Formalization or Flexibility? Some lessons from a socio-technical analysis of business process modeling

João Porto de Albuquerque[1]*, **Marcel Christ**[1]

[1]University of Hamburg, Department of Informatics
Vogt-Kölln-Str. 30, D-22527 Hamburg

{porto, christ}@informatik.uni-hamburg.de

Abstract. *In order to achieve quality in software development processes, it has been argued that one must not only rely upon rigorous descriptions of processes that consolidate past experience, but also maintain flexibility in responding to new, unexpected situations. Reconciling these two requirements is not a trivial task, and we propose that it requires a socio-technical perspective of the relationship between process models and the practices of development and use of those artifacts. In the pursuit of this goal, this paper presents an empirical study of business process modeling sessions within an aircraft maintenance company. The analysis is performed in dialogue with works on actor-network theory.*

1. Introduction

The improvement of the quality of software development processes is frequently searched through a formal definition of the practices involved. As expressed in the well-known *Capability Maturity Model Integration* (CMMI), a rigorous process description should clearly state its "purpose, inputs, entry criteria, activities, roles, measures, verification steps, outputs, and exit criteria" [CMMI 2006, p.35]. In this way, formal process descriptions combined with efforts to quantitative measurement and continuous optimization of processes are regarded as key factors to process improvement[1].

However, while compliance with formal process descriptions would lead to more predictability about characteristics of products and services yielded (and the associated resources required), a "blind" attachment to previous ways of working is harmful to the process flexibility, diminishing responsiveness to new, unexpected situations. Indeed, research on management and organization studies have controversially debated the trope *organizational flexibility* in the last years [Lee and Hassard 1999, Tienari and Tainio 1999], with the common claim that organizational form cannot be fixed, but is rather an emergent property of relationships, such that "we must allow [organizational] form to change at a moment's notice" [Lee and Hassard 1999, p.401]. In the field of software development, there has been recently great attention to agile development techniques [Cockburn 2002] that strive to give flexibility to software development by employing *light-weight* methods and rather informal processes with focus on "the use of light-but-sufficient rules of project behavior and the use of human- and communication-oriented rules"[Cockburn 2002, p.8].

Could we combine these two requirements (namely formalization of processes and flexibility) in order to improve quality of software development processes? Or are they

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[1]As reflected by the capability and maturity levels of CMMI [CMMI 2006, pp.32–38].

contradictory, even mutually exclusive? From the viewpoint of the process definition, combining the two types of requirements above would imply elaborating process descriptions (and ways of dealing with them) to support practice with cumulative results of past experience, whereas at the same time keeping space for improvement and innovation that responds to changing situations and environment. In order to reason about how could a process improver achieve (or not) such acrobatic feat, we need a better understanding of the relations between the design of process models and the actual use of these artifacts in day-to-day work practices. This can only be achieved through a socio-technical approach that does not separate social from technical issues, but rather considers the different factors entangled in the practices of technical design and artifact use.

In the pursuit of this goal, we following present preliminary results from an ongoing research project that analyzes the introduction of an integrated quality management system within an aircraft maintenance corporation (called AMC[2]). Since the analyzed quality management project is based on business process modeling, this provides us with the opportunity of looking at the relation between formal artifacts (process models) and the situated practices that create and make use of the artifacts. We accomplish this analysis under a socio-technical perspective in dialogue with works of the actor-network theory tradition (e.g. [Callon 1986, Law 1992, Callon 1991, Akrich 1992]).

This paper is organized as follows: Sect. 2 briefly presents the research approach and the method used to gather empirical material. Sections 3, 4, and 5 respectively discuss the different phases of the analyzed quality management project. Lastly, Section 6 discusses the results achieved and makes final remarks.

2. Research approach and method

The actor-network theory (ANT) is the name given to a rather heterogeneous body of work originated in science and technology studies[3]. It has been thereafter used in research on a number of different fields, including information systems [Tatnall and Gilding 1999, Walsham 1997, Hanseth et al. 2004, Monteiro and Hanseth 1995]. In the context of the present paper, the use of ANT has the decisive advantage of offering analytical instruments to overcome a view fragmented in social and technical factors, by means of an analysis of heterogeneous arrangements composed by human and non-human entities, such as people, texts, concepts, machines and others[4]. As such, as pointed out by Monteiro and Hanseth, ANT provides a more specific consideration of technology than that found in other social theories [Monteiro and Hanseth 1995]. For the sake of brevity, we opted not to introduce the ANT approach here as it was already done elsewhere[5], but rather to try to make the concepts that we use clear within the discussions of the empirical case analyzed below.

[2]All names of companies and persons are anonymized.

[3]See, for instance, [Callon 1986, Law 1992, Latour 1999, Akrich 1992], and [Law and Hassard 1999] and the online resource at `http://www.lancs.ac.uk/fass/centres/css/ant/ant.htm` for the discussion of later developments.

[4]The symmetry adopted in the analytical posture is not to be confounded with the proposition of equivalence between humans and non-humans. It must be considered in the context of a relational ontology that does not take for granted *a priori* divisions between technical and social elements (for a well argumented discussion of this issue in the context of information systems see [McMaster and Wastell 2005].).

[5]See, for instance, [Law 1992] for an introductory text in ANT, and [Monteiro and Hanseth 1995] for the discussion in the particular context of information systems.

The case study analyzed here comprises a quality management project initiated some five years ago in a large-scale aircraft maintenance company (AMC) in Germany. AMC has about 22,000 employees and is structured as a global network with twenty affiliates and subsidiaries. The empirical material was gathered by means of semi-structured interviews about the history and reasons of the quality management project, and by the observation of several modeling workshops.

3. Prologue

A severe technical failure during the take-off of an aircraft has triggered the change in AMC's quality management process that we analyze below. Shortly after take-off, the captain noticed an anomaly in the control of the aircraft. The left wing dipped, and the aircraft banked further left even though the captain responded with a sidestick input to the right. The first officer then took over the control of the aircraft. The crew could not fix the problem and found out that the captain's sidestick was reversed in roll. In spite of this serious technical failure, they managed to return to the airport. Later, further investigation revealed that two pairs of pins inside the connector of a board computer had accidentally been swapped during a recent maintenance.

This incident was the reason for the quality management department to start an initiative of re-organizing and re-establishing the existing quality management system. Up to this point, quality management was perceived by people in AMC as an inconvenient task required by the aeronautical authority. Indeed, there was a repository of operating instructions that should assure the quality of work, but it basically consisted of long documents and heterogeneous diagrams—which were identified as the main source of failures. These documents were created by different business units, each using its own language and particular definitions of processes and roles. As a consequence, in order to track a business process through the different business units, one would need to read many documents with heterogeneous graphical notations, different formats, and divergent terminologies. Therefore, it should not come as a surprise that these documents were rarely used.

4. The Quality Management Project: Defining Problems and Actors

The head of the quality management department thus saw the opportunity to start a new project to establish a new integrated quality management system. Based on the pressing argument offered by the aforementioned incident, it was not hard to convince the company's top management of the necessity of such an initiative: In order to improve the quality of work and to make business processes more transparent and manageable, a corporation-wide business process modeling initiative was started.

The Quality Management Project (QMP) was performed on a national level along about five years. It was aimed at gradually modeling the business processes of each business unit, so as to integrate all processes into a corporation-wide, easy-to-use *process map* that could be used by employees to visualize the processes—thus getting rid of the old text-based documents and non-standardized diagrams.

The process map used a graphical representation of the airport and aircrafts at its highest level, from which the process models related to specific units could be retrieved by selecting the corresponding part of the airport or aircrafts. As such, this graphical

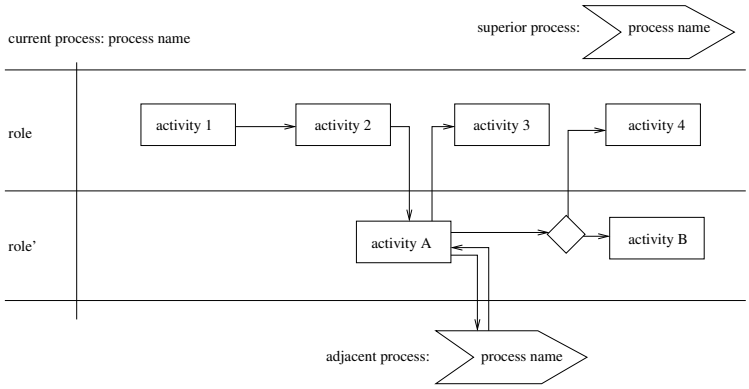

Figure 1. Example of an AMC Process Model

representation created a *process architecture* to structure the processes carried out by the existing business units, giving and overview of the mutual relations between processes and units, and thus improving the usability of the tool.

4.1. Modeling Framework and Tool

The process modeling tool chosen was the standard software ARIS Toolset (Architecture of Integrated Information Systems [Scheer 2000]), but its diagrams were adjusted to the needs of AMC in respect to process representation. Before the process modeling initiative began, a survey among the employees was performed in order to collect as many opinions as possible and identify the most accepted modeling technique. As a result of the survey, the QMP opted for non-executable swimlane- and role-based process landscapes, combined with classical organization charts to display the role hierarchy.

Figure 1 illustrates a process diagram following the adopted notation: Swim lanes separate different roles (`role` and `role'`) and their activities (`activity 1` – `activity 4` and `activity A` – `activity B`), as well as superior and adjacent processes. The corresponding organization charts are omitted here for the sake of brevity.

Each employee in AMC belongs to a business unit that is mapped to a role. The roles are used in two ways: On the one hand, they are used to represent in organization charts the hierarchical relations between units, and on the other, each business process is assigned to roles that are responsible for it. In this way, roles can be used as a filter to produce a specific view of the business process repository. For instance, if an employee belonging to a given business unit (said BU_1) logs in to the quality management tool (either by entering his role's name or by navigating through the aircraft-like graphical interface mentioned above) only the processes that are associated with the role of BU_1 are displayed. This mechanism is supplemented in the tool with ordinary functions for "search by process name" and "search by role name".

4.2. Problematization of actors and interests

Although the focus of our analysis lies upon the modeling processes (further explored below), it is useful to start briefly analyzing the establishment process of QMP. In this context, we consider the building process of a system of alliances around the quality management system, which is initiated by the quality management department. The first step here is the *problematization* [Callon 1986] of quality management in AMC, i.e. the

interdefinition of the identity of the actors involved. In our case, the quality management department must interact with: a) the managers of business units; b) the employees of each business unit; c) the modeling tool[6]; d) the aeronautic authority. If the project is to succeed, the support of each of these groups must be assured. They are thus defined by the quality management department as follows:

Business Unit Managers: are interested in improving the quality of the business processes in their units. They are also assumed to be able to request employees in their units to engage in the project.

Employees: have practical (tacit) knowledge about business processes, but their practices are uncoordinated and sometimes have conflicts. They tend to have a critical stance on quality management, since it may imply in additional work to what they "already have to do". However, they are interested in supporting tools that facilitate their activities.

Modeling Framework/Tool: provides standardization of processes and better visualization trough the representation of work practices as business processes.

Aeronautic Authority: wants to have transparent access to processes in order to verify compliance with rules and regulations.

In this manner, actors were defined by the quality management department in such a way that QMP was seen to be relevant, and even necessary, for their particular interests. In the ANT literature this process is called *interessment*, resulting in that QMP becomes an *obligatory passage point* for the actors to reach their goals [Callon 1986].

While the support of managers and authorities are perceived to be quite straightforward considering the definitions above (once the project was approved by the company's top management), achieving the support of employees demands more effort. Although they could be extrinsically motivated by their bosses to participate (e.g. to give input to process modeling), if they don't regard the project as beneficial—but rather as a useless burden—they might provide incomplete or incorrect information. Moreover, if they do not actively use the resulting process repository to orient their practices, the whole project will be rendered innocuous. As such, the quality management department needed a strategy to co-opt employees, convincing them that they will profit from the project—or, an *interessment device* in Callon's terminology [Callon 1986].

The argument put forward for this end was two-fold. First, the better visualization of processes afforded by QMP would, according to the quality department, contribute to a better coordination of activities, thus making the work of employees easier. Secondly, and more importantly, the intent of QMP was not to document every competence of employees—i.e. everything they *can* do—but rather to catalogue the things one must *know* in order to do a good job in each business unit[7]. As such, a process model should not be considered as a substitute of the tacit "know-how" of employees, but rather as a complementary resource to practice. This argumentation was also crucial to prevent employees of having concerns about becoming unnecessary (and thus vulnerable to be

[6]Notice that ANT uses the analytical principle of extended symmetry [Callon 1986] that takes into account the role of technical artifacts in negotiation processes. For this reason, actors are also called actants—a term borrowed from semiotics (see [Akrich and Latour 1992]).

[7]The terms used in German build a nice play of words: the focus was not on *können* (to can) but on *kennen* (to know).

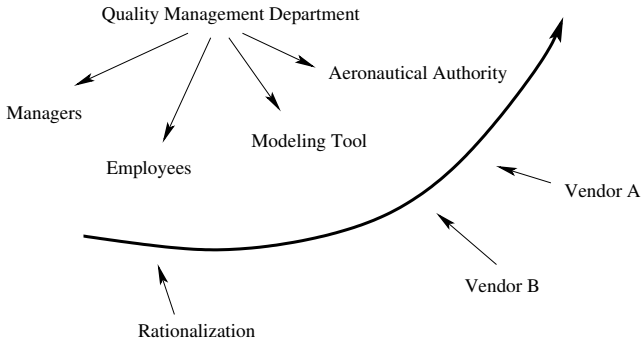

Figure 2. Interessment of Actors

fired) due to the exposure of everything they know. This fear of process "*rationalization*" is also connected to the remembrance of related management programs (common in the 1980s and 1990s) such as *downsizing* and *business process reengineering*, which frequently aimed at personal reduction—the fear can be seen here as an *anti-program* to the project, in Latour's parlance [Latour 1999, p.160].

In this manner, the quality management project starts with the establishment of a system of alliances between the involved actors, which in turn (re)defines their interests and groups them around common goal. Moreover, the quality management department strives to raise the interest of the other actors for QMP, in order to avoid that they associate themselves to other conflictive entities (e.g. the fear of rationalization mentioned before, but also other vendors of different modeling tools, for instance). This establishment is depicted in Fig. 2 (adapted from [Callon 1986]). The project will only be effective though, if the modeling is successful and the process models are used in practice—and this leads us to the modeling workshops.

5. Modeling Workshops: Mobilizing and Inscribing

The modeling of business processes were carried out in workshops conducted by a modeler from the quality management department with up to ten (mostly three to six) employees as representative of their business units, e.g. repairperson (factory work floor), lawyers (legal department), traders (sales and insurance departments). Each representative was interviewed by the modeler about the most important activities performed, decisions made, and data used in her/his work. Based on the answers, the models were interactively drawn and projected on a big screen. Each modeling session took up to three hours, and at the end all modeled processes were shared via e-mail among the participants for a final inspection and feedback. If necessary, participants would agree to meet again on another modeling workshop to improve or change the model.

Recurring to the ANT vocabulary, we can say that the employees of a certain business unit are *mobilized* [Callon 1986, p.198] through the representatives that act as their spokesmen in the modeling workshops. The representatives are thus assumed to report about the work practices of all absent employees they are representing, whereas these absent employees are expected to accept the result of the negotiations that take place in the modeling sessions, and effectively (re)orient their practices according to the models finally achieved. Of course, these assumptions must hold true in practice in order

to the *enrollment*[8] of the actors be successful.

With the introduction of the process-based modeling tool in QMP, each business unit now had to designate a person to fulfill the role of *process owner*, whose responsibility is (i) to control and (ii) regularly update the processes of the corresponding business units (there are processes that connect different business units). The final versions of process models are then inspected by the process owners who decide whether processes are correct and are ready for the final *conformity check*. The conformity of the process in respect to the requirements of the aeronautical authority is thus verified by employees of the quality management department. Once this last check is executed, the process is integrated into the process repository (process map) and goes "live"—it can thus be accessed by all employees of AMC.

In this process, the figure of the *process owner* functions as a key component for achieving the enrollment of the represented employees. As mentioned in Sect. 3, before QMP was started there was no conception of "business processes", and the existing disconnected operation instructions and diagrams were mostly (consciously or not) ignored by the employees. With QMP and the modeling formalism used, the assignment of a *owner* to each process—which was already *inscribed* into the modeling technique—is made mandatory. The process owner is thus the responsible for the accuracy of the process model, what entails both ensuring that model reflects the work practices and seeing that everybody's practice actually complies to the model.

5.1. Negotiations and conflicts: inscribing organizational practices

During the modeling sessions some interesting discussions among employees took place—as well as unexpected phenomena. During the interactive modeling and visualization of the models, work processes, roles, and hierarchies must be *explicitly* described. This caused employees to disagree about certain aspects of the activities being modeled, such as: (i) who should execute them and who is the *process owner* (*responsibility conflicts*), (ii) who else is involved and why (*interface conflicts*), (iii) in a sequence of activities: who is the first and why (*role conflicts*)?

What we see here is a negotiation concerning the shape of organizational practices and the *inscription* [Akrich 1992] of these practices into formal artifacts, i.e. the process models embody and *prescribe* determined associations of the elements in the organization[9]. These elements included people, tasks and the relationship between them—which were correspondingly represented in the models by roles, activities and sequential links (see Fig. 1).

Thus, although no radical restructuring process of the organization (like a "big" business process reengineering) was being performed, the organizational form—in the sense of the practices that give shape to the organization—was being renegotiated and remodeled. The different actors (or groups, or units) had different sets of practices, which yielded different, co-existent organizational forms. In the modeling though, these practices were confronted and some of them were perceived as incompatible and conflicting.

[8]The metaphor *enrollment* "designates the device by which a set of interrelated roles is defined and attributed to actors who accept them"[Callon 1986, p.196].

[9]As stated by Akrich: "technical objects define actors, the space in which they move, and ways in which they interact"[Akrich 1992, p.212].

Up to the moment, such "conflicts" were dealt with on an individual basis (informally whenever they happened), such that they were actually not identified as conflicts. But now, along with the visualization brought by the graphical representation, an "official" version was being produced, and the actors involved in the modeling (the unit representatives and the modeler) struggled to have their "versions" of the organizational practices *translated* in the process models. Clearly, this was directly connected with the position that the process models have in the QMP network[10], for, as argued by Suchman, representations of work practices always serve interests [Suchman 1995]. In the context of QMP, the process models are expected to orient future organizational practices, and building upon the ANT concept of *prescription* [Akrich 1992], we could say that the models inscribe *organizational prescriptions*, i.e. they prescribe certain organizational orderings.

As a result of the negotiation, we can thus say that each modeling session builds a network around the business process model obtained, aligning the actors involved and *translating* their interests. The network corresponding to the whole project (QMP) can be seen to arise from the agglutination of the networks of each process[11].

5.2. More conflicts and betrayal

Interestingly, not only the model "contents" but also the very notation formalism was subject of controversy. Such conflicts occurred in the modeling of processes that had an inter-organizational character, connecting different business locations. Those processes were critical because they prescribe the way how data and activities are passed from one location to another. In the modeling technique adopted this relation is represented by an arrow that goes from the sender to the receiver. When modeling such processes, the representatives of different units interpreted this notation as defining a hierarchy relation between the business locations. The sender location was seen as higher ranked, since the receiver was "dependent" on the given data and must thus conform to the activities performed by the sender.

Consequently, there was a conflict in the modeling sessions between two different possible arrangements (or *programs of action*) involving the notation. The modeling formalism incorporated in the tool pressed for a separation between a process-oriented description of activity sequences (represented by process models) and the hierarchical organizational structure (depicted in organization charts), thus suggesting the arrows between sender and receiver to be associated to sequential, non-hierarchical connections. This arrangement was inscribed in the tool and was defended by the modeler during the sessions[12]. On the other hand, the employees saw the opportunity of translating via this notation a relation of hierarchical superiority into the process model, and lively argued over the precedence of the activities to be performed by each one. In this manner, this example shows that even the formalism itself can be enrolled in practices to serve interests other than the ones for which it was originally designed and thus betray them (the artifact

[10]Understood here following the ANT tradition as arrangements of heterogeneous elements (see for instance [Law 1992]).

[11]This separation is only an analytical one (or a possible framing), for the networks are in fact deeply entangled and constitute a unique whole.

[12]We could say that the quality management department (puntualized as the modeler) *subscribed* to the prescription inscribed in the formalism [Akrich and Latour 1992].

is then de-inscribed [Akrich 1992])[13].

5.3. Flexibility and/or Irreversibility?

Now that we have analyzed the socio-technical negotiations involved in the modeling of business process of our case study, we are ready to approach our initial motivation by asking: How flexible are the organizational practices engendered by our quality management system? In order to analyze this question we will oppose flexibility to the concept of *irreversibility* as defined by [Callon 1991]. The degree of irreversibility of a translation is said to depend on two things: "(a) the extent to which it is subsequently impossible to go back to a point where that translation was only one amongst others; and (b) the extent to which it shapes and determines subsequent translations." [Callon 1991, p.150].

According to the quality management department, the approach of QMP is based on flexibility and the amount and the nature of processes, organization charts, and roles are changing constantly. Indeed, the quality management tool provides a feedback function with which any employee may request model updates[14]. The requests are then first checked by the process owner, and if considered reasonable, they are passed on to the quality management department for the conformity check (see Sect. 5). After a successful check, the modified model is committed to the process repository.

In this manner, the process models remain (at least partially) negotiable in the QMP network. This gives the network a certain degree of flexibility that prevents the organization from becoming completely irreversibilized, i.e. from becoming a automaton-like network that "transforms its actors into docile agents and its intermediaries into stimuli which automatically evoke certain kinds of responses" [Callon 1991, p.151]. Therefore, with the negotiations of representatives in the modeling workshops and the possibility of model update requests by any employee, channels are kept open to enable changes and incremental innovations in the processes of the organization.

Both the roles acquired by the employees and by the process models in the QMP network are thus crucial to preserve this level of flexibility. The employees are not mere 'executers' of rational processes optimally designed by outside experts, but rather active problem-solving agents and process designers themselves.[15] Conversely, the process models assume the role of orientating devices for practice (and not of fixed rules to be followed), which can be updated and renegotiated.[16]

Does that mean that QMP yielded a completely reversible network, such that all associations knit along the way can be easily untied and renegotiated? Certainly not, since in network building processes—especially those which involve translation strategies that rely upon material artifacts—the obduracy of the relations established is more often

[13]It thus corroborates Bowers' argument that "[f]ormalisms are *soft or plastic* in their significance, their meaning or what should be done with them are open to negotiation" [Bowers 1992, p.256, original emphasis maintained].

[14]In an interview with members of the quality management project, the claim about the frequently updates was endorsed by showing the high usage levels registered in the tool statistics.

[15]A parallel can done here with the view of practice of Schön as a complex activity that transcends the application of formal rules and reified 'knowledge' (see for instance, the example involving Columbian children in [Schön 1991, pp. 189–203]).

[16]Here the parallel is with Suchman's [Suchman 1987] argument that plans are to be seen not as formal structures controlling practice, but as resources used in the contingencies of situated action.

than not an important goal (see for instance [Law 1992]). If we look carefully to the updating process described above, we see that the ways to introduce model changes are not arbitrary, but must rather follow a very well determined procedure. The sequential procedure to request a change necessarily pass by: (a) the tool; (b) the process owner; and (c) the quality management department. The first interesting point to note in this procedure is the degree of irreversibility of the *process owner* assignment. Unlike the form of process models, a revision mechanism for the assignment process-owner is not provided; instead, each change request reaffirms the association of the owner with her/his process by making sure s/he is aware of and in accordance with the changes introduced into the model. As such, while process models are kept updatable and are provided with some flexibility, the *distribution of responsibilities* accomplished by the owner assignment has a higher degree of irreversibility.

The distribution of responsibility is also the main reason for the conformity with legal regulations to be verified by the quality management department. Indeed, the QMP network has configured the responsibilities in such a precise way, that each group of actors was made accountable for specific parts of the overall modeling process. This fact was practically exemplified by an anecdotic (yet real) story related by an employee of the quality management department. Whenever an aircraft maintained by the company falls, there would be a great rush in the quality management department to know what was the detected cause of the failure and then to perform a comprehensive check in the corresponding process models and the relevant regulations. If it was determined that the model was compliant with the rules, everybody would take a deep breath and relax, since it was not their fault. This example shows the strength of the distribution of responsibilities established in the project network by the best way to do this: putting its irreversibility to the test [Callon 1991, p.150]. Off course, in such situation of crisis, many competing translations arise, each trying to impute the responsibility for the failure to the different actors involved. Here we see the strength of the responsibility links inscribed in the QMP network (model conformity with the quality department, model accuracy with the process owner) entails an irreversibility that does not allow space for contend about the accountability of the different actors. As such, we see that we must further qualify our initial indagation about flexibility in order to differentiate between the several types of associations included in a project's network. In this case, the associations drawn in process models are more flexible than the distribution of responsibilities performed by the arrangement of actors in the project.

6. Discussion and final remarks

We have sought to exemplify the use and usefulness of a socio-technical analysis to give insight about different aspects of the modeling of processes, using the particular context of business process modeling in a quality management system. Our approach pursued a dialogue with works on actor-network theory, enabling us to see process modeling as a socio-technical activity in which technical and "non-technical" issues are indissociable. We believe that this analysis enables us to reflect on formalization and flexibility in software development processes in a number of ways, two of which we following outline.

The first point is related to how we regard models. In software engineering (and generally computer science) we tend to see models as 'pure' technical entities that obey formal syntactic rules and are interpreted (or better, executed) according to a rigorous se-

mantic. Any deviation from this standard is seen as an imperfection, and indeed we sometimes use the terms semi-formal to express the deficiency of some modeling techniques to reach the ideal conditions of formality (this is in fact the case for the modeling technique used in QMP). Although this 'purely' logical definition of models may well have its merits in some contexts (as for example in theoretic computing), a very different picture from models arises from the case study we analyzed above. When we regard models within the practices of model development and model use, we see that the 'technical' aspects are inextricably linked to a series of other elements that not only *influence* the technical questions as external disturbances; instead, models and 'non-technical' elements co-constitute each other within the continuous movements of the practices. Clearly, this is of particular importance in the context of software process improvement, where models are used to guide and support human activities. Looking at the analysis of modeling workshops of Sect. 5, we see the form and meaning of models as resulting from negotiation processes between all actors involved. On the one hand, the achieved models inscribe intentions, prescriptions of organizational forms, interests and visions of the world—thus helping to configure the social space in which they are used. On the other hand, the model elements (and even the notation of the formalism) is associated in the practices with elements different from those originally foreseen—what alters the very meaning and significance of models.

A second point can be made from the analysis of flexibility of the quality management system. Although formalization and flexibility are frequently considered antithetic, in the case study analyzed the formalization of work practices into business process models did not make the organization totally inflexible. Decisive factors for this were the role of models and employees in the process, which were based on a view where formal artifacts and informal practices are not mutually exclusive, but rather complementary. Furthermore, the flexibility of process does not mean here that the elements of the project analyzed are only loosely connected and their associations are not binding: the distribution of responsibilities that emerges from the project have proved very robust. In this manner, we think that these lessons are of great value for a software process improver (and, more generally, for a modeler) in the consideration of the whole complexity of the socio-technical arrangements s/he contributes to build.

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