Ten Years Plus with EKD: Reflections from Using an Enterprise Modeling Method in Practice

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Abstract. This paper presents experiences and reflections from using the EKD Enterprise Modeling method since the beginning of the 1990'ies. A large number of application cases have been carried out. The paper focuses on the EKD modeling language, the EKD modeling process and supporting tools.

Keywords. Enterprise modeling, participative modeling

1 Introduction

Enterprise Modeling (EM) has for many years been a central theme in information systems engineering research. A number of different methods have been proposed. There are two main reasons for using EM [1]: (1) *Developing the business* that entails developing business vision, strategies, redesigning business operations, developing the supporting information systems, etc., and (2) *Ensuring the quality of the business,* focusing on sharing the knowledge about the business, its vision and the way it operates, as well as ensuring the acceptance of business decisions through committing the stakeholders to the decisions made. Examples of EM methods can be found in [2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, and 13]. Examples of application domains for EM can be found in [14, 15, 16, 17, 18, 19, and 20]. Since the beginning of the 1990's, the authors of this paper have been involved in the development, refinement and application of the Enterprise Knowledge Development (EKD) method for EM. We have applied it in a fair number of cases in a variety of organizations, which now enables us to look back and reflect on using the method from a practice perspective. The cases are hence not related to an evaluation strategy and selected with some defined criteria in mind. The paper focuses on experiences related to the EKD modeling language, the EKD modeling process and tool support for the method.

The remainder of this paper is organized as follows. In section 2 we present the EKD Enterprise Modeling method. Section 3 describes a number of applications of the method. Our reflections and experiences are presented in Section 4, while Section 5 discusses the findings and provides some directions for future work.

2 Enterprise Knowledge Development (EKD)

In Scandinavia, methods for Enterprise Modeling (EM) was initially developed in the 1980's by Plandata, Sweden [21], and later refined by the Swedish Institute for System Development (SISU). A significant innovation was then the notion of business goals as part of an Enterprise Model, enriching traditional model component types such as entities and business processes. The SISU framework was further developed in the ESPRIT projects F3 – "From Fuzzy to Formal" and ELEKTRA – "Electrical Enterprise Knowledge for Transforming Applications". The current framework is denoted EKD–"Enterprise Knowledge Development" [7, 12].

1.1 The EKD modeling language

EKD – Enterprise Knowledge Development method [7] is a representative of the Scandinavian strand of EM methods. It defines the modeling process as a set of guidelines for a participative way of working and the modeling product in terms of six sub-models, each focusing on a specific aspect of an organization (see table 1).

	Goals Model (GM)	**Business Rules Model (BRM)**	**Concepts Model (CM)**	**Business Process Model (BPM)**	**Actors and Resources Model (ARM)**	**Technical Component & Requirements Model(TCRM)**
Focus	Vision and strategy	Policies and rules	Business ontology	Business operations	Organizational structure	Information system needs
Issues	What does the organization want to achieve or to avoid and why?	What are the business rules, how do they support organization's goals?	What are the things and "phenomena" addressed in other sub-models?	What are the business processes? How do they handle information and material?	Who are responsible for goals and process? How are the actors interrelated?	What are the business requirements to the IS? How are they related to other models?
Com-po-nents	Goal, prob-lem, external constraint, opportunity	Business rule	Concept, attribute	Process, external proc., information set, material set	Actor, role, organizational unit, individual	IS goal, IS problem, IS requirement, IS component

Table 1: **Overview of the sub-models of the EKD method [22]**

The modeling components of the sub-models are related between themselves within a sub-model (intra-model relationships), as well as with components of other sub-models (inter-model relationships). Figure 4 shows *inter-model relationships*. The ability to trace decisions, components and other aspects throughout the enterprise is dependent on the use and understanding of these relationships. For instance, statements in the GM need to be defined more clearly as different concepts in the CM. A link is then specified between the corresponding GM component and the concepts in the CM. In the same way, goals in the GM motivate particular processes in the BPM. The processes are needed to achieve the goals stated. A link therefore is defined between a goal and the process. Links between models make the model traceable. They show, for instance, why certain processes and information system requirements have been introduced.

While different sub-models address the problem domain from different perspectives, the inter-model links ensure that these perspectives are integrated and provide a complete view of the problem domain. They allow the modeling team to

assess the business value and impact of the design decisions. There are two alternative approaches to notation in EKD: (1) A fairly simple notation, suitable when the domain stakeholders are not used to modeling and the application does not require a high degree of formality and (2) a semantically richer notation, suitable when the application requires a higher degree of formality and/or the stakeholders are more experienced with modeling. The modeling situation at hand should govern the choice of notation, which will be shown in the subsequent discussion about the method. The full notation of EKD can be found in [7].

2.1 The EKD Modeling Process

In order to achieve high quality results, the modeling process is equally important as the modeling language used. There are two aspects of the process: the approach to participation and the process to develop the model.

When it comes to gathering domain knowledge to be included in Enterprise Models, there are different approaches. Common approaches are interviews with domain experts, analysis of existing documentation, observation of existing work practices, and facilitated group modeling. EM practitioners and EKD method developers have advocated a participatory way of working using facilitated group modeling (see e.g. [7, 9, 23, and 24]). In facilitated group modeling, participation is *consensus-driven* in the sense that domain stakeholders "own" the models and govern their contents. In contrast, *consultative* participation means that analysts create models and domain stakeholders are then consulted in order to validate the models. In the participatory approach stakeholders meet in modeling sessions, led by a facilitator, to create models collaboratively. In the sessions, models are often documented on large plastic sheets using paper cards. The "plastic wall" (Figure 2) is viewed as the official "minutes", for which every domain stakeholder in the session is responsible. [23] give two main arguments for using the participative approach, namely:

1. The *quality of models is enhanced* if they result from collaboration between stakeholders, rather than from consultants' interpreting stakeholder interviews.
2. The approach involves stakeholders in the decision making process, which facilitates the *achievement of acceptance and commitment*. This is particularly important when modeling is focused on changing some aspect of the domain, such as e.g. its visions/strategies, business processes and information system support.

In a modeling session, the EKD process populates and refines the sub-model types used in that particular session gradually and in parallel. When working with a model type, driving questions are asked in order to keep this parallel modeling process going. This process has three goals: (1) define the relevant inter-model links, (2) to drive the modeling process forward, and (3) ensure the quality of the model. Figure 1 illustrates driving questions and their consequences for establishing inter-model links in the model. It is also argued that shifting between model types while focusing on the same domain problem enhances the participants' understanding of the problem domain and the specific problem at hand. More about the modeling process used in EKD and about facilitating modeling group sessions can be found in [23 and 24].

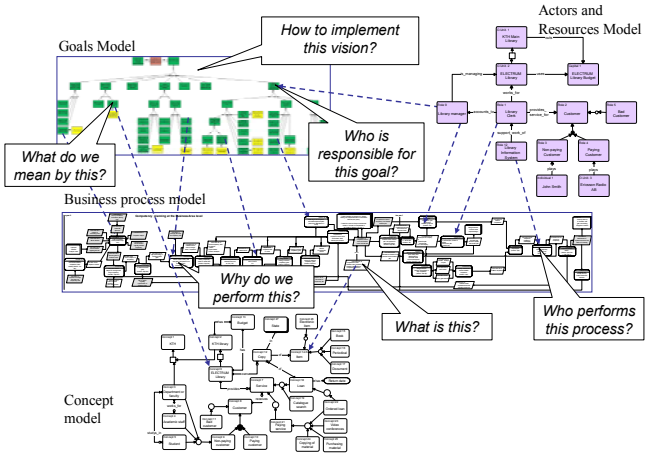

Figure 1: **Working with inter-model links through driving questions**

3 Applications of EKD

The authors of this paper have applied versions of EKD in a variety of projects and application areas since the beginning of the 1990's. In this section we briefly outline the most significant application cases.

Two application cases at *Telia*, Sweden's largest telecommunications company in 1996 [25]. In the first case, the F3 EM [9] method was used for reviewing requirements specifications. In the second case it was used for defining the problem area at the outset of a new development project. The tool used for documenting the models was Micrografx FlowCharter.

Application case at *Volvo* during 1994-1997. The focus here was requirements specification for a system to support the business process of purchasing. The case study had two parts, the Volvo Car Motor sub-project and the Volvo Truck Motor sub-project. Both sub-projects involved full implementation of the F3 EM methodology resulting in a set of models describing differences and similarities between the views of the two sub-projects on the purchasing system problem. The Micrografx FlowCharter tool was used to document the models.

Application at *Vattenfall AB*, Sweden's largest Electricity Supply company during 1996-2000 within two FP4 ESPRIT projects: ELKD – Electrical Knowledge Development (No R20818) and ELEKTRA – Electrical Enterprise Knowledge for Transforming Applications (No 22927). The main objective of Vattenfall within these projects was to restructure its human resource management (HRM) system and to close the gap between business planning and competence planning (see further [26]). The project was structured into five pilot projects, each focusing on certain aspects of competence management at Vattenfall. Results included problem elicitation and analysis, concept clarification and analysis, as well as designs of business processes. These results were consolidated in a number of EKD modeling sessions in order to finalize the vision and design of the future HRM system at Vattenfall. We used the

Micrografx FlowCharter tool for documenting the models together with the BSCW tool for communicating within the project.

Application case at *Riga City Council* (RCC), Latvia, during 2001-2002 within the FP5 IST programme project "Hypermedia and Pattern Based Knowledge Management of Smart Organizations" (no IST-2000-28401) See further [27, 28]. The objective of this project was to develop and deploy a knowledge management (KM) system. Hence, the purpose of EKD modeling was to develop a specification and an adoption plan for a KM system. The case was structured into a number of sub-projects taking place at various departments – the Drug Abuse Prevention Center, the Traffic Department, the School Board, the Municipal Police, the Department of Environment, and the Department of Real Estate. Each of these used EKD to elaborate and resolve specific issues related to KM. Across the cases ca 60 stakeholders, 4 modeling facilitators and 7 modeling technicians were involved. The results were later integrated in order to develop a KM strategy for the RCC. The Micrografx FlowCharter tool was used for documenting the models and the BSCW tool for communicating within the project.

Application case at *Verbundplan GmbH*, Austria, the consulting branch of the largest energy producer in Austria, took place during 2001-2002 within the FP5 IST programme project "Hypermedia and Pattern Based Knowledge Management of Smart Organizations", see [27, 29]. Similarly to the RCC case, the purpose of EKD modeling was to establish the vision, KM process as well as to capture business requirements for a KM system. EKD modeling was performed in three sub-projects: repairing damages in hydro power plants, risk management, and project identification. The results contributed to establishing the corporate KM process and the KM system. Models were documented by the Micrografx FlowCharter tool and the modeling team communicated through the BSCW tool. At the later stages of the project models were part of corporate knowledge repository supported by the Requirements Engineering Through Hypertext (RETH) tool and its web-export functionality [30].

Application case at Skaraborgs Sjukhus (SKaS) during 2003-2006, within the project Efficient Knowledge Management and Learning in Knowledge Intensive Organizations (EKLär), supported by Vinnova, Sweden. SKaS is a cluster of hospitals in Western Sweden collaborates with primary care centers and municipal home care. The objective of the project was to develop a KM system and routines to support knowledge sharing among actors in the healthcare process (see further [16]). The purpose of EM was to develop a knowledge map that describes the contents in and structure of the knowledge repository. The knowledge map is in the form of an EKD Concepts Model. iGrafx Flowcharter was used to document the model. The specifics of this project was that although the resulting Concepts model could be considered as relatively small, it was refined numerous times and constantly updated throughout the project in order to reflect the stakeholders' understanding of the knowledge domain. This model essentially serves as a "blueprint" for the knowledge repository at SKaS.

Apart from these projects, EKD and its earlier versions have been used in a number of smaller problem solving and organizational design cases at e.g. Strömma AB (S), Ericsson (S), RRC College (LV), Livani Sistrict (LV), and British Airospace (UK).

4 Experiences from using EKD in practice

We have collected our experiences throughout more than 10 years of EKD application. Some are of a general nature and some are specifically related to the EKD modeling language, the EKD modeling process and tool support for the method.

4.1 General experiences

In our experience EKD has the potential to provide good results in terms of high quality models, improved understanding of the problem among domain stakeholders, improved communication between stakeholders and personal commitment among stakeholders to the modeling result. However, it is fair to say that the achievement of these results is more resource-consuming than may appear at first, due to the perceived simplicity of the method. It may appear that anyone can use the method with a minimum of training and practical experience. Our experience as well as research (see e.g. [23]) has shown that this is a false perception. The following preconditions need to be fulfilled before using the method in a real life situation that has any real importance to the organization concerned:

- The modeling team must be given a *clearly stated mission* to pursue.
- *Sufficient time* and other *resources* must be allocated to the activity, for the project group *and* for other people in the organization to engage in the modeling work.
- The *modeling team must be given authority* to design or re-design organizational as well as technical processes, procedures, concepts, and rules.
- The *team must be well-balanced* in terms of knowledge about the problem at hand.
- There is a skilled and *experienced modeling facilitator* available.

In addition to these conditions, each particular situation should be assessed in order to decide whether or not it is appropriate to use the method. We have found that the characteristics in Table 2 distinguish appropriate from inappropriate situations.

Appropriate situations:	**Inappropriate situations:**
consensus-oriented organizational culture	authoritative organizational culture
management by objectives	management by directives
when agreement among stakeholders needs to be ensured	constant "fire-fighting"
when reliable information is otherwise difficult to obtain (e.g. multiple stakeholder perspectives need to be consolidated, wicked or ill-defined problems)	strong sense of hidden agendas
	trivial problem
	lack of skilful modellers

Table 2: **Characteristics that distinguish situations for EKD usage**

These characteristics are mainly related to the fact that EKD uses a participative approach to modeling. General recommendations for using participative modeling can be found in [22, 23 and 24].

4.2 The EKD modeling language

Each model type in EKD has its particular focus. Depending on the application context, some become more heavily used than others. However, whichever the

application the Goals Model, the Business Process Model, the Concepts Model and the Actors and Resources Model tend to dominate EKD usage. These sub-models answer the Why, How, What and Who questions that need to be asked about an enterprise regardless of situation, be it systems development, process development or strategic development.

Even though EKD has its own modeling language, it allows replacing the modeling language of one sub-model with a similar modeling language addressing the same modeling problem. It also allows adding sub-models. Such adaptations can be made as long as the inter-model relationships in EKD are kept intact. This feature is useful when the situation in general is appropriate for using EKD but it has specific needs with regard to modeling capacity that the method cannot cater for.

There are two alternative notations in EKD, one simple and one more semantically rich. In the main portion of our work we have used the simple notation in modeling sessions, due to the fact that the stakeholders involved have to a large extent not been experienced modelers. We have found this to be a successful approach. In fact, an experienced facilitator makes training of domain stakeholders unnecessary. The facilitator will instead introduce the ideas of modeling and the notation little by little. Some situations, however, require more formality. We suggest that such formality is introduced after the modeling sessions using interviews with the stakeholders.

We have not seen the feature of explicit inter-model links in other methods. EKD suggests that they are useful for ensuring the quality of models and for driving the modeling process forward and reasoning about the model. The facilitator can use them to validate the models and the decisions of the modeling group..

As for model quality, practitioners are mainly concerned with whether the set of resulting models are coherent as a whole and that they are possible to implement. [23]. This is our experience too. Also, depending on the project objectives an empirical study [31] shows that a sub-set of the criteria of completeness, flexibility, simplicity, understandability, integration, usability (implementability), correctness apply to Enterprise Models in most cases. Sometimes sessions do not produce high quality models. Nevertheless, they may still add value through the discussions among participants. The EKD modeling process hence produces two kinds of useful results: (1) The produced models, which are used in further development activities, and (2) The changed thinking and the improved knowledge of the participants.

4.3 Modelling process

The most useful features of the EKD process throughout our work are: 1) the parallel development of sub-models using inter-model links and 2) the participatory approach to modeling. In our opinion modeling languages need to be combined with a suggested way of working. This is, however, seldom provided. EKD is an exception. The danger of a lacking process is that it may imply that modeling in practice is fairly simple. In our experience it takes a long time to become a skilled modeler, and also to become a skilled modeling facilitator. Training should not be taken lightly. An organization that plan to develop this competency should have a long-term strategy. More about competency requirements for modeling can be found in [23].

The planning an EM project/activity is also critical. It is highly desirable that method experts have a strong influence on selecting domain stakeholders for the modeling team. Once they have been chosen, they need to be prepared for what will happen during the sessions. This is particularly critical in organizations that are not used to modeling in general and particularly to modeling in a group. Before the modeling session each participant has to understand the objective of the modelling session, agree upon the importance of this objective, feel personally capable to contribute to a positive result, and be comfortable with the rest of the team (including the facilitator). More about preparing for EM can be found in [22].

4.4 Tool support

The EM process needs to be supported by tools. The tool requirements depend on the organization's intentions (e.g. will the models be kept "alive") and situational factors (e.g. the presence of skillful tool operators and resources). More on how to select and introduce EM tools in organizations is available in [32].

Group meeting facilitation tools, e.g. GroupSystems, are used to support modeling. They have become more sophisticated and popular. However, they still lack specific support for participative EM, e.g. for guiding the modeling process [33], or "close to reality" graphic resolution. We recommend using a large plastic sheet and colored notes to document the model during a modeling session (Fig.2). Then modeling can be set up in almost any room with a sufficiently large and flat wall. Also it, allows the participants to work on the model without disturbing each other. If a computerized tool and a large projection screen are used, the participants have to "queue" in order to enter their contributions. This usually slows down the creative process. In addition the "plastic wall" is also cheap and does not require technicians to set it up.

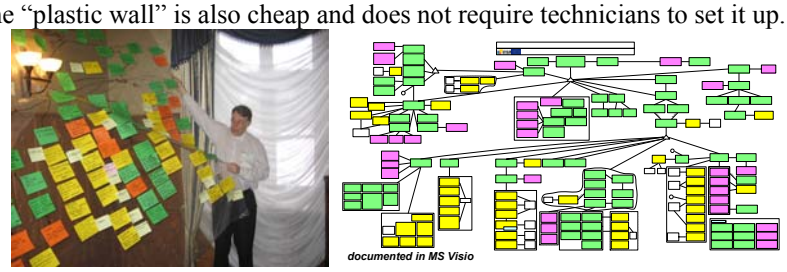

Figure 2: **Modeling result – an EKD Goals Model after 10 hours of modeling with 12 domain experts and after documenting it in Microsoft Visio.**

After the modeling session the models on plastic may be captured with a digital camera. If they are to be preserved, e.g. included in reports, posted on the intranet, it needs to be documented in a computerized *modeling tool* (see fig.2). This category of tools includes simple drawing tools and more advanced model development and management tools. In "stand-alone" projects only drawing support may be needed. If so, simple drawing tools such as Microsoft Visio and iGrafx FlowCharter have proven to be useful and cost-effective [1, 32]. In other cases, e.g. when enterprise models need to be communicated to large audiences or linked with existing information systems, more advanced tools should be used. In this category of tools we find e.g. Aris (IDS Scheer) and Metis (Troux Technologies). Apart from modeling

tools EM projects need group *communication and collaboration tools*. We have successfully used Basic Support for Collaborative Work (BSCW) tool (Fraunhofer).

Business requirements for EM tools include integration of EM tools with MS Office, model visualization and presentation requirements (often in web-format) as well as reporting and querying requirements. We have also observed a growing need to connect models to information systems, thus making the models executable. An extended presentation of requirements for EM tools is available in [32].

5 Conclusions and Future Work

This paper has presented some experiences from using the EKD EM method for more than ten years. The experiences made will influence further development of the method and its supporting tools. One of the main weak points is that, at present, the method lacks a software tool that supports the deployment of the method.

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