

The B-KIDE Framework and Tool for Business Process Oriented Knowledge Infrastructure Development

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Abstract: The need for an effective management of knowledge is gaining increasing recognition in today's economy. To acknowledge this fact, new promising and powerful technologies have emerged from industrial and academic research. With these innovations maturing, organizations are more and more willing to adapt such new knowledge management technologies to improve their knowledge intensive businesses. However, the successful application in given business contexts is a complex, multidimensional challenge and a current research topic. Therefore, this contribution addresses this challenge and introduces a framework for the development of business process-supportive, technological knowledge infrastructures. While business processes represent the organizational setting for the application of knowledge management technologies, knowledge infrastructures represent a concept that can enable knowledge management in organizations. The B-KIDE Framework introduced in this work provides support for the development of knowledge infrastructures that comprise innovative knowledge management functionality and are visibly supportive of an organization's business processes. The developed B-KIDE Tool eases the application of the B-KIDE Framework for knowledge infrastructure developers. Three empirical studies that were conducted with industrial partners from heterogeneous industry sectors corroborate the relevance and viability of the introduced concepts.

Key Words: Knowledge Management, Knowledge Infrastructures, Business Processes, System Analysis, System Design, Development Tools

1 Introduction

Knowledge in modern economies is increasingly playing a key role in achieving organizational success. Knowledge management (KM) as a concept and a scientific discipline emerged to acknowledge this fact. Three main reasons can be identified for this development [Siv01]. 1) *Need:* Today's information technology-enabled organizations have to process and make use of ever more information in ever decreasing time cycles. 2) *Recognition of need:* Organizations increasingly recognize the need for and the importance of conscious management of knowledge [MRH⁺04]. 3) *Availability of KM-Instruments:* Past research activities (such as [MT02, MR02, Leh02, LSF⁺02, Rol03]) and product innovations

(such as [Hyp, Liv, Lot]) in the field of knowledge management promise to provide sound instruments for addressing current KM challenges and enabling the management of knowledge in organizational settings. These three observations represent insightful explanations for the emergence of knowledge management.

Practicing *knowledge management* in organizations can be achieved through the development and implementation of *knowledge infrastructures* [Siv01]. In this contribution, *knowledge infrastructures* are defined as the set of all successfully implemented interventions, measures, institutions and facilities that represent a supportive environment for knowledge workers who execute knowledge intensive tasks. These knowledge infrastructures consist of three main dimensions: 1) people 2) organizational- and 3) technological systems whereas knowledge is defined to be information that is relevant for business actions [Str03a]. According to a Delphi study on the future of knowledge management¹, the successful integration of knowledge management into an organization's business processes is regarded to be the most pressing and challenging theoretical research issue for the understanding and advancement of knowledge management. By taking the increasing number of organizations certified according to a process oriented management standard into account [isoa, isob], the importance of this issue is even more emphasized. Among others, these insights motivated the research of this contribution, which aims to enable the development of technological knowledge infrastructures that are integrated in and supportive of an organization's knowledge intensive business processes. Two main research challenges are of utmost relevance in the context of this objective:

(1) Support for Business Process Networks: Business process management deals with the management, continuous improvement and optimization of business processes [ISO00a]. In knowledge intensive organizations, business processes are typically more and more knowledge intensive [ESR99] and interconnected. Instead of focussing only on the optimization of *isolated business processes*, current standards for business process- and quality management (such as [ISO00a]) suggest that organizations should investigate, support and improve their *networks of business processes, especially focussing on interactions between them* [ISO00c, section 5.1.2]. Knowledge as the key resource of knowledge intensive organizations represents a significant cause for interactions between knowledge intensive business processes [Str03a]. By failing to focus on such knowledge interactions, an organization is not able to optimize the sum of its efforts (its business process network), instead it is targeting local optima (specific business processes) that do not necessarily contribute to an organization's overall goals.

¹ carried out in 2001/2002 by the Fraunhofer Competence Center Knowledge Management, Berlin and the Institute for Psychology of the Humboldt-University, Berlin [MHV03, chapter 8]

Although today's organizational knowledge management initiatives already focus on multiple business processes rather than on a single business process [MR02], surprisingly neither existing process standards (such as [ISO00b]) nor existing business process modeling techniques (such as [Sch96]) nor knowledge management approaches provide comprehensive concepts on how to tackle this identified challenge. [RL00] strikingly acknowledge the need for scientific concepts in this area by stressing that successful support for knowledge intensive business processes is, to a greater extent, a matter of supporting knowledge flows (knowledge interactions that span multiple business processes [Rem02]) rather than workflows.

(2) Application of Knowledge Management Technologies: Today, a heterogeneous set of knowledge management (KM) technologies is available from industrial vendors (such as [Hyp, Liv, Lot] and others) as well as from academia (such as [WK02, Dus02, Eng03, HTEN03] and others). Failures of technology-driven KM projects in the past that did not take critical business requirements of organizations into account [Rol03, Chapter 3] urgently call for concepts that aid the application and configuration of KM technologies to specific business contexts. KM technology itself can today be classified according to different dimensions. The MT²-Model introduced by [MT02] distinctly classifies KM system functionalities based on different types of communication between people and technological systems. Each class is represented through a specific arrow index. One specific class of KM functionality (titled 'Arrow 3' in the MT-Model) describes the ability of technological knowledge infrastructures to *generate new knowledge and autonomously perform appropriate actions (such as the routing of information between people) based on the implicit input of data by users without burdening them*. The non-intrusive nature of this KM functionality combined with its high potential to support the execution of knowledge intensive business processes especially makes this type of KM functionality the most promising one to be effectively applied to specific, operative business contexts. The scientific question that emerges from this conclusion is how such a business alignment of KM functionality can be achieved. Therefore, research challenge 2 calls for concepts that support the successful application of KM functionality³ to given business contexts.

The two research challenges introduced provide a profound fundament for the definition of the main objective of this contribution, which is to:

Introduce a framework that allows for the development of *business process-supportive, technological knowledge infrastructures* for knowledge inten-

² MT...Maurer-Tochtermann

³ more specifically: 'Arrow 3' KM functionality of the MT-Model

sive organizations.

2 Related Work

This contribution relates to and builds on concepts from areas such as Business Process Oriented Knowledge Management [All98, Hei01, Rem02, PMA02], Modeling and Engineering of Business Information Systems [Sin95, Sin97, FS01], Requirements Engineering [RR99], Systems Analysis [YC79], Social Network Analysis [Pai03, MPF04, CLC04] and Knowledge Management Technologies [MT02, MR02, Rol03]. Since Business Process Oriented Knowledge Management (BpoKM) represents the most significant area for addressing the identified objective, a model of challenges in this domain is introduced in figure 1. *Business Process Analysis* focuses on knowledge oriented analysis of business processes and represents the fundament of most approaches in the field of bpoKM. *Business Process Modeling* deals with the integration of knowledge-aspects into business process models (such as [All98, PMA02, GPSW03]). *Business Process Learning* aims to provide support for learning in or about business processes (such as [SP01, PPS02]). *Business Process Support* focuses on support for knowledge workers in their respective business processes (such as [BsV00, RES⁺00, Jan00, Hei01, HHDG02, MHV03]). *Business Process Execution* deals with knowledge-oriented extensions to traditional workflow management systems (such as [WWT98, MH99, RMS00, AML⁺01]). *Business Process Improvement* deals with improvements of business processes from a knowledge perspective (such as [DHB01, VA⁺02]). Because the anticipated framework aims to provide guidance in the development of business process supportive knowledge infrastructures, the contribution at hand can be well be assigned to the domain of *Business Process Support*.

The methodological research approach chosen to serve as a fundament for this contribution was *design research*. In this contribution, design researchers are considered to create realities through constructive intervention, then reflectively become positivist observers, recording the behavior of the system and comparing it to the predictions (theory) set out during a suggestion phase [VK04]. Other research approaches (such as case study research [Mac97] or action research [Koc97]) were utilized in this work as well - in clearly defined areas of application within an overall design research approach.

3 Knowledge Infrastructure Development

Today, organizational knowledge management initiatives such as the development of knowledge infrastructures are largely organized as a project [MR02].

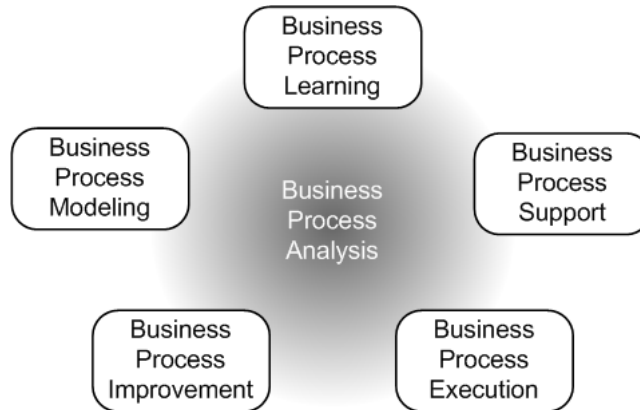


Figure 1: A Model of BpoKM Challenges

Figure 2 introduces relevant *roles* and respective *tasks* of knowledge infrastructure development projects⁴.

The *knowledge manager* (or CKO - chief knowledge officer) is regarded to be highest ranked role in knowledge management [Mai02, p.143]. In this steering position, his main responsibility is to develop and implement a knowledge management strategy⁵ and to initiate and coordinate knowledge management projects. The *project manager* (or knowledge project manager [MHV03]) is in charge of running KM projects [SAA⁺02, p. 22]. He focuses on aspects related to project management such as the development of project goals and plans or the coordination of project team members [MHV03, p. 107]. *Knowledge workers* are the primary target group for KM projects [Mai02, p. 150]. Therefore, KM projects aim to support and improve the work of knowledge workers [DJB95]. *Knowledge analysts* are responsible for analyzing organizational knowledge work executed by knowledge workers. Similar to the concept of system analysts [You89, p. 56], they investigate a complex object system (organizational knowledge work) and create models that illustrate core aspects of the system under investigation. The *knowledge infrastructure designer* is responsible for transforming the developed models of organizational work into a design of a knowledge infrastructure, that describes a supportive environment for knowledge workers (in analogy to [You89, p. 57]). Lastly, the developed knowledge infrastructure design represents the basis for implementation (not depicted in figure 2).

⁴ The dotted lines in figure 2 illustrate aspects that are outside of the scope of this contribution.

⁵ [Leh00, p. 226], [SAA⁺02, p. 22], [MHV03, p.107]

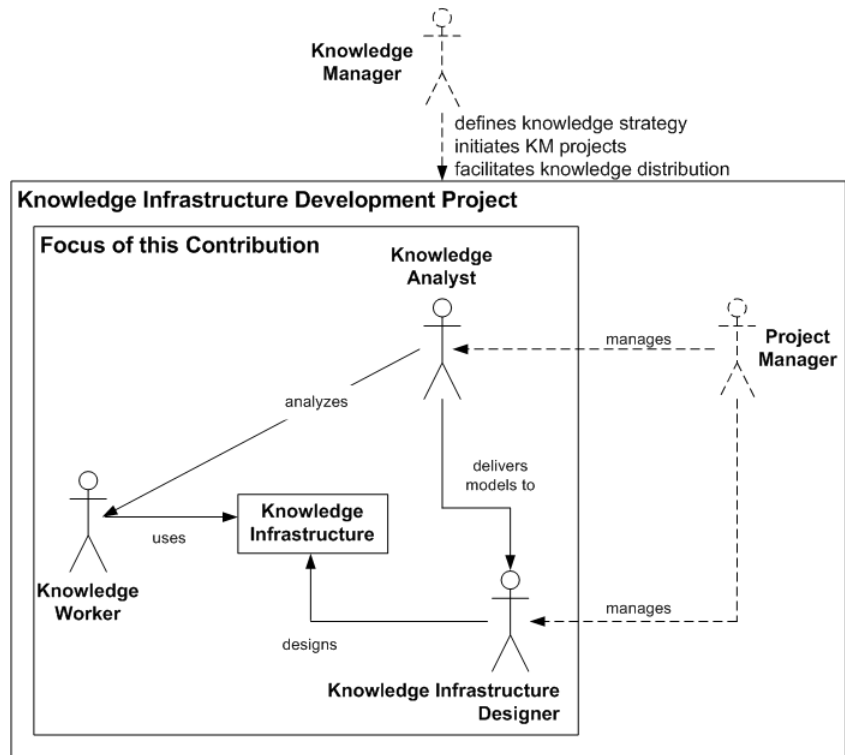


Figure 2: Knowledge Infrastructure Development Projects (based on [SAA⁺02])

4 The B-KIDE Framework

In industrial environments, buildings already are planned and designed based on business processes. To give an example: In order to design BMW's⁶ new development center in Munich, the industrial architect in charge Gunter Henn analyzed the center's targeted product development processes and deduced impacts on the building's architecture [Wol03, Str03b]. What can be concluded is that business processes obviously pose implications for the architecture of organizational buildings. Therefore, a fundamental hypothesis of this contribution is that business processes pose implications for the development of organizational knowledge infrastructures as well.

4.1 Principle Approach

In knowledge intensive settings, business processes are typically complex [ESR99] and weakly structured and therefore are not capable of being a direct basis for the

⁶ BMW...Bayrische Motoren Werke

development of business process supportive knowledge infrastructures. A commonly used approach to overcome this problem is to identify and model organizational knowledge processes based on business processes⁷ that visualize relevant, executed knowledge work in different ways. The concept of knowledge processes [Str03a] allows for the visualization of distributed organizational knowledge flows in a novel and effective way. Figure 3 introduces this concept via an accessible yet abstract example. The depicted knowledge process visualizes how knowledge of a given knowledge domain is generated, stored, transferred and applied across a set of business processes and involved organizational roles in an organization. The question mark in figure 3 thereby indicates an improvement potential for the exemplary knowledge process. By the identification of such knowledge processes⁸, a more profound basis for knowledge infrastructures that aim to support the execution of knowledge intensive business processes is established.

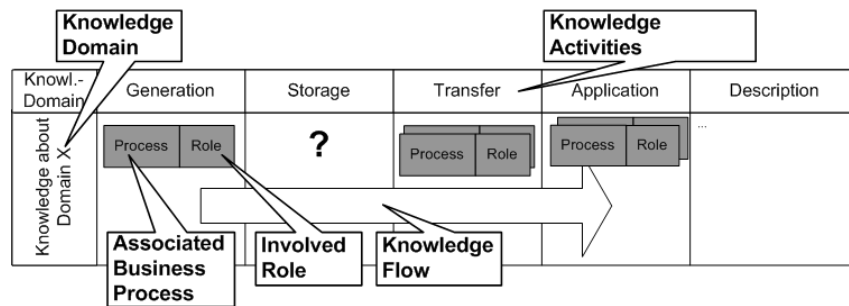


Figure 3: Simplified Illustration of a Knowledge Process

4.2 B-KIDE Framework Components

The conceptual B-KIDE⁹ Framework illustrated in figure 4 represents an elaboration of the principle approach and consists of three main components: 1) the B-KIDE Model Architecture 2) the B-KIDE Method and 3) the B-KIDE Context. While the B-KIDE Model Architecture deals with aspects of modeling knowledge processes, the B-KIDE Method focuses on the development of knowledge infrastructures based on these knowledge processes. The B-KIDE Context describes the environment in which the B-KIDE Framework and a complementary supporting software tool, the B-KIDE Tool, can be employed. The B-KIDE

⁷ such as [Str03a], [Rem02, chapter 11.3], [GPSW03]

⁸ that are considered to run *within and/or across business processes*

⁹ B-KIDE...Business process oriented Knowledge Infrastructure DEvelopment

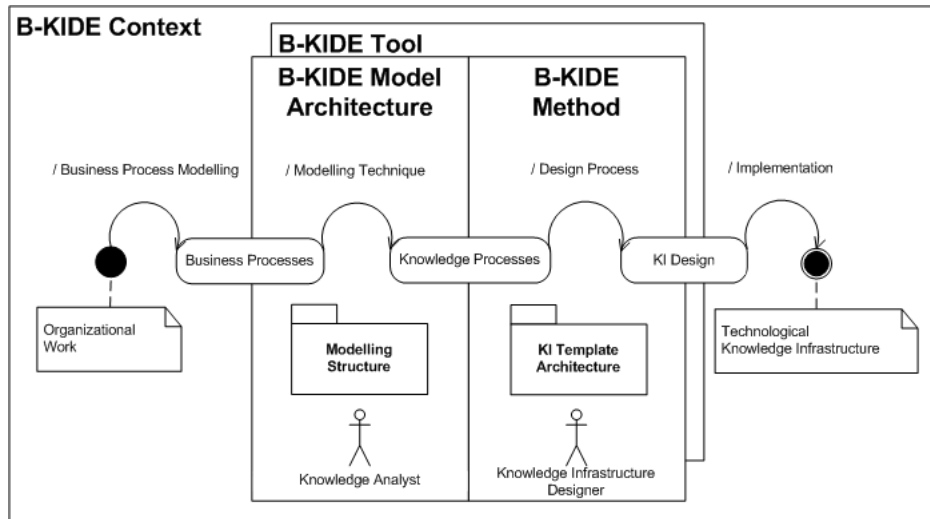


Figure 4: B-KIDE Framework - Principle Approach and Components

Tool represents an implementation of the B-KIDE Model Architecture and supports the application of the B-KIDE Method. It aids knowledge analysts on an operative level in building models about organizational knowledge work and knowledge infrastructure designers in the development of appropriate knowledge infrastructures based on these models (similar to what [Tol98] defines as method-tool companionship).

4.3 B-KIDE Context

The B-KIDE Framework and the according B-KIDE Tool aim to provide conceptual as well as operational (tool) support for knowledge analysts and knowledge infrastructure designers. Knowledge analysts are aided in modeling organizational knowledge work while knowledge infrastructure designers are aided in the process of designing business process supportive knowledge infrastructures. The B-KIDE Framework focuses on the initial, statical identification of *currently executed* knowledge processes in organizations as a basis for the development of business process supportive knowledge infrastructures. Dynamic aspects of knowledge processes (e.g. change over time) are not considered. By relating the SER¹⁰-Model introduced by [FMO⁺94] to the context of this contribution it becomes clear that the B-KIDE Framework contributes to a seeding phase of knowledge infrastructure development. The B-KIDE Framework supports the development of knowledge infrastructures on an implementation- and

¹⁰ SER...Seeding - Evolutionary Growth - Reseeding

vendor-independent level. Thereby, resulting knowledge infrastructures can be represented through a variety of technological options such as organizational intranets, file servers, document-, content- or knowledge management systems.

4.4 B-KIDE Model Architecture

The B-KIDE Model Architecture provides directives for creating models of organizational knowledge work based on business processes. The main output is a formal representation of knowledge processes identified in an organization. The B-KIDE Model Architecture consists of two main elements: 1) a *modeling structure* and 2) a *modeling technique*. These two elements correspond to what [HvR00] describe, in the context of modeling object systems, as the "Way of Modeling" and the "Way of Working". The *modeling structure* (The Way of Modeling) introduces the conceptualizations that are used in a modeling effort (notations, conceptual structures) while the *modeling technique* (The Way of Working) describes the procedures by which models about an object system are constructed (the process and corresponding activities). Both are introduced in greater detail in the following sections.

4.4.1 Modeling Structure

The B-KIDE Modeling Structure defines how organizational knowledge work is being modeled with the B-KIDE Framework. Figure 5 depicts the essential elements & relationships of the modeling structure illustrated by a conceptual UML¹¹ diagram.

In this figure, *Knowledge Domains* represent topical fields of knowledge which are relevant in the context of undertaking certain *Business Actions*. *Specific Knowledge Activities* are basic knowledge processing activities executed by individuals, groups of people or technological systems. They represent qualified associations (such as the generation, storage, transfer and application) between *Knowledge Work* and *Knowledge Domains*. In the B-KIDE Modeling Structure, the *Specific Knowledge Activities* generation, storage, transfer and application [Hei01] are utilized since they adequately¹² describe knowledge work on an operative (or knowledge object) level¹³. *Specific Knowledge Activities* are further semantically refined through additional association objects, represented by *Generation, Storage, Transfer and Application Objects*. An example for a Transfer

¹¹ UML...Unified Modeling Language

¹² with respect to the identified challenges of this contribution

¹³ Here, a necessary distinction between specific *knowledge* activities (on a knowledge object level [SAA⁺02]) and specific *knowledge management* activities (on a knowledge management level [SAA⁺02] - such as knowledge planning, identification or assessment) has been made.

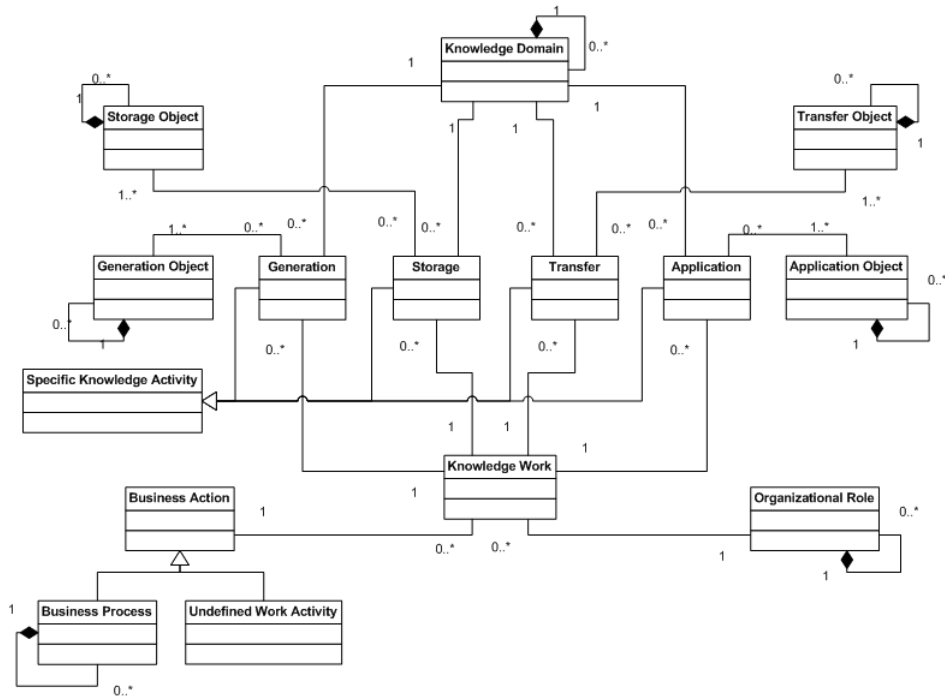


Figure 5: The B-KIDE Modeling Structure

Object would be a specific “newsletter” or a “voice chat tool”. These objects are organized in hierarchical reference models¹⁴ to ensure unique existence of them in B-KIDE models of organizational knowledge work (similar to the ARIS-House concept by [Sch00]). Beneath that, *Knowledge Domains*, *Business Processes* and *Organizational Roles* as well are organized in hierarchical reference models because of the same reason. *Knowledge Work* is performed whenever knowledge of a certain *Knowledge Domain* is being processed (generated, stored, transferred or applied) by an *Organizational Role* in a *Business Action*. A business action is either a *Business Process* or an *Undefined Work Activity*. *Business Processes* represent an organizational environment in which *Knowledge Work* is performed. *Undefined Work Activities* represent the complement set to *Business Processes*. They contain all *Business Actions* that are not modeled in *Business Processes*.

4.4.2 Modeling Technique

Modeling with the B-KIDE Framework is based on structured, process-oriented interviews with knowledge workers of a target organization. The knowledge an-

¹⁴ so-called B-KIDE Reference Models

alyst is responsible for performing these interviews with selected organizational roles. The main instrument for that purpose is the B-KIDE Tool. The B-KIDE Modeling Technique in figure 6 describes the way of modeling organizational knowledge work with the B-KIDE Framework. The process is divided into the following four main sub activities:

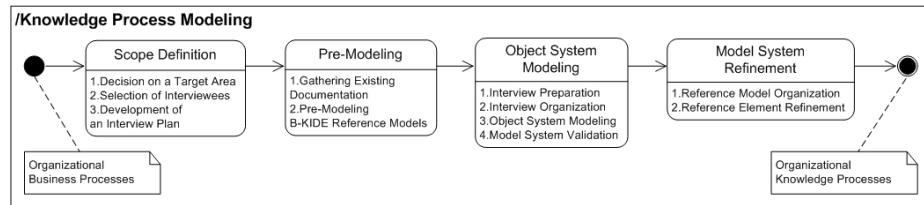


Figure 6: The B-KIDE Modelling Technique

Scope Definition: During scope definition, a decision concerning the targeted business area has to be made. This includes the determination of business processes and organizational roles that should be supported by the anticipated knowledge infrastructure. Based on this scope, interviewees need to be selected and an according interview plan needs to be developed.

Pre-Modeling: In order to prepare for the actual modeling, existing documentation about organizational structures can be gathered and analyzed. This includes material such as existing business process models, knowledge structure diagrams, hierarchical organization charts, business strategies, existing technological systems, filing structures, communication channels and others. Based on this documentation, the introduced B-KIDE Reference Models can be prepared to some extent before actually starting to model the object system of organizational knowledge work through interviews. Thereby, pre-modeling significantly lowers the burden of work for knowledge analysts during interview situations.

Object System Modeling: This activity is concerned with the actual process of interviewing in order to develop an inter-subjective model of organizational knowledge work. The knowledge analyst prepares the interview by utilizing available B-KIDE interview guidelines and employs the B-KIDE Tool to raise questions and documents answers given in accordance with the B-KIDE Modeling Structure. He uses (provisional) reference models of past interviews for current interview situations, following an iterative approach of modeling reference models (as e.g. pursued by [SAA⁺02, page 206] as well). At the end of each interview, the knowledge analyst together with the interviewee correct and validate the gathered data¹⁵.

¹⁵ Aspects of validation include checks for 1) self-consistency, 2) uniqueness of model

Model System Refinement: After finishing each interview, the knowledge analyst reorganizes and refines the hierarchical reference models according to his gained understanding about the object system. Although the knowledge analyst (the modeler) thereby slightly influences the model system, this activity supports the knowledge analyst in subsequent interview situations.

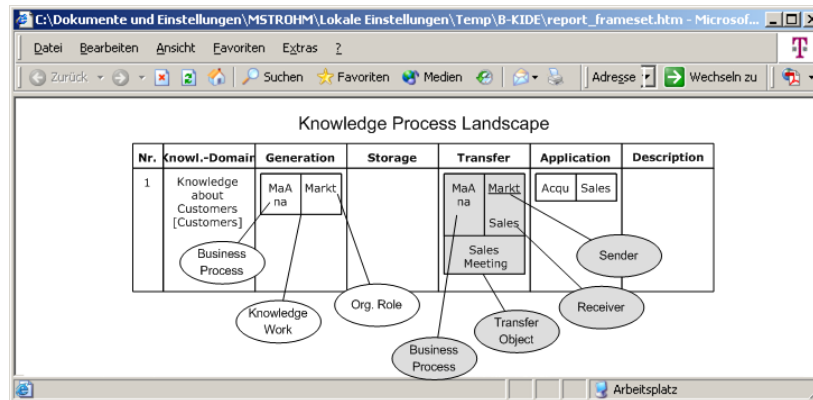


Figure 7: The B-KIDE Tool Report "Knowledge Process Landscape"

The application of the B-KIDE Modeling Structure & -Technique together with the B-KIDE Tool (that is introduced in greater detail in section 5) results in visualizations of knowledge processes as illustrated in figure 7¹⁶. The exemplary knowledge process depicted is interpreted in the following way: The knowledge domain "knowledge about potential customers" is generated in the business process "Market Analysis" by the organizational role "Marketing". The knowledge is transferred via Sales Meetings (in the "Market Analysis" business process) to Sales agents, who need to apply it in their respective business process "Acquisition". No storage of knowledge takes place in that situation. Such formal knowledge process visualizations represent the basis for the development of business process supportive knowledge infrastructure designs with the B-KIDE Framework.

elements and 3) model accuracy (based on [KS98, p.103-104]).

¹⁶ This screenshot was graphically revised in order to increase comprehensibility of the concepts to be communicated

4.5 B-KIDE Method

The B-KIDE Method provides a set of directives for the development of knowledge infrastructure designs based on knowledge processes and consists of two main elements: A *knowledge infrastructure template architecture* and a normative *design process*.

4.5.1 Knowledge Infrastructure Template Architecture

The knowledge infrastructure template architecture in figure 8 represents a system architecture, which describes the basic layers of technological solutions that are capable of tackling the challenges of this contribution. The basic layers are: 1) *Contents* 2) *Taxonomies and Meta Knowledge*¹⁷ and 3) *Access*. Existing research provides comprehensive concepts for these layers. For example, extensive classifications of *contents* of technological knowledge management systems are available [Mai02, chapter 7]. The development of *taxonomy and meta knowledge* concepts is aided by e.g. available standards [Dub03, Ass02], procedures [DB03], methods [MHA03], best practices [RR03] or the concept of ontologies [AML⁺01, KHS03]. On the *access* layer, instruments such as hierarchical tree or list navigation, catalogues [Net04], retrieval systems, complex visualizations [KSG⁺03], standards [Ame03] as well as portals [Dia01, Noh02, LSF⁺03] aid development efforts. Based on identified knowledge processes, the knowledge in-

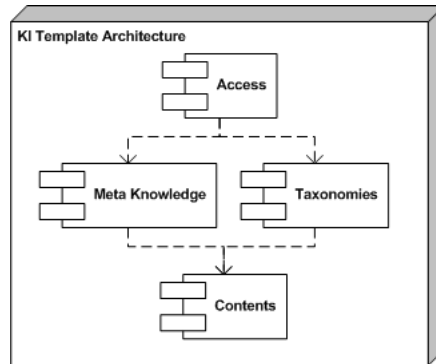


Figure 8: The Knowledge Infrastructure Template Architecture

rastructure template architecture is instantiated per knowledge infrastructure development project by utilizing the B-KIDE Method and existing concepts (as

¹⁷ Both, taxonomies and meta knowledge, represent concepts for knowledge organization and therefore are grouped together

briefly listed above) for the design of business process supportive knowledge infrastructures for organizations. By applying the B-KIDE Method, knowledge processes become reified in knowledge infrastructures.

4.5.2 Design Process

To aid the design of knowledge infrastructures that support an organizations knowledge intensive business processes, a normative design process is introduced. Based on knowledge processes identified by knowledge analysts, this design process aids knowledge infrastructure designers in integrating identified (knowledge) requirements into knowledge infrastructure designs. Typically, design is either perceived as a product or a process. Because of the emergent field of knowledge management systems and vendors and the lack of common conceptualizations, this work predominately focuses on a process approach to design. Thereby, the resulting approach can be applied across different knowledge management system vendors and conceptualizations. In this contribution, the following definition of design by [YC79] is applied:

”Design means to plan or mark out the form and method of a solution. It is the process which determines the major characteristics of the final system [...]” [YC79, p. 8]

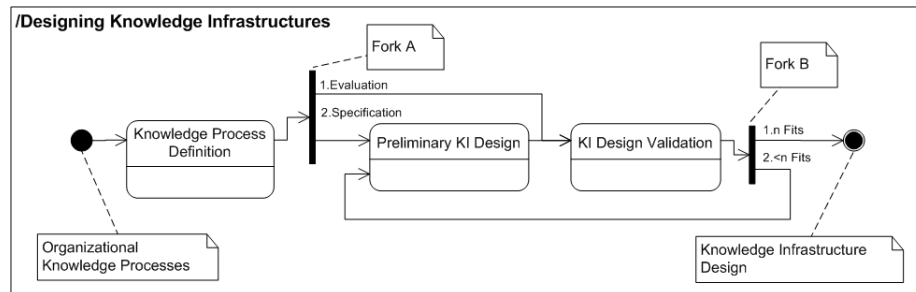


Figure 9: Design Process: Designing Knowledge Infrastructures

The design process is divided in the following three main sub activities:

Knowledge Process Definition: Identified knowledge processes represent the major imperative for the design process. By integrating requirements from knowledge processes in knowledge infrastructure designs, the resulting knowledge infrastructures are able to provide comprehensive support for knowledge

intensive business processes. For specifying these requirements, the knowledge infrastructure designer uses the identified as-is knowledge processes and, together with knowledge workers and representatives of the management, defines to-be knowledge processes based on them. In addition to that, *fit criteria* [RR99] need to be developed. Fit criteria allow to check the developed knowledge infrastructure design¹⁸ for integration of appropriate knowledge process support. While the fit criteria are developed in this design activity, the check is performed later on - in the design activity "design validation".

Fork A in figure 9 illustrates the two principle ways the B-KIDE Method can be applied: Option 1 represents a way to evaluate existing knowledge infrastructures and knowledge infrastructure designs for improvement potentials while option 2 specifies new knowledge infrastructure designs.

Preliminary Knowledge Infrastructure Design: In this activity, the introduced template architecture is instantiated according to the constraints of specific knowledge infrastructure development projects. In each reference architecture layer the knowledge infrastructure designer considers the requirements specified by the knowledge process definitions. Thereby, the knowledge infrastructure designer either designs and introduces a new technological infrastructure, or alters existing infrastructures to enhance technological environments of knowledge workers. The fit criteria developed in design activity 1 (which are applied in design activity 3) already guide the KI designer in his design efforts. This not only allows him to perform the design process in a more efficient way, it also reduces the complexity of this task.

Knowledge Infrastructure Design Validation: This design activity validates the developed knowledge infrastructure design in terms of its support for the defined knowledge processes. The fit criteria developed in design activity 1 now fulfill the purpose of an objective instrument that is utilized for validating the preliminary knowledge infrastructure design. By checking each fit criteria against 1) every defined knowledge process and 2) against the knowledge infrastructure design, the knowledge infrastructure designer can identify *fits* as well as *deficits* in the current design. A lack of sufficient *fits* leads to iterating through design activity 2 & 3 (as depicted by fork B in figure 9).

To summarize:

The application of the B-KIDE Method yields to a design space that is *quantitatively open* (in terms of the number of possible designs) but *qualitatively closed* (in terms of the requirements supported).

In other words, the application of the B-KIDE Method in knowledge infrastructure development projects prescribes *what* needs to be implemented in the

¹⁸ Here, knowledge infrastructure design is understood as a product (vs. a process); e.g. a design document that marks out the form of the final solution.

targeted knowledge infrastructure designs (in the sense of functional requirements - in order to support the defined knowledge processes), but not *how* this functionality is provided.

5 The B-KIDE Tool

5.1 Introduction

The B-KIDE Tool supports knowledge analysts and knowledge infrastructure designers in applying the B-KIDE Framework. The tool implements the B-KIDE Modeling Structure to provide a formal, supportive instrument that reduces complexity of B-KIDE Framework application. The B-KIDE Tool represents an instrument for structured, business process-oriented interviews between knowledge analysts and knowledge workers (employees) of an organization. The gathered interview data is utilized by knowledge infrastructure designers to lay out the design of business process supportive knowledge infrastructures.

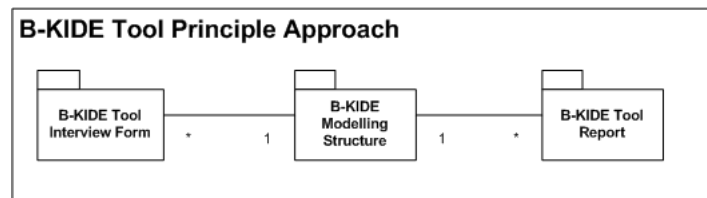


Figure 10: B-KIDE Tool Principle Approach

Figure 10 illustrates the principle approach of the B-KIDE Tool. Front end interview forms, applied by knowledge analysts during interview situations, provide means to map interview data on the B-KIDE Modeling Structure. This ensures that gathered data conforms to the B-KIDE Modeling Structure. On top of the interview data, a set of B-KIDE Tool Reports¹⁹ allows for generating a broad range of different model perspectives (such as a Knowledge Process Landscape) and thereby, allows for generating different models of organizational knowledge work as a basis for profound analysis.

5.2 Tool Structure

The B-KIDE Tool is based on the object-oriented structure depicted in the UML diagram in figure 11. Thus, a *B-KIDE project* consists of multiple interviews and a set of reference models. Each *interview* contains information about

¹⁹ as already exemplarily introduced in figure 7

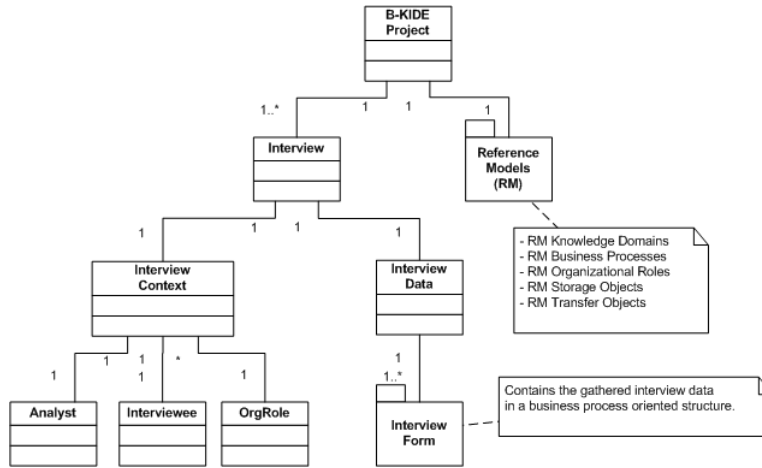


Figure 11: Simplified Illustration of the B-KIDE Tool’s Main Structure

the interview context as well as the actual interview data. *Interview context* contains information about the according interviewee, his organizational role, and the analyst who performs the interview. *Interview data* contains all elicited, interviewee-specific interview information gathered through a series of *interview forms*. In addition to that, *reference models*, which exist in parallel to interview data, represent models of specific dimensions of organizational systems and provide the fundament for modeling organizational knowledge work with the B-KIDE Tool. These dimensions are based on the five reference models²⁰ from the B-KIDE Model Architecture, which are: 1) Knowledge Domain Reference Model 2) Business Process Reference Model 3) Organizational Roles Reference Model 4) Transfer Object Reference Model and 5) Storage Object Reference Model. With the B-KIDE Tool, these dimensions are modeled in a collaborative effort between knowledge analysts and interviewees.

Figure 12 depicts the implementation of the main elements in the B-KIDE Tool user interface. While the area containing the *reference models* remains the same across different interviews of the same project, the *interview context* depicts information specific to certain interviews. The *interview data* area, which changes with changing interviewees, represents the central area for analysts to gather information during interviews. Knowledge analysts raise questions provided by the B-KIDE Tool (Situation ‘A’ in figure 12) and document answers through e.g. dragging & dropping elements from the reference model area up to the interview data area (Situation ‘B’ in figure 12). The application of the

²⁰ The Generation and Application Reference Models were not implemented in the B-KIDE Tool because of the foci of the anticipated case/pilot studies

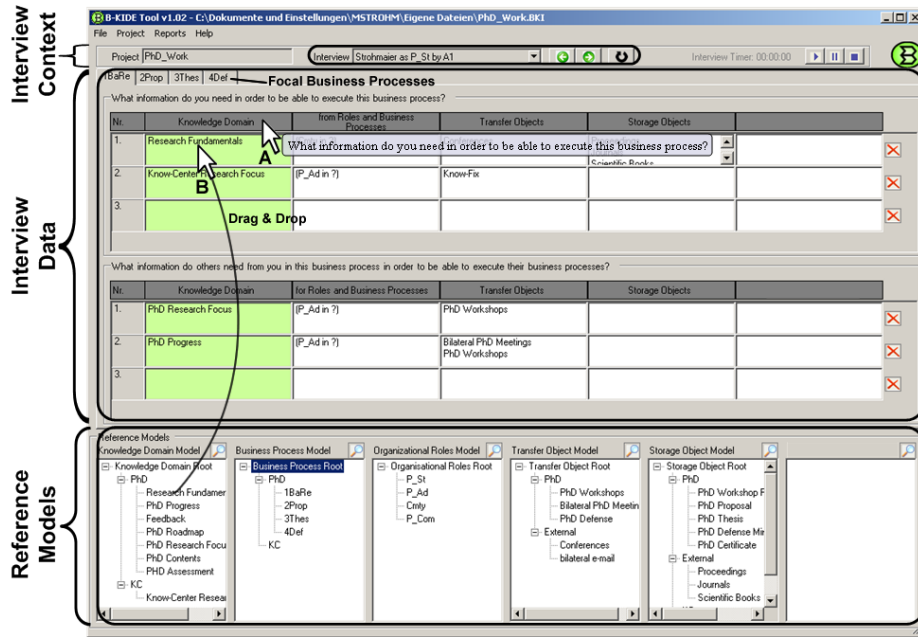


Figure 12: Main User Interface of the B-KIDE Tool

B-KIDE Tool on an operative level is illustrated by the following accessible application scenario.

Application Scenario: Knowledge analyst Arthur, utilizing the B-KIDE Tool, asks interviewee Bill, what information he needs in order to be able to execute the business process "Acquisition", in which he is involved. Bill replies that information about potential customers is necessary for him in order to successfully execute this process. Arthur drags the already existing knowledge domain "knowledge about customers" from the knowledge domain reference model up to the respective answer field within the interview data area. The B-KIDE Tool notices this action and translates the established relation²¹ to the B-KIDE modeling structure. In doing that, knowledge work in business processes is modeled in a way that was depicted and introduced in figure 5.

Interview data within the B-KIDE Tool is structured according to the UML diagram depicted in figure 13. Here, the mapping of interview data onto the B-KIDE Modeling Structure takes place. An *Interview Form* consists of two

²¹ In prose, this relation can be described in the following way: *In Business Process "Acquisition", knowledge about customers is applied by the organizational role "sales agent"*.

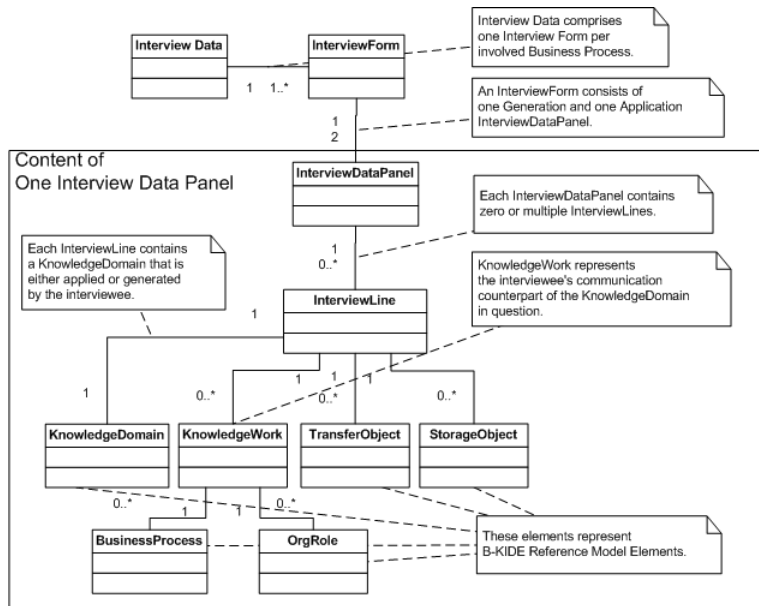


Figure 13: B-KIDE Tool Interview Data Area

Interview Data Panels (that focus on the generation respectively application of knowledge by a knowledge worker through the utilization of request/respond patterns), that themselves contain multiple interview lines. Each *Interview Line* is concerned with a specific *Knowledge Domain* that is either applied or generated by the interviewed knowledge worker. For each knowledge domain, communication partners (*Organizational Roles* in corresponding *Business Processes*) and aspects of storage/transfer can be documented. The structure provided by the B-KIDE Tool to document that information ensures the appropriate mapping of the gathered data onto the B-KIDE Modeling Structure.

5.3 B-KIDE Tool Reports

The B-KIDE Tool supports the generation of two main model perspectives on the B-KIDE Modeling Structure. Firstly, a *Business Process Landscape* visualizes organizational business processes and related knowledge work. The main structuring elements of this perspective are business processes. This perspective is similar to traditional approaches of business process oriented modeling of knowledge work as introduced by e.g. [GPSW03, All98]. Secondly, a *Knowledge Process Landscape* visualizes organizational knowledge domains and related business processes. This represents an orthogonal (knowledge-oriented) view on

business processes and a novel approach to knowledge process modeling. As already introduced in figure 3, the main structuring elements here are not business processes, but knowledge domains. Figure 14 illustrates how B-KIDE Tool Reports can be generated with the B-KIDE Tool.

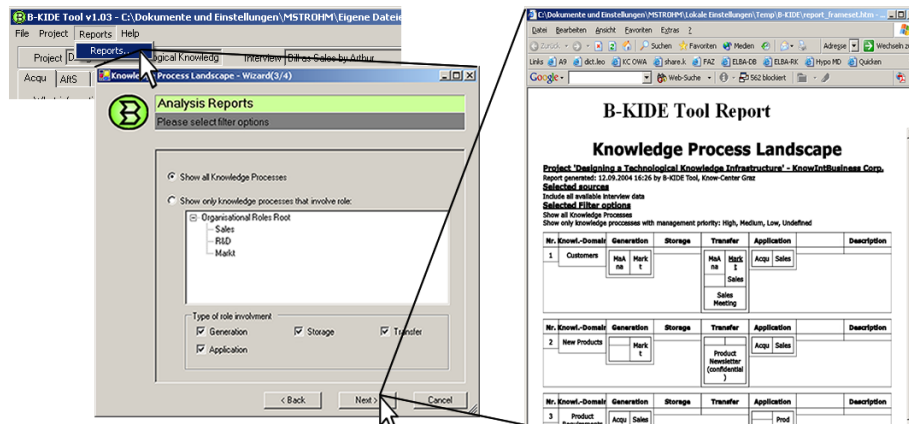


Figure 14: Knowledge Process Landscape Generation with the B-KIDE Tool

5.4 B-KIDE Tool Implementation

The B-KIDE Tool implementation is based on Microsoft's .NET Framework ©[Mic] and the according programming language VB.NET in combination with advanced technologies such as the *Extensible Markup Language* (XML) [BPSM⁺04] or *Scalable Vector Graphics* (SVG) [Gro03] utilizing sophisticated programming techniques such as object-oriented application/data design and object persistence.

6 Empirical Work

6.1 Overview over Conducted Studies

The concept of case and pilot studies was employed to assess the ability of the B-KIDE Framework to achieve reasonable results in complex, real world scenarios. The selection of appropriate studies was driven by the ambition to apply the B-KIDE Framework in the most heterogenous environment available in order to determine the supported degree of generality. Table 1²² gives an overview of the main contents of the three studies conducted with partners from software, automotive and consulting industry. Subsequently one conducted study is introduced in greater detail (Case Study 1) while the remaining other studies (Pilot Study 1 and 2) are only briefly discussed.

	Case Study 1	Pilot Study 1	Pilot Study 2
Project Context	Software Industry, ISO9001:2000 certified	Automotive Industry, formally defined business processes	Consulting Industry, no formally designed business processes
Project Goals	Knowledge Portal Design	EDM System Improvement	Intranet Improvement
Hypothesis tested	B-KIDE Framework	B-KIDE Framework & B-KIDE Tool	
Framework Application	Design	Evaluation	Design
Project Results	Design and implementation of four knowledge portals	EDM system improvement potentials	Design of a KI to support the acquisition process
Study Style	Explorative	Justificative	Justificative
Primary Actor	The Author	A 3rd Person	A 3rd Person
Evaluation concerning	B-KIDE Framework Objective		

Table 1: Overview of Conducted Studies

²² Abbreviations: EDM...Engineering Data Management, KI...Knowledge Infrastructure

that, a set of four fit criteria was developed (such as "All defined roles shall be able to provide knowledge they generate within the defined knowledge processes to the anticipated knowledge infrastructure in a fast and easily comprehensible way."). By utilizing the fit criteria in the knowledge infrastructure design process, the defined-to-be knowledge processes (KP) were integrated into the knowledge infrastructure design (as schematically depicted in figure 16). This procedure led to an implementation of a technological knowledge infrastructure that contained four strongly interconnected, role-oriented and business-process supportive knowledge portals based on [Hyp], a knowledge management software that provides 'Arrow 3' KM functionality [MT02]. Beneath the (visible) results of figure 16, a set of concepts (including an access-, structure- and content concept) derived from the Knowledge Infrastructure Reference Architecture was developed. The implemented knowledge infrastructure successfully provides support for the defined knowledge processes and thereby, for the respective targeted knowledge intensive business process network.

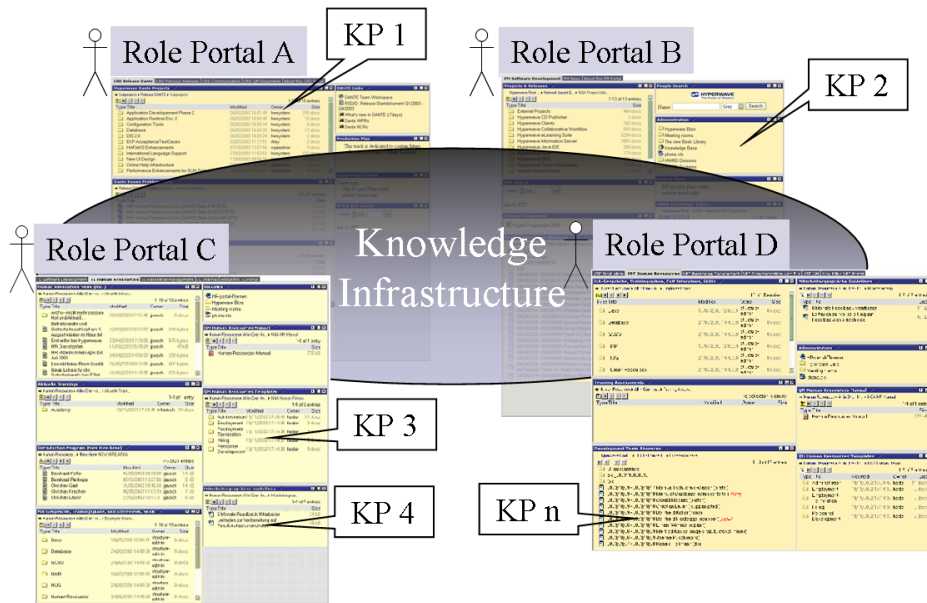


Figure 16: Case Study 1 Results: Four Role Oriented Knowledge Portals

6.3 Pilot Studies

In subsequent pilot studies, the concept of action research was utilized. Action research here was regarded to pursue a dual goal [Koc97]: 1) Improving the organization participating in the research through so-called positive interventions (pilot studies) and 2) rigorously generating valid and consistent knowledge with respect to the defined B-KIDE Framework objective. Two justificative pilot studies were conducted that both applied (through instantiation and utilization) the B-KIDE Framework and the B-KIDE Tool developed. Pilot Study 1, conducted in cooperation with a company from the automotive industry, focused on the evaluation of an existing knowledge infrastructure (a technological Engineering Data Management System). Based on the delta between defined and identified knowledge processes, a set of improvement potentials could be generated. These improvement potentials led to increased support of the EDM system for the pilot study company's business processes. In case study 2, the organizational intranet of a study partner from the consulting industry was improved to better support the existing business process 'Acquisition'. By applying the B-KIDE Framework in this pilot, a knowledge infrastructure design (based on the company's intranet) was developed that traceably supported knowledge work of the targeted roles in their respective business processes.

6.4 Lessons Learned

The application of the B-KIDE Framework in the three conducted studies generated valuable input for framework improvements. One issue that emerged from applying the B-KIDE Framework to real world scenarios was the introduction and labelling of knowledge domains during modeling. Knowledge analysts struggled with heterogenous vocabulary and term boundaries in organizations. To overcome this issue, two major measures were taken: 1) the element *Knowledge Domain* was extended with an attribute *Buzzwords* to allow for the assignment of multiple labels to a single knowledge domain. 2) Pre-modeling of knowledge domains was introduced to the pre-modeling activity of the B-KIDE Modeling Technique. Thereby, together with domain experts, an initial prototype of a Knowledge Domain Reference Model is developed in order to ease the process of interviewing. Experiences made in one pilot study indicate that with such a procedure, approximately 50% of all identified knowledge domains can be pre-modeled.

The utilization of the B-KIDE Tool in knowledge infrastructure development projects allowed knowledge analysts that were mainly unfamiliar with the B-KIDE Framework to easily conduct process-oriented interviews that conform to the B-KIDE Modeling Structure. Experiences in the three studies showed that the application of the B-KIDE Tool significantly lowered the work burden

for knowledge analysts. Yet, users needed some amount of training to be able to appropriately apply the B-KIDE Tool. Therefore, interview guidelines for knowledge analysts were provided and with each knowledge analyst, a set of supervised test interviews (two to three) was conducted in order to enhance the performance of subsequent interviews.

7 Outlook and Conclusions

This contribution successfully meets its two addressed research challenges: The B-KIDE Framework is able to identify and support relevant knowledge interactions in complex business process networks. This was successfully achieved in three conducted studies with industrial partners. By applying the B-KIDE Method for the development of technological knowledge infrastructures, an agreed upon degree of support for knowledge interactions (knowledge processes) could be ensured and achieved. Research challenge 2 was successfully addressed as well: The B-KIDE Framework provides comprehensive guidelines on how to employ 'Arrow 3' KM functionality (e.g. the routing of relevant information) in given business contexts in a way that suits both, organizations and employees. Two²³ of the three studies performed actually integrated 'Arrow 3' KM functionality in their respective knowledge infrastructure designs for the support of knowledge intensive business processes.

In the process of performing this research, a number of issues were identified but not addressed. The B-KIDE Framework focuses on how KM functionality can be applied in specific business contexts to support the execution of complex business process networks. However, when it comes to detailed questions of knowledge infrastructure designs²⁴ the B-KIDE Framework refers to available design approaches. While this is a reasonable approach because of the heterogenous set of available KM technologies, it bears an interesting starting point for future research. Future work on this topic should focus on the development of KM-functionality-specific design approaches based on available concepts to further ease the process of developing knowledge infrastructures for knowledge infrastructure designers. Secondly, the developed B-KIDE Tool only indirectly supports knowledge infrastructure designers in defining knowledge processes through XML-based B-KIDE Tool Reports. Future development of the B-KIDE Tool should focus on that issue by providing a user interface that allows for the definition of to-be knowledge processes based on identified ones. This would further lower the work burden for knowledge infrastructure designers

²³ These two studies were the ones where the B-KIDE Method was applied in a design (vs. evaluation) mode: Case study 1 and pilot study 2

²⁴ Here, again, knowledge infrastructure design is understood as a product (vs. a process)

and would lead to a more comprehensively tool-supported B-KIDE Framework.

To conclude, this work contributes to a series of current scientific topics, including the following:

- This contribution provides a generic framework for the development of business process-supportive, technological knowledge infrastructures. The B-KIDE Framework leads to knowledge infrastructure designs that ensure a certain degree of support for knowledge intensive business processes and corresponding knowledge workers in a traceable and repeatable way. Thereby, it ensures quality and reduces arbitrariness of the developed knowledge infrastructure designs across various application domains. The B-KIDE Framework therefore represents a universally applicable theory for knowledge infrastructure development projects in organizations that is easily testable by the principle of instantiation.
- Although the identification of knowledge processes has received attention from current research, this contribution introduces a novel and suitable concept for the identification and visualization of complex knowledge processes and interactions that span a multitude of business processes and related knowledge workers. The introduced concept of knowledge processes allows for the identification, visualization and modeling of greatly distributed knowledge work in organizations. Thereby, it enables detailed investigations of organizational knowledge work by taking the complex nature of knowledge into account.
- This contribution uniquely integrates organizational and technological dimensions of knowledge infrastructure development efforts. By introducing an integrative concept, which connects knowledge requirements of business processes to technological KM functionality, the B-KIDE Framework significantly contributes to current research focussing on closing the gap between business process management- and information systems design approaches [Gia99, WC03].
- This contribution introduces a novel model architecture and a supportive software tool that enable the development of inter-subjective models of organizational knowledge work. Analyzing complex, combined social and technological systems such as organizations is not typically accomplished through direct interventions in the system, but indirectly through appropriate models of the system in question [FS01]. The B-KIDE Framework introduces a model architecture for modeling organizational knowledge work that specifies model elements, relationships, rules and semantics and thus enables modelers to check structural and behavioral consistency as well as completeness of

their models. The B-KIDE Tool represents an implementation of the B-KIDE Model Architecture that eases the application of the introduced concepts. Applying the B-KIDE Framework together with the accompanying B-KIDE Tool reduces complexity found in knowledge intensive organizations (with respect to a modeling goal) and leads to the development of inter-subjective models of organizational knowledge work.

- This contribution answers the question of how certain maturity levels of existing KM maturity models (such as [PP02, OP03]) can be achieved. The application of the B-KIDE Framework in knowledge infrastructure development projects enables organizations to raise their knowledge management maturity level and to significantly increase their ability to appropriately deal with the critical resource knowledge.

More comprehensive details and background information about the B-KIDE Framework and the B-KIDE Tool can be found in [Str04].

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