1]). For example, raw materials received in the "Get raw material action" are identical with materials to be checked by the "Raw material control" action.

Note that in Figure 8 we show all constraints of sequentiality (we represent them with dotted arrows between constrained actions) and only some identity constraints related mainly to the QC role (we represent them with dashed lines between identical objects).

The business process model specified with roles from Figure 8 is similar with the process from Figure 2 with the difference that tools (Tool1 and Tool2) are not shown explicitly in Figure 2. In Figure 2 these tools are specified in sub-processes of the main process.

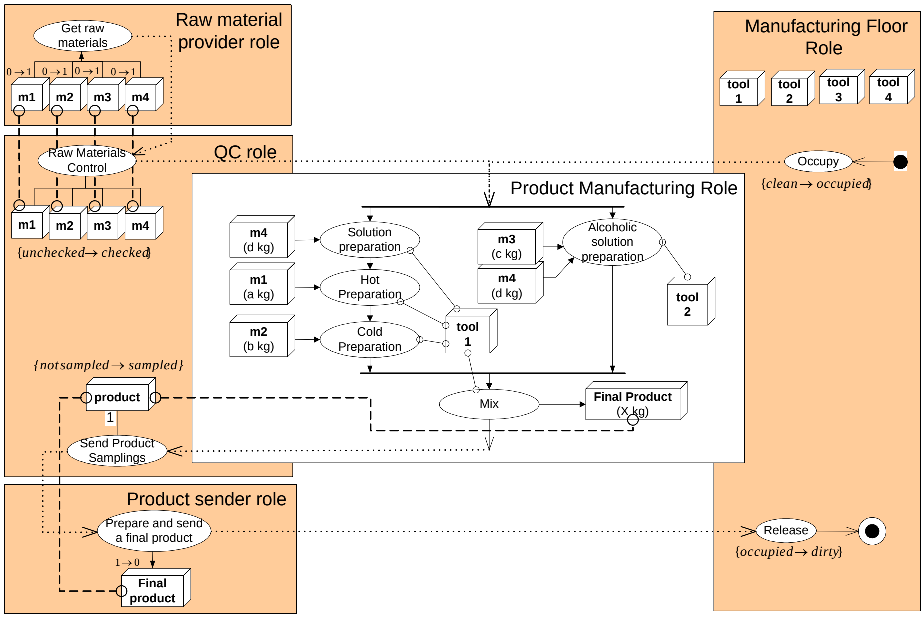

Fig. 8. Manufacturing process as a composition of base roles

3 Conclusion

Up to this point we explained how a manufacturing process can be specified as the composition of multiple roles. However, we did not explain why we decided to take the four upper mentioned roles. The main reason for this is that each role is a view of a certain specialist (engineer, see Figure 9):

- *Product manufacturing role* is the view of a *manufacturing process engineer*: It is defined based on a pharmaceutical formula and the available manufacturing tools.
- *Raw material provider* and *product sender roles* are the views of a *logistic engineer*. They specify the distribution of raw materials and manufactured products.
- *Manufacturing tools* are the views of a *manufacturing tools engineer*: This role specifies manufacturing tools to be used in the manufacturing process.
- *QC role* is the view of a *QA (quality assurance) engineer*: This role specifies quality control actions in the manufacturing process.

Our model of the manufacturing process makes explicit the views of different engineers (Figure 9) and the way these views are composed in one model. This improves the overall understanding of a process: it becomes clear why the process is specified in certain way. Every role can be separately discussed with a specific engineer. The design decisions about the composition of these roles are made explicit. This makes easier to reengineer a process in a changing business environment: if a certain role of a process has to be changed as a result of a regulatory, technical, or social change then it becomes easier to see how this change will be reflected in the whole process. For example, the QC role is very sensitive to regulatory and techno-

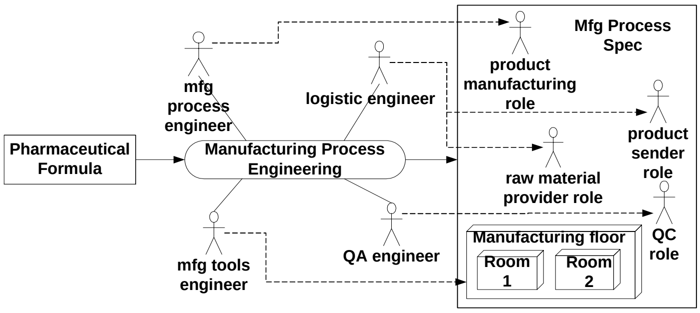

Fig. 9. Manufacturing process engineering and its artifacts

logical changes. If the FDA (American Food and Drug Administration) changes its regulation and requires some verification to be made during the manufacturing process, the process will need to be changed to maintain the fit with FDA. Similarly, if a technological change enables the company to perform automatic quality control where the manual control is done today, the process has to reflect this change. Furthermore, the QA engineer must always check for new technologies that can improve the QC. The QC role can be used to specify what needs to be checked to maintain the quality control actions (regulatory or technical changes). This example shows that our approach can be used to maintain the fit between the business process and its environment by means for tracking changes in the environment on the per role bases.

The drawback of our method is that it requires a lot of the "paper" work without an appropriate case-tool. The diagram that represents the result of the composition (Figure 2) should be automatically generated from the diagram with base roles and composition constraints (Figure 8). However, without the tool this work should be done manually. This consumes time, introduces "copy paste" mistakes and inconsistencies.

References

1. Balabko, P., Wegmann, A., "A Synthesis of Business Role Models", Proc. of ICEIS conference, Anger, France, (2003)
2. Balabko P., A. Wegmann, "Context Based Reasoning in Business Process Models", Proceedings of IEEE IRI`03, Las Vegas, USA, (2003)
3. NIST, "IDEFØ - standard for Function Modeling in FIPS Publication 183", NIST, (1993), retrieved from http://www.idef.com/idef0.html on March 20, 2004
4. OMG, "OMG Unified Modeling Language Specification, v 1.3," Version 1.3, ed, (1999).
5. Ould M. A., Business Processes: Modeling and analysis for re-engineering and improvement, John Wiley & Sons, (1995)
6. Singh, B. & Rein, G.L., "Role Interaction Nets (RINs): A Process Description Formalism", MCC, (1992)
7. Reenskaug T., "Working With Objects: The OOram Software Engineering Method", 1996 ed: Manning Publication Co., (1996)
8. Wegmann A., "The Systemic Enterprise Architecture Methodology (SEAM)", Proc. ICEIS conference, Anger, France, (2003)
9. Yu, E., and Mylopoulos, J. "Using Goals, Rules and Methods to Support Reasoning in Business Process Reengineering," Proc. Int. Conf. System Sciences, Hawaii, pp. 234-243, (1994)