Process Modeling Value Framework

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Abstract. This paper presents an approach to increase the value gained from enterprise modeling activities in an organization. The main objective of the approach is to facilitate communication and coordination of modeling initiatives between stakeholders and within and across projects. The approach as a normative process model is presented and discussed in the context of case projects and activities, and we conclude that although work remains both on sophistication of the approach and on validation of its general applicability and value, our results show that it addresses recognized challenges in a useful way.

Keywords: Business process modeling, enterprise modeling.

1 Introduction

Enterprises have a long history as functional organizations. The introduction of machinery in the 18th century lead to the principle of work specialization and the division of labor, and on to the need of capturing, structuring, storing and distributing information and knowledge on both the product and the business process. Business process models have for a long time provided a means to structure the enormous amount of information needed in many business processes [8]. The availability of computers provided more flexibility in information handling, and led to the adoption of modeling languages originally developed for systems modeling like IDEF0 [6]. The modeling of work processes, organizational structures and infrastructure as an approach to organizational and software development and documentation is becoming an established practice in many companies [7]. Process modeling is not done for one specific objective only, which partly explains the great diversity of approaches found in literature and practice. Five main categories for process modeling can be distinguished leading on the overviews presented in [2, 16]:

1. Human sense-making and communication to make sense of aspects of an enterprise and to support communication among different stakeholders. Sense-making models are used within an activity in order to make sense of something in an ad-hoc manner, and will usually not be maintained afterwards.
2. Computer-assisted analysis to gain knowledge about the enterprise through simulation or deduction.

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3. Business Process Management, following up the adherence of the work process to standards and regulations. Here the model is meant to act as part of a corporate memory meant to exist as a reference point over time.
4. Model deployment and activation to integrate the model in an information system. Deployment can be manual, automatic (in automated workflow systems), or interactive.
5. Using the model as a context for a system development project, without being directly implemented (as it is in category 4).

We have investigated the practice and experience of process modeling across four business areas and a number of projects and initiatives in a large, international company. Our objective was to identify possible improvements and facilitate potential sharing of relevant resources, aiming towards an optimization of the *value* gained from modeling and models. Merriam-Webster Online defines value as: "something (as a principle or quality) intrinsically valuable or desirable". We have aimed for a company-wide, inclusive scope in our use of the term, guided by what has been deemed relevant by involved stakeholders.

Three important observations were made up front:

- Even within projects a variety of objectives were found, spanning the categories presented above. A corresponding variety was found in tools, methods and attitudes to the potential value of modeling.
- In some initiatives there were significant divergence of expectations to the modeling results and value - between different stakeholders and also over time.
- Communication and sharing of resources between projects were mainly done through more or less ad-hoc reuse of models and personnel known by project workers in advance.

From this we made three assumptions:

- Single project value and stakeholder satisfaction could be increased by to a larger degree focusing on, communicating and prioritizing between diverging expectations and objectives.
- This would require a common platform for communication about modeling initiatives expectations, objectives, and other attributes.
- Such a platform could also facilitate reuse of relevant knowledge, tools, models, methods and processes between units and projects.

These assumptions lead to the development of a framework on best practice for increasing the value of process modeling and models. This proposal consists of a taxonomy, a recommended model of activities for process modeling value increasing initiatives, and links to relevant knowledge and best practices for each step of the process. Work leading up to this work has been reported in [3,4,11,12].

The rest of this paper starts with presenting the methods used in our work, from identification of needs, development and assessment. We then give an overview of the framework of best practice for increasing the value of process modeling and models, and discuss its applicability with regard to challenges identified in earlier projects. Finally, we conclude on the applicability and usefulness within the limitations of our validation, and indicate needs for further development of the framework as well as for more large-scale validation within a wider scope.

2 Research Method

The research presented in this paper is based on qualitative analysis of a limited number of case studies. According to Benbasat, Goldstein, and Mead [1], a case study is an approach well suited when the context of investigation takes place over time, is a complex process involving multiple actors, and is influenced by events that happen unexpectedly. Our situation satisfies these criteria, and the work has taken place within the frames of a three year project, including one in-depth case study, and several other less extensive case-studies. In deciding whether to use case studies or not, Yin [15] states that a single case study is relevant when the goal is to identify new and previously not researched issues. When the intent is to build and test a theory, a multiple case study should be designed. The intention of our study has been to find out how to increase the value of modeling and models in an organization. There has not been reported much research within this area previously, and we have therefore chosen a multiple case approach for the work presented in this paper.

The framework for increasing value of process modeling and models has been developed through an iterative process, refining the model. We can identify four iterations.

1. In the first iteration we studied the modeling initiative in a particular project in detail, using observation, participation, and semi-structured interviews. After a phase of explorative research, we focused on identifying the expectations and experiences towards the modeling and the models, on their score related to process modeling success factors, as well the extensive reuse of the models across the organization, viewing this as possible knowledge creation and sharing as a part of organizational learning. A hypothesis on process modeling value was established.
2. In the second iteration, we went through semi-structured interviews with representatives of several different modeling initiatives throughout the organization to survey their experience with modeling, especially with respect to benefits and value of reusing knowledge through models across projects and organizational units. A number of initiatives were selected for the study where we were able to get in-depth knowledge from those involved in the process. An interview guide was established. These interviews were focused on expected and experienced use and value from the modeling efforts in the case study, aiming at identifying as many expectations as possible, including any that may not have been documented in project documentation, because they were not considered directly relevant to the primary goals of the project. Following open questions, the interviews were structured around keywords from the work of [14] concerning “process modeling success”. Results of the study are based on these interviews, studies of project documentation and models. The interview guides were used as basis for structuring contact summary sheets with the main concepts, themes, issues and questions relating to the contact [9].
3. As a third iteration we carried out a workshop with a group of modeling experts, discussing the framework in relation to their own experiences through numerous process modeling projects. This resulted in an updated version of the framework.
4. In the last iteration, we included the framework in an actual business project using action research, where one of our researchers also acted as a modeler. This was an informal test of the framework, but gave valuable input to validate and update it.

Our results this far have certain limitations relative to internal validity [9] as representatives of some of the involved roles have been followed more closely than others. As for descriptive validity (what happened in specific situations) the close day to day interaction with the users, especially in the first and the last iteration by one of the researchers, give us confidence in the results on this point. As for the interpretive validity (what it means to the people involved) we have again in-depth accounts from central stakeholders, but again not all stakeholders have been involved to the same degree. The same can be said on evaluative validity (judgments of the worth and value of actions and meaning). That we find many results that fit the categories of existing theoretical frameworks gives us confidence on the theoretical validity of the results.

3 A Framework for Increasing the Value of Process Modeling

This best practice framework aims to increase the value of the modeling and models through enhanced awareness about current and future stakeholders, any (potential) conflicts of interest, stakeholder expectations and potential value to be gained, as well as any negative effects increasing total cost. Based on this knowledge, decisions regarding resource allocation, choice of modeling methods and tools, delegation of responsibilities etc. can be made to optimize the value of a modeling activity and its resulting models, on a project level as well as on an organizational level. The basic elements of the framework are a recommended main *process* (see Fig. 2) and some basic *concepts* (see Fig.1), elaborated on in the description of each step in the main process.

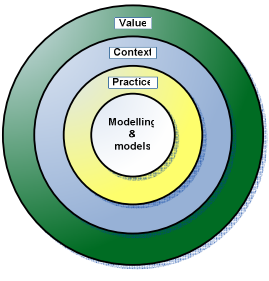

Fig. 1. Main concepts of value framework

Context is the surroundings of an initiative that might influence decisions. *Value* is identified in relation to the identified context, but also on potential value outside the initial project scope. The *practice* focuses on the strategies and practice around the modeling and the models.

The recommended process is initiated when a need for modeling has been identified. It contains four areas. Its three main steps related to the individual projects are detailed below. 'Manage modeling capabilities' is work done at an organizational level.

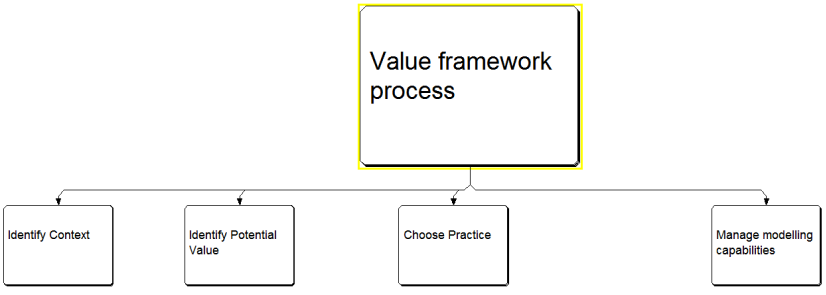

Fig. 2. The overall framework

3.1 Identifying Context

Identifying the context is mostly about expressing the circumstances of the identified need for modeling, as a basis for further communication, prioritization and planning. It will usually coincide with the writing of an application for funding, development of a project mandate and/or a project plan. At this step one should keep within the scope of the initial need, usually expressed in traditional project documentation with formal obligations. The main issues to be clarified are detailed in Fig 3, and include:

- Identification of the organizations installed base, including existing reusable models or descriptions and other relevant tacit or explicit constraints.
- Identification of the context of the modeling or model activity/initiative, including users and other stakeholders, uses, and objectives.

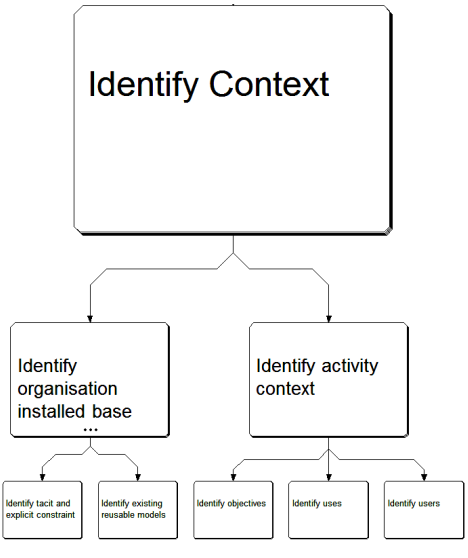

Fig. 3. Identify context

There are different actors related to a modeling initiative and a model, holding one or more *roles*. *Users* are using the models or participating personally in the modeling in order to achieve objectives. Other *stakeholders* may not be using the models directly, but extract value from planned objectives. Techniques e.g. from user-centered design is useful at this stage in the identification of stakeholder types. *Use* includes how the modeling and models are going to be used in order to achieve the objectives. *Objectives* are the goals and purposes of the modeling and models. *Installed base* includes tacit and explicit assets already existing in the organization that will have influence on the modeling and model context. *Constraints* include issues such as personal and organizational knowledge, which may be tacit or explicitly expressed constraints, organizational guidelines or instructions (explicit constraints), existing tools and languages etc. *Reusable models* are models or other documentation that were created for other purposes, but that could be reused in the new project.

Table 1. Examples of activity context

Uses	Users	Objectives
• Facilitate human understanding and learning • Communication tool • Support process improvement • Support process management • Support the work process • Automate process guidance • Automate execution support • Computer-assisted analysis • Model deployment and activation • Basis and context for software development • Training of personnel • Measuring and analyzing processes • Document best practice • Requirement specification tool	• Top management • Middle management • Work executers • Software process engineers • Project managers • Software engineers • System engineers • Software developers • Software executives • Customer management	• Increase human understanding • Improve process • Manage process • Work more effectively • Improve business performance • Less faults • Common view of future directions

3.2 Identifying Potential Value

In step 1, we identified the context where the modeling and the models were meant to play a role. In step 2, *"Identify potential value"*, the aim is to capture any (potential) extra and positive benefits of the modeling and models, exceeding the primary objectives captured in step 1. Value may be connected to the resulting models, or to the modeling activity in itself.

Often the objectives identified in step 1 will relate to the concrete modeling project, while any potential value to the rest of the organization will typically be ignored in the formal project documentation developed at this stage – due to a lack of awareness, or to avoid complicating responsibilities and bindings.

Value can be explicit and easy to grasp, but also tacit. Tacit value, e.g. the improved understanding of a work process for a modeler originally producing models for others,

are often not explicitly captured in traditional project documentation, but may still affect decisions before or during a project, or the perceived value of the project in retrospect. Future reuse of the models can be an added value of the current modeling and models, especially if this potential is taken into account at an early stage.

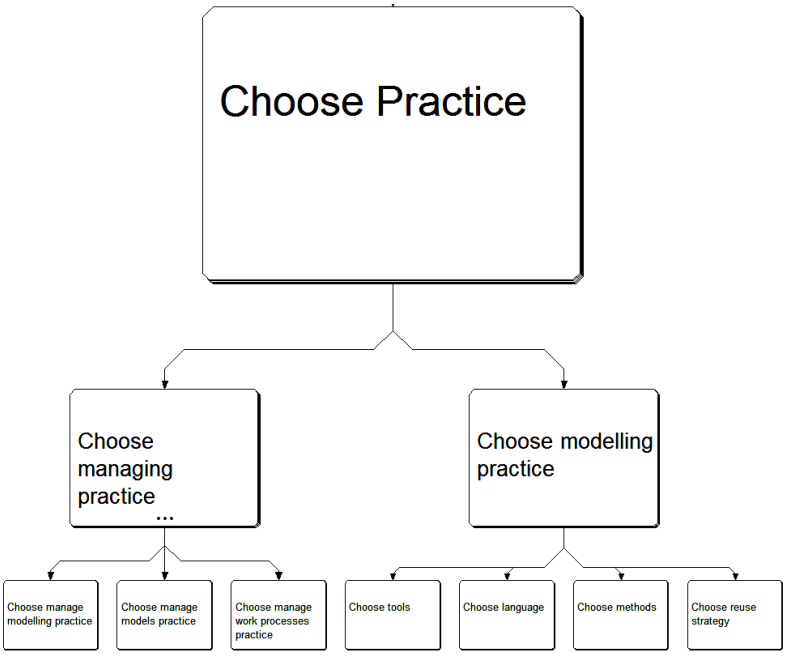

Fig. 4. Choose practice

3.3 Choosing Practice

The choice of a suitable practice should be based on the identified contexts of the modeling and models, as well as the identified expected value. Modeling practice include reuse strategy, methods, languages and tools, while managing practice define

Table 2. Examples of modelling practice

Reuse strategy	Method	Language	Tool
• Do not reuse anything, start from scratch • Reuse documentation • Reuse models indirectly or directly • Reuse methods, language and/or tools	• Visual representation • Modeling • Mapping • Text description • Modeling workshops	• IDEF0 • UML • "Boxes and arrows" • Text • Checklists • Templates • Images • Video clips	• Visio • PowerPoint • METIS • Aris • Excel • Word • "Pen and paper"

Table 3. Examples of managing practice

Manage modelling	Manage models	Manage work processes
• Manage the methods, languages and tools • Keep the models updated	• Place the models on intranet	• Instruct the modeler when and how the work processes should be updated

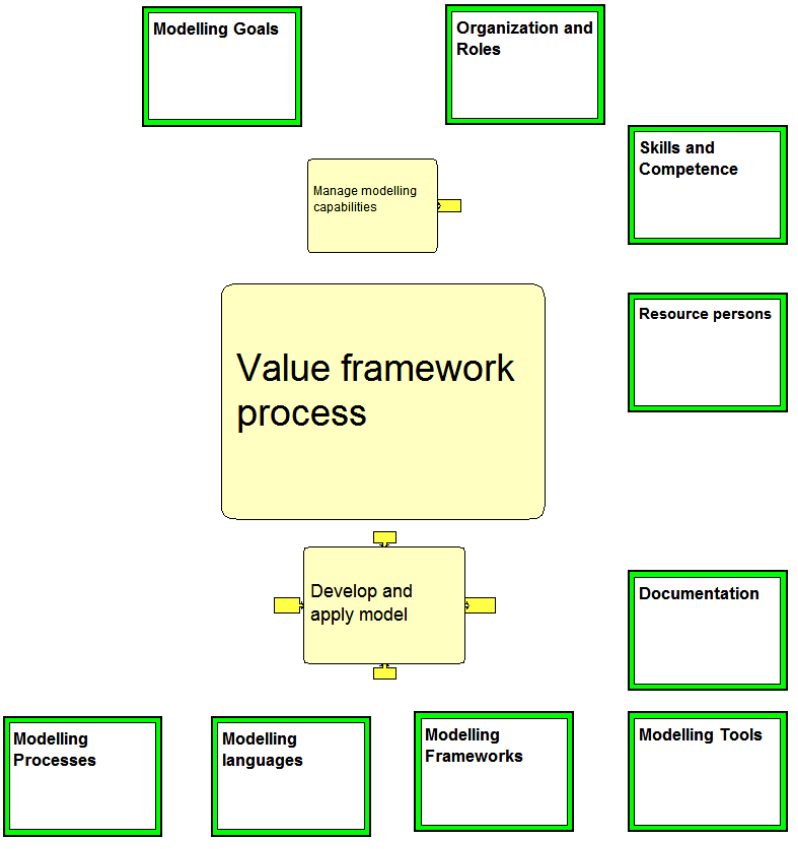

Fig. 5. Top level METIS model for structuring resources related to the framework

how to manage the modeling, the models and the work processes. The general framework of quality of models and modeling languages inspired by organizational semiotics [10] is especially helpful here relative to modeling practice related to methods, languages, and tools, having the stakeholders of the models and the goals of modeling already defined in the previous steps. When goals or stakeholder types are changed during a modeling project, one needs to reassess these aspects, and potentially select a new modeling language, method or tool.

The choice of *modeling practice* (Fig. 4) includes deciding what methods, languages and tools to be used for the development of the models. The need of formality

may differ based on the context and the expected value identified. Modeling for corporate memory may require more formality in the methods, tools and languages, than modeling for sense-making, where the model serves as an artifact for a limited time.

It is important to recognize the differences of the three areas of modeling, models, and work processes, and to assign these to three different roles. The *practice of managing* the modeling process, the models and the work processes being modeled has to be based on the identified contexts and potential values, and on the chosen modeling practice. If the context is pure sense-making, and the models are to be thrown away after they are modeled, an establishment of a practice for managing of model and work process is not necessary. The closer the context of use is to corporate memory, the more important is it to have a formal managing practice. Dependent on the contexts of use and the modeling practice, it has to be decided whether the models and the work processes should be managed after the modeling activity or not. It is important to differ between the management of the work processes itself and the models.

3.4 Framework Model

To increase the likelihood of dissemination, we have developed a model of the framework and related areas in the METIS modeling tool [13]. Fig. 5 is a screen shot of the top-level of this model, indicating the areas of information provided (not showing the internal links between different areas).

4 Applying the Framework

Through the cases we have identified expected and experienced value of modeling work and models, as well as experienced challenges. In this chapter we quote some of the reported (potential) value. We will then look into how the framework addresses the reported challenges.

4.1 Identifying Potential Value

The stakeholders in our case studies indicated many valuable outputs in addition to those initially intended for the modeling project. Some of these are:

Communication:

- The high-level models encouraged an agreement among the management participants that was vital for the rest of the project, creating important common references, identification and enthusiasm.
- The models triggered communication, being something that everyone could relate to. “Three boxes and some arrows: This is a fantastic communication tool”.
- Communication was initiated and facilitated by and through the models.
- Modeling is seen as a mechanism to extract knowledge from people’s heads.

Learning:

- The modeling process itself turned out to be a learning experience for the participating domain experts, increasing their knowledge about the processes.

- Through the workshop sessions the participants learned a lot from interacting with each other, "new" information was uncovered, and understanding improved.
- People understand themselves better after a modeling session.
- The participation in the modeling process of domain experts is important. The result would not have been the same if modelers from outside created the models based on interviews.
- The models helped taking care of and storing the *competence* of people in the organization.
- Training takes less time when process models were used.

Long-term benefits:

- The process model gives the organization one language and one tool for everyone in the organization; a common frame of reference.
- Simple and effective diagrams show what is important for the organization.
- Through modeling AsIs (the current situation), and not only ToBe (the requested situation), best practice is secured and not forgotten.
- The models are used in *marketing* towards potential customers. There is a marketing value in telling the world that they have documented processes.

4.2 Addressing Challenges of Modeling

In order to extract more value from the modeling initiatives and the models, we will in the following address some of the major identified challenges in our case studies, and examine how the framework could indicate a solution to these. For each paragraph we state the challenge, then how it is addressed in the framework.

Challenge 1: During organizational changes, models may have to be merged as processes are unified. Different modeling tools and languages increase the challenge.

Example: Several as-is processes were to be harmonized and their documenting models merged into one common process model. The models were created for different user groups, originated in different organizational units and also countries. The modeling processes were also different, involving different types of people.

Framework application: Such models are most likely based on different methods, languages and tools, created for different objectives, uses and users and other stakeholders. The historic context and the organizational installed base of modeling and managing practice of each of the models should be investigated in order to establish a re-use strategy and choose the correct current modeling and managing practice.

Challenge 2: To handle situations when the modeling starts out as an informal activity, but the resulting models develop into a process defining tool in the BPM sense. The original language and tools often do not meet new expectations for the model to be kept updated, be scaleable, and extendable with new functionality. The experience is that the chosen tool and language often do not fit into this new scenario.

Framework application: Awareness of where on the scale of sense-making versus corporate memory the models were initially created, and where on the scale the models have ended up (and where they can be expected to end up). Sense-making models

do not require a very high level of formality, while corporate memory models often do. Being conscious about this will make it easier to identify what has to be changed in the modeling and managing practice in order to align with the new situation.

Challenge 3: To keep the models and other descriptions updated and consistent.

Example: It becomes difficult to keep the models updated as the complexity increase, and the number of non-integrated tools increases.

Framework application: The framework suggests careful analysis of the expected model context before choosing the modeling practice. Considering the future complexity when choosing methods, language and tools will make model management easier. The framework also states the importance of viewing the management of the models as a specific activity, stressing the importance of appointing a model responsible. This is a different role than the modeling responsible or the work process responsible (process owner).

Challenge 4: To implement the models in the organization, particularly outside the modeling team.

Example: It is often a challenge to make the models an integrated part of the organization, and to involve the users to the extent that they feel an ownership and responsibility for them. When the persons doing the modeling leaves the project and the modeling is left to the domain experts to finish, implement and keep updated, experience shows that the focus on the models often fades. If the modelers leave too early, the models may not be implemented.

Framework application: Identify all the expected users and other stakeholders during the initial phase of the modeling activity, look into their expected areas of use and identify potential value. By choosing a modeling practice to increase the value across all identified stakeholders, ownership and usefulness is improved even for stakeholders not participating in the modeling. If many stakeholders should be involved in the modeling one can use techniques such as ”modeling conferences” [5].

Challenge 5: To produce views of the model according to different needs.

Example: Specific users and specific objectives of use require adapted views of the model. The creation of these is a challenge, both technically and as regards content.

Framework application: Identify the users and other stakeholders as parts of the context, analyze their background knowledge and needs, and what each of them are going to use the models for. Methods, language and tools should then be chosen based on this.

Challenge 6: The models often restrict and limit the communication.

Example: High level models are easy to agree upon, but real gaps between the model and current situation stay uncovered. A model is only one view of the world. When a model is the communication generating artifact, the discussions often leave out those issues not included in the model.

Framework application: Carefully identify the context and the potential value of the modeling and models before creating the models. Consciousness about how to increase

the potential value of communication will potentially help creating a more fitting model. Awareness of the limitations of a model and its restrictions is the key.

Challenge 7: The models are used in situations they were not intended for.

Example: Models are often created primarily for one objective. This is challenging when others want to use them as basis for other work, especially if the original assumptions are not documented.

Framework application: Through an analysis in the early phase of the modeling activity, identify the primary use as well as potential future use and additional potential value. Accommodation of indications of future use of the models should be considered when choosing the modeling and the managing practice. When in a re-use situation, where a modeling initiative is going to re-use earlier developed models, it is important to investigate the context the models were created for, and what modeling and managing practice have been used. The decision of a re-use strategy should be based on this investigation.

Challenge 8: To be conscious about distributing the responsibility of the modeling, models and processes correctly.

Example: One person was responsible for everything that had to do with the processes *and* the models.

Framework application: The framework makes distinctions between the activities of managing the modeling, the models, and the work processes. One role is related to the management of the modeling, another to the management of the models, a third to the management of the work processes.

5 Conclusion and Further Work

Based on extensive research across units and projects in an international company, we have identified expectations, challenges and experience pointing to potential increase in value from modeling activities. To support the realization of these values, a Process Modeling Value Framework has been developed.

The Value Framework has been evaluated against challenges and experiences of earlier modeling initiatives, as well as tested in a modeling project. There are clear indications that further development and use of the framework will facilitate communication and alignment within and between project initiatives and organizational units, thus potentially increasing value from projects through improved relevance and quality of results as well as reduced cost.

Our research has been practically oriented, aiming towards identification of the important issues in real-life modeling projects and activities, both with regard to the actors' motivation and their experience. Based on the broad investigations we have made, we are confident that our results are valid for the case company.

We expect our findings to be reproducible for other enterprises of similar size and complexity, but this still remains to be shown.

Even within the presented enterprise, on a practical level, there is still a way to go to implement and collect real-life experience with the framework. Our studies demonstrate

feasibility and advantages of use, but do not address the actual adoption of the framework by practitioners not involved in the development.

We have identified advantages both on a project and organizational level, and we expect that the project level advantages will be sufficient to motivate for the use of the framework – and that the organizational level advantages can be realized this way. This assumption however still has to be tested – and a successful implementation in the whole organization will, as a minimum, require a dedicated dissemination and marketing effort.

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