6 Organization

As shown earlier, a KM strategy describing the strategic intent of a KM initiative has to be implemented with the help of organizational instruments. This section is devoted to the organizational design of a KM initiative. Figure B-22 proposes a model of the tasks and flows in knowledge management. The model builds on the concepts and theories depicted in section 4.1.1 - “From organizational learning to knowledge management” on page 22. In particular concepts and approaches from the following research fields were integrated within the model:

Organizational psychology and organizational sociology. These fields suggest that the group (in its general sense of a collective of people) is the single most important entity processing information in organizations (especially Hartwick et al. 1982, Wegner 1986). The idea of a transactive memory system (TMS, Wegner 1986) has found its way into the model in numerous respects. TMS are a brilliant way to explain the effect of inter-subjective knowledge, its linking and embedding on the information processing in a group as well as of each of the participating individuals.

Life cycle of information production. Levitan's (1982) life cycle of information production which was extended by Rehäuser/Krcmar (1996) as well as Matsuda’s (1992, 1993) process of organizational intelligence was used to embed the organizational learning cycle in a bigger environment starting with the perception of information in an organization's environment until the communication and dissemination of new information resources.

Life cycle of knowledge tasks, functions or processes. A number of authors see KM as a life cycle or a set of knowledge tasks, functions or processes. Goal of knowledge management is to improve these knowledge tasks with the help of systematic interventions, instruments or measures[275]. However, most of these approaches only list the knowledge tasks, but do not describe how they are related to each other. This important aspect is covered in the model by the integration of concepts of organizational learning.

Organizational learning theories. Organizational learning is at the core of the model. Nonaka’s (1994, 20) spiral model was integrated into the organizational learning cycle, which also reflects the organizational learning cycle found by Müller-Stewens/Pautzke (1991). The concepts used in Argyris/Schön's (1978) theory are assigned to the two fields *institutionalized knowledge* (espoused theories) and *knowledge-in-use* (theories-in-use). Research into organizational learning has made clear that only a small portion of the organizational learning processes can be formally organized (by some authors referred to as the “tip of the iceberg”)

275. See also sections 4.1.4 - “Definition” on page 52 and 6.3.1 - “Knowledge management tasks” on page 207.

whereas a great portion of organizational learning is a rather informal process for which organizations can only create an environment conducive for this process.

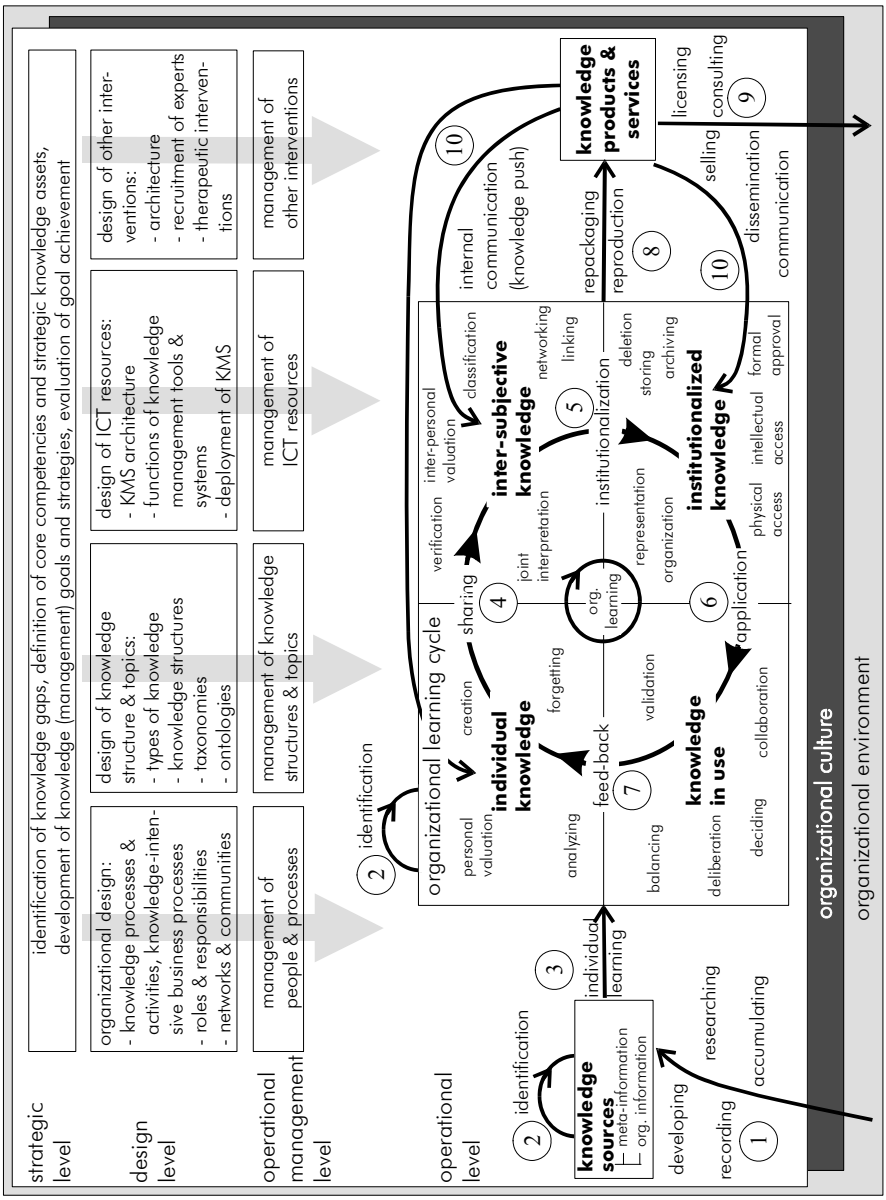

FIGURE B-22. Model of the tasks and flows in knowledge management

The organizational learning cycle consequently is not only used to classify and relate the knowledge tasks proposed in the various KM approaches. It is also used

to show that, as opposed to *knowledge sources* and *knowledge products and services* (see Figure B-22), the organizational learning cycle cannot be systematically organized. However, an increased understanding of these processes might help organizations to create formal processes which help to speed up the "spinning of the organizational learning wheel" meaning that individual knowledge is applied, shared, institutionalized, reused and developed quicker and by a broader "knowledge community" than before.

Knowledge management systems. Last but not least, the market for KMS was studied in order to make sure that the model is complete with respect to the handling of KMS supporting knowledge tasks and processes[276].

Due to the variety of the fields that were integrated, the resulting model presented in Figure B-22 is highly complex. As shown in section 4.1 - "Knowledge management" on page 21, the research interests, objects and questions in the fields and disciplines that form the roots of KM are quite diverse. Thus, the model should be seen as a *boundary object* between the fields and disciplines guiding the discussion of the theoretical and empirical investigation (see also part C). In the following, the model will be described in detail, and is used as a guide for this chapter and also provides anchors to the other chapters of part B.

Generally, the model starts on the strategic level with a KM strategy. This strategy is in turn designed and implemented to create a supportive environment for the knowledge tasks and flows on the operational level.

Strategic level. Starting point is the identification of knowledge gaps or knowledge-related problems in an organization. A strategic KM initiative can also analyze the (core) competencies and strategic knowledge assets of an organization before strategic knowledge (management) goals are defined and corresponding knowledge (management) strategies are developed that aim at achieving these goals or at developing, improving or applying (core) competencies[277].

Design level. On the design level, interventions can be basically divided into four distinct areas: design and implementation of *(1) organizational and people-oriented instruments*[278], *(2) knowledge structure & topics*[279], *(3) ICT resources*[280] and *(4) other interventions*[281]. Generally, the design of a KM initiative can be supported by modeling methods and techniques[282]. The resulting models that describe the four groups of instruments form the *mediators* between knowledge goals on the

276. See Maier/Klosa 1999c and chapter 7 - "Systems" on page 273; see also e.g., Ruggles 1997, 5ff and 77ff, Borghoff/Pareschi 1998, especially 5ff.
277. See chapter 5 - "Strategy" on page 93.
278. See sections 6.1, 6.2 and 6.3.
279. See sections 7.2 - "Contents" on page 281 and 7.7 - "Semantic integration" on page 374.
280. See section 7 - "Systems" on page 273.
281. See section 6.5.
282. See section 6.6.

strategic level and knowledge tasks and flows on the operational level which are to a large part informal in nature. Whereas the instruments might closely influence the process of selecting, organizing and handling *knowledge sources* and especially *knowledge products and services*, the core process—the *organizational learning cycle*—as well as the underlying *organizational culture*[283] cannot be designed directly. The instruments rather foster an environment conducive to a more effective organizational learning cycle.

Operational management level. On the operational management level, the effects of the implementation of the four groups of instruments are constantly evaluated based on the operative knowledge goals derived from the strategic knowledge goals: (1) management of people and processes, (2) management of knowledge structures and topics, (3) management of the ICT resources and related services as well as (4) management of other interventions[284].

Operational level. Knowledge-related flows in an organization begin and end in the *environment of the organization*. New knowledge flows can be triggered from outside the organization as well as from inside, especially when an organization closely cooperates with its partners. Due to the manyfold collaboration and knowledge exchange that crosses the organizational boundaries, direct participation of non-members in the organizational learning cycle is the rule. Examples are virtual enterprises, temporal support by consultants, strategic alliances, joint ventures, share in R&D-intensive organizations, projects or other forms of collaboration or cooperation with customers, suppliers and even competitors such as joint R&D, distribution or marketing (Picot/Reichwald 1994, 559ff). These examples show only the officially accredited forms of collaboration that cross organizational boundaries. There are many more unofficial and informal networks of people that span organizations and even industries and impact or even drive the organizational learning cycle.

Thus, the model focuses on knowledge flows and collective learning processes from the perspective of one organization, even though these flows and processes clearly do not and should not stop at the organizational boundary (which in many cases is not clearly identifiable anyhow).

The model uses three concepts in order to describe different stages of a "knowledge life cycle" in an organization which is interwoven with the organizational learning cycle. All three concepts together represent the organizational memory or the organizational knowledge base. First, there are *knowledge sources* which represent selected external data and organization-internal data recorded within the organization. These knowledge sources are the "raw material for the *organizational learning cycle*. *Knowledge products and services* in turn are disseminated to the environment and communicated within the organization (knowledge push).

283. See section 6.4.
284. See chapter 8 - "Economics" on page 396.

These three concepts are connected with one another via knowledge flows. The *organizational culture*[285] plays a special role, because it acts as the basis for knowledge tasks and flows within an organization. Thus, the whole set of knowledge tasks and flows is on the one hand embedded in the organizational culture. On the other hand, KM initiatives also change the organizational culture, hopefully into a more open one where willingness to share knowledge and willingness to reuse knowledge and to learn from others is increased.

In the following, the three main concepts on the operational level will be studied before KM-oriented structural and process organization will be discussed in detail. The numbers in Figure B-22 refer to the main knowledge processes within an organization.

Knowledge sources. The organizational knowledge processing starts with the establishment of data in the organization, which is perceived by organizational agents (human or computer agents) from outside the organization, called *knowledge acquisition* (1) or from within the organization which is called *knowledge identification* (2). Knowledge identification not only encompasses the organization's knowledge sources (e.g., documents, data bases and data warehouses, reports, books, magazines, links to Web sites and on-line data bases) but also the knowledge that is created within the organizational learning cycle. Two kinds of knowledge sources can be distinguished: the knowledge elements themselves and meta-knowledge, information about knowledge elements, which can be accessed, if required, in the environment and provides context about the knowledge elements.

Organizational learning cycle. Via *individual learning* (3) the knowledge sources become part of the organizational learning cycle in which knowledge creation takes place. The knowledge created can be distinguished according to its state in the cycle into *individual knowledge* which is accessible by the organization, *shared knowledge* and *institutionalized knowledge* (Pautzke 1989, 79). The individual knowledge is analyzed and its value is determined by the individual. It can be verified and linked to other individuals' knowledge by communicating it. The *knowledge is shared* (4) and *inter-subjective knowledge* is created. A special form of inter-subjective knowledge processing takes place in networks and communities. Communities are thought of as an instrument well suited for joint interpretation and inter-personal valuation of individual knowledge (section 6.1.3).

A portion of the inter-subjective knowledge directly influences the individual's information processing and learning, especially valuation, analyzing and linking. This effect can be described by the concept of the *transactive memory system (TMS)*. A TMS denotes the collaboration of a number of individual memory systems and the communication between these in so-called transactive processes (Wegner 1986, 191ff, also Maier/Kunz 1997, 11ff). The TMS is built up gradually

285. See section 6.4.

by the members of a group or team and influences the individuals' information processing not only within the group, but also outside.

To be fully accessible and independent of individuals, knowledge has to be *institutionalized* (5). The *institutionalized knowledge* which Argyris and Schön also called "espoused theories" represents proclaimed, officially accredited or agreed ways of reacting to certain situations as opposed to *knowledge in use* (6) which denotes the rules and hypotheses which are actually *applied* ("theories-in-use", Argyris/Schön 1978, 11). The knowledge in use may or may not be compatible with *institutionalized knowledge*. Furthermore, the individual using this knowledge may or may not be aware of the incompatibility of the two (Argyris/Schön 1978, 11). The results of actions finally give *feed-back* (7). New individual knowledge is created.

Knowledge products and services. The knowledge created, shared, institutionalized and applied within the organizational learning cycle can be *refined and repackaged* (8) and thus used to create knowledge products and services. On the one hand, these products and services can be *communicated*, *sold*, e.g., in the form of *licensing* and *consulting*, and *disseminated* to the environment (9). On the other hand, knowledge products can be *communicated internally* as some kind of "official statements", a form of *knowledge push* and knowledge services can be offered to the organization's knowledge workers (10). Especially in large organizations, knowledge might be distilled, packaged and then communicated to all project teams or work groups that are engaged in similar areas. For example the professional services company Ernst & Young calls this form of knowledge products *power packs* (Ezingeard et al. 2000).

The organizational design consists of *structural organization* (section 6.1), *instruments* for systematic interventions into the way an organization handles knowledge (section 6.2) and *process organization* (section 6.3). Instruments of the structural organization comprise the establishment of a *separate organizational unit responsible for knowledge management* (section 6.1.1), of *KM-specific roles and responsibilities* (section 6.1.2) as well as the design of collective structures, e.g., *groups, teams and communities* (section 6.1.3). KM instruments are defined (section 6.2.1) and classified into *product-oriented* (section 6.2.2) and *process-oriented instruments* (section 6.2.3). Process organization consists of the definition and implementation of *KM tasks* (section 6.3.1) and *KM processes* (section 6.3.2).

6.1 Structural organization

Generally, traditional design alternatives of the organizational structure, such as the hierarchy[286], have long been criticized for their rigidity (bureaucracy) and for

286. The hierarchy is also called the line organization, structuring the organization according to e.g., functions, regions, products or customers, with its extension to include line and staff positions, see Kieser/Kubicek 1992, 67ff.

requiring the design of extensive communication and coordination processes in order to guarantee the free flow of information and knowledge between organizational units, especially in a dynamic, unstable competitive environment[287]. Multidimensional organizational structures were proposed as a solution to this problem. This form of the organizational design is also called the matrix organization and structures the organization with respect to two or more dimensions at the same time. Examples are functions and projects or functions and regions[288]. Recently, there have been numerous approaches for alternatives to the traditional organizational design that pay attention to the management of knowledge. Examples are[289]:

Infinitely flat organization. Ideally, an infinite number of equally ranking organizational units is grouped around a center which coordinates the activities, serves as a knowledge source, develops specific competencies and transfers best practices. Examples are franchising companies.

Inverted organization. The inverted organization turns the traditional organizational pyramid upside down. Core competencies as well as knowledge about customers resides in the leaves of the tree, not at the center of the organization (management). Knowledge is exchanged primarily informally, horizontally between the experts who are in contact with customers as well as formally, vertically with the "lower levels of the hierarchy", i.e., with management in order to develop an organizational knowledge base. Management primarily provides a logistic and administrative infrastructure for the experts. Examples are hospitals or professional services companies.

Hypertext organization[290]. In this perspective, the well-known metaphor of a hypertext document[291] is used to denote the synthesis of the traditional hierarchical organizational structure with non-hierarchical, self-organizing structures in order to combine efficiency and stability of the hierarchy with dynamism and flexibility of cross-functional task forces. The design of these two systems of activities should enable the organization to shift efficiently and effectively between these two forms of knowledge creation. While the hierarchical organization primarily performs *combination* and *internalization* of knowledge, the self-organizing teams perform

287. For a brief summary see e.g., Frese 1992, 1681, also Rehäuser/Krcmar 1996, 26.
288. There is a lot of literature on the matrix organization. The approach was developed in the 70s and was a popular approach receiving a lot of attention in the organization science literature in the 80s and early 90s, see e.g., Galbraith 1971, Reber/Strehl 1988, Scholz 1992, Schreyögg 1999, 176ff.
289. See e.g., Quinn 1992, 113ff, Nonaka 1994, 32f, Rehäuser/Krcmar 1996, 26ff, North 1998, 79ff, Schreyögg 1999, 194ff and 254ff.
290. The idea of the hypertext organization was developed by Nonaka, Konno, Tokuoka, and Kawamura and presented in the journal *Diamond Harvard Business* in 1992 in Japanese (Nonaka 1994, 32ff).
291. A hypertext document is a text document that contains hyperlinks. Hyperlinks are connectors to other documents with the help of cross-references to their URL that can be activated by a mouse-click (Horn 1999, 380, also Mertens et al. 1997, 191f).

socialization and *externalization* (Nonaka 1994, 33). The hypertext organization consists of three layers: the *knowledge-base layer* (organizational culture, procedures, documents, data bases), the *business system layer* (performs routine operation by traditional hierarchy) and the *project-system layer* (multiple self-organizing project teams form a hyper network across business systems). Examples can be found in the Japanese industry.

Starburst organization. These organizations permanently "generate" new business units or found new companies which in turn follow the same model. Important and complex competencies are in both, the core as well as the spin-offs. The spin-offs operate quite independently whereas the core plays the role of a knowledge holding. Examples are film studios or software companies which develop different markets and niches on the basis of a common set of software applications or technologies.

Spider's web organization. The spider's web is a metaphor for an ideal network of highly specialized organizational units, e.g., competence centers, regional units, projects or experts between which primarily informal communication and cooperation take place. Ideally, there is no center and knowledge is exclusively exchanged between the various knots. In specific situations (e.g., a new order, a project), knowledge is mobilized and thus typically the knots cooperate temporarily. Examples are financial services networks (e.g., MLP AG).

All of these organizational forms aim at accelerating organizational learning and thus the development, combination and use of organizational competencies. Once again ICT plays the role of an *enabler*, a catalyst for these new, highly decentralized organizational forms (North 1998, 79). In the following, the discussion is limited to the implementation of a separate organizational unit responsible for (certain tasks) of knowledge management, to specific roles and their responsibilities with respect to KM and to concepts of work groups, teams and particularly communities as specific forms of knowledge networks that play an important role in KM.

6.1.1 Separate knowledge management unit

One alternative to formally implement KM in an organization is to establish a *separate organizational unit* responsible for KM. The management of knowledge, the coordination of knowledge-related tasks and instruments as well as the administration, maintenance and updating of a knowledge-related organizational and technological infrastructure can be considered permanent tasks. Thus, many organizations establish a position, a group or even a department coordinating corporate KM initiatives. Examples are the CKM – Corporate Knowledge Management office at Siemens that coordinates the over 130 KM projects worked on by over 350 KM specialists throughout Siemens (Klementz 2000, 2), the CBK – Center for Business Knowledge at Ernst & Young (Ezingeard et al. 2000), the sTM – sd&m Technology Management at the software house sd&m (Trittmann/Brössler 2000) or the

KTD – Knowledge Transfer Department at Buckman Laboratories (Pan/Scarbrough 1998, 59).

In many cases, the KM unit will be an extension of an already existing organizational unit, such as document management or technology management. One of the concepts preceding a formal KM unit best represented in the literature is the *competence center* or *think tank* (Probst et al. 1998, 204, 207ff, 358, Roehl 2000, 180f). These are units that systematically bundle capabilities (experts, networks, documents etc.) within a targeted domain. A think tank identifies, develops, refines and develops experiences (lessons learned, best practices) for a certain topic, regularly a cross-functional and cross-disciplinary topic, e.g., "Eastern Europe" or "Energy" at the professional services company McKinsey (Probst et al. 1998, 208).

Apart from the permanent institutionalization of KM in a separate organizational unit, many organizations start a KM initiative with the help of a project. *KM projects* are concerned with e.g., the assessment of potentials of KM for an organization, the development of a KM vision, mission and goals, the design and implementation of an organizational and especially technological KM infrastructure, the promotion of KM-specific instruments, the definition of decentral KM roles etc.

Another form of organizational design for KM that requires even less of a permanent commitment to this approach is the establishment of a *KM committee* or a *KM community*[292]. In this case, a group of employees, regularly from different organizational units, e.g., from strategic development, various functional departments and the department of IT/organization, together develop a KM vision and promote the effort.

In many organizations, the structural organization of KM has developed in certain stages. KM had started out as a group of interested employees that informally defined a KM initiative which later was turned into one or more KM project(s). In many organizations, especially in large organizations, either one KM project was later switched into a permanent organizational unit or one unit was established to coordinate all the KM projects and activities throughout the organization.

The structural organization of the KM function will be studied with the help of the following list of design alternatives ordered from a formal, lasting approach to an informal, temporary approach:

- *separate organizational unit*: as a functional or service unit,
- *project*,
- *no separate organizational unit*: as a community or a committee.

It is expected that those organizations that institutionalize a separate organizational unit staff it with more employees and also invest more in KM[293] than those organizations that set up a KM project or have an entirely decentralized, informal approach with no separate organizational unit. Therefore, the following hypothesis will be tested:

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292. See also section 6.1.3.3 - "Communities" on page 180.
293. Investment is measured in terms of non-salary expenses; see also section 8.1 - "Expenses and funding" on page 397.

Hypothesis 8: The more formal the organizational design of a knowledge management initiative, the higher are the expenses for knowledge management

The reasoning behind this hypothesis is that organizations that already had established a functional unit responsible for certain KM-related tasks such as information brokering preceding the KM unit, have already assigned employees to a unit and a defined budget and, therefore do not have to assign new ones. Moreover, the installation of a separate organizational unit for KM shows that this organization regards KM as a permanent task rather than a temporary one as in a project. Additionally, employees assuming KM roles in organizations with a decentral approach might not work exclusively for KM, so that some of them might not be counted as KM staff at all.

6.1.2 Knowledge management roles

The term knowledge always implies a relation to its application, a pragmatic connotation[294]. Consequently, KM cannot be centralized in an organization e.g., in analogy to the management of capital. The role of a centralized unit is only a coordinating and administrating one. Generally, the most important KM-related instruments have to be applied as close to where the knowledge is needed as possible, which is directly in the functional departments or projects. Thus, many organizations, especially the professional services companies, have established KM-related roles which are distributed throughout the organization. Figure B-23 gives an overview of KM roles which have been either suggested in the literature[295] or mentioned in the interviews as part of the empirical study (see part C).

In the top area of the figure the CKO (Chief Knowledge Officer, knowledge manager) is responsible for knowledge management leadership. He or she might share responsibility with knowledge partners and/or stakeholders from the business units which knowledge management serves. In the upper middle part of the figure there are specific KM roles that can be assigned in order to guarantee the efficient and effective performing of important KM tasks and processes. The KM diamond in the center of the figure denotes those four KM roles that act as a kind of exchange platform for knowledge in an organization, a knowledge hub. The left hand side of the knowledge diamond reflects the human-oriented, personalization perspective of KM whereas the right hand side reflects the technology-oriented, codification perspective.

The basis of the model is formed by the knowledge workers which participate in the KM initiative. From an IT point of view, these are called participants rather than users in order to stress their active role with respect to the ICT systems in place. Knowledge workers are more or less enthusiastic about knowledge management putting them somewhere on the dimension between the two poles knowledge

294. See also section 4.2 - “Knowledge” on page 60.
295. Examples can be found in Baubin/Wirtz 1996, Probst et al. 1998, Earl/Scott 1999, Bach 1999, 67.

sponsor and knowledge skeptic. Knowledge workers are grouped in work groups, teams and communities which have been identified as the most important unit of analysis and intervention in KM initiatives. That is why the collectives form the basis of the KM roles on which the whole KM initiative is founded.

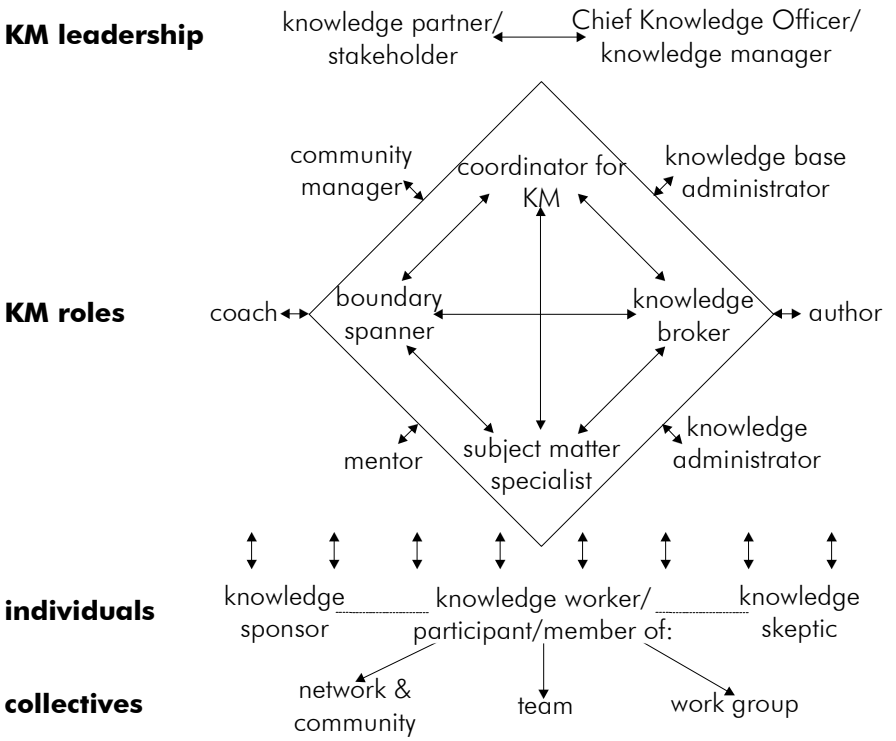

FIGURE B-23. Model of knowledge management roles and collectives

The KM roles depicted in Figure B-23 and the collectives are discussed in detail in the following.

6.1.2.1 Knowledge manager (CKO)

The highest ranked role in knowledge management is called the *chief knowledge officer* (CKO)[296], a term coined in analogy to other executive positions, such as the chief information officer (CIO). Other terms used to describe a similar role to the one held by a CKO are *knowledge manager* (McKeen/Staples 2003), *knowledge strategist* (Ruggles 1998, 86), *director intellectual capital* (e.g., Skandia), *director knowledge transfer* (e.g., Buckman Laboratories), *knowledge asset manager* or *intellectual asset manager* (e.g., Dow Chemical, Davenport/Prusak 1998, 224).

296. See e.g., Davenport/Prusak 1998, Guns 1998, Earl/Scott 1999, Bontis 2001.

The term CKO has been in use to denote the head of knowledge management for quite a while, even though in the beginning it was more connected to AI and expert systems and its relation to executives (Hertz 1988, 45ff). Today, in many organizations, the terms "CKO" and "knowledge manager" refer to the same position. However, especially in multinational professional services companies there are also examples where one CKO supervises several knowledge managers which are responsible for KM, e.g., in one particular business unit (e.g., Ezingeard et al. 2000, 811).

According to the interviews and the KM cases reported in the literature, the primary responsibilities of a Chief Knowledge Officer (CKO) are[297]:

- to build a knowledge culture, to raise awareness, to get commitment of business leaders and to motivate employees to share knowledge,
- to design a KM strategy aligned to the business strategy of the organization and to set the appropriate scope for knowledge initiatives,
- to launch knowledge-based products and services,
- to design, implement and oversee schemes and processes for knowledge codification and transfer,
- to lead a separate organizational unit which is designed to e.g., broker knowledge or to research and develop new knowledge,
- to establish new knowledge-related roles,
- to get a knowledge (best practice, experiences, skills) data base up and running,
- to oversee the concept, design, implementation and management of ICT supporting knowledge management, e.g., Intranet, knowledge repositories, data warehouses, Groupware etc.,
- to globalize knowledge management and thus coordinate several existing KM initiatives,
- to measure the value of intangible assets.

As an individual member of the organization, a CKO has to represent many of the positive connotations that KM approaches have. The CKO acts as a symbol and promoter for extensive knowledge sharing, a trustful organizational culture, the use of new methods in training and education for employees, teams, and communities, the application of KM-related ICT systems and last but not least the integration of KM-related measures into corporate accounting and leadership systems (see Bontis 2001, 31ff).

In practice, the CKO is often a highly educated, experienced organizational performer, previously mostly in managing line jobs, who has been with the current organization for quite some time and is attracted to the position because of its newness, the challenge, receiving intrinsic rewards and an understanding that knowledge management can make a visible change within the organization (McKeen/

297. See also Apostolou/Mentzas 1998, 13, Guns 1998, 316ff, Ezingeard et al. 2000, 811, Bontis 2001, 31ff, McKeen/Staples 2003, 32ff

Staples 2003, 38). The CKO role is somewhat unique in the executive board of an organization because the CKO directly reports to the CEO, but does not have budget, staff and entitlements that match his or her peers on the board, with no clear-cut description of the job, setting out to make a fundamental change to the organizational routines and culture with somewhat blurry mission, goals and evaluation criteria[298].

6.1.2.2 Subject matter specialist

A *subject matter specialist, subject matter expert, knowledge integrator* or *knowledge editor* or *person responsible for a field of competence* is an important role in knowledge management that is responsible for a multitude of tasks. Subject matter specialists have expertise in one particular area and serve as[299]:

- *gatekeeper of information and knowledge*: In this function, they formally approve contributions made by participants before they are entered into an organization's knowledge base.
- *quality assurer*: Subject matter specialists review documents, provide additional links, improve the document's quality in terms of readability, understandability, use of a common language etc.
- *expert in one or more topics*: In this function, a subject matter specialist might answer questions concerning his or her topic(s) if they remain unanswered within a certain amount of time.
- *linking pin to agencies and research institutions*: A subject matter specialist might be responsible for keeping track of new developments in his or her topic(s), periodically provide reports about the newest developments, etc.

6.1.2.3 Knowledge administrator

Knowledge administrators (e.g., Apostolou/Mentzas 1998, 13) are also called *knowledge engineers* or *knowledge editors*. As opposed to subject matter specialists who are responsible for one specific domain or topic, knowledge administrators are responsible to help authors capture, store and maintain knowledge independent of the domain in which they are working. If subject matter specialists are experts in the semantics and the contents, knowledge administrators are experts in the way knowledge elements have to be documented, linked, structured and organized. They help participants externalize and document their knowledge.

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298. These findings are based on an empirical study in which 41 knowledge managers were questioned mostly from the US and Canada (92%) representing a variety of sectors and industries. The majority of respondents were from organizations operating in the services sector (55%) or in both, the services and physical goods sectors (34%). With respect to industries, most respondents' organizations belonged to professional services (22%), financial services (19%), high technology/computers/telecommunications (19%), government (16%) and manufacturing (14%). About half of the organizations had more than 10,000 employees (48%), 21% had between 1,000 and 10,000 and 31% had up to 1,000 employees (McKeen/Staples 2003, 26f, 38).
299. See e.g., APQC 1996, 60f, Baubin/Wirtz 1996, 143, Probst et al. 1998, 362, Ruggles 1998, 86.

6.1.2.4 Knowledge base administrator

In analogy to data base administrators[300], knowledge base administrators are responsible for the development and maintenance of the technological infrastructure of KM, the knowledge management systems. At Accenture, there are three different roles responsible for the administration of their KMS Knowledge Xchange: knowledge base sponsors, knowledge base integrators and knowledge base developers (Baubin/Wirtz 1996, 143). The *knowledge base sponsor* develops policies, standards and procedures for the KMS and develops the KMS architecture. The *knowledge base integrator* provides overall coordination of structure and content for one knowledge base and ensures that security and ownership specifications are implemented. The *knowledge base developer* finally develops, supports and maintains the technical implementations of the knowledge base, ensures that it conforms with general IT standards (set forth by the CIO), executes and administers the security and ownership specifications and implements modifications to a knowledge base structure.

6.1.2.5 Knowledge broker

A *knowledge broker* is a person helping participants to locate the knowledge or experts needed (Ruggles 1998, 86). *Knowledge brokers* are also called *knowledge connectors*, *knowledge navigators*, *knowledge translators* and *knowledge stewards* (e.g., Skyrme/Amidon 1997, 33) or, in a more focused setting, *best practice sharing facilitators* (Klementz 2000, 2). Ernst & Young distinguishes between the following three levels of orders their knowledge brokers can get:

- *navigate*: to support people in navigating the organization-wide KMS,
- *research*: to collect documents and locate experts to a given topic by accessing the KMS,
- *analyze*: to create a formal report on a topic which includes valuing, summarizing and relating documents and experts found in the KMS.

The role of knowledge brokers might involve participation in several communities in order to broker knowledge from one community to another (Brown/Duguid 1998, 103). They argue that knowledge brokers work best in the context of overlapping communities. They call persons that "broker" knowledge between mutually exclusive communities "translators" (Brown/Duguid 1998, 103). A translator can frame the knowledge and interests of one community in terms of a different community's practice. In this respect, the knowledge broker also takes on the role of a *boundary spanner*[301]. Thus, knowledge broker is a key role in organizational knowledge management (see Delphi 1997, 22).

6.1.2.6 Boundary spanner

A *boundary spanner* has to network fields of competencies and broker contacts between experts in different fields needed to realize new business ideas (Probst et

300. See Maier et al. 2001 for a recent study on data management tasks.
301. See section 6.1.2.6 - "Boundary spanner" on page 166 below.

al. 1998, 363) or between communities (Schoen 2000, 118). This might involve e.g., the organization of theme-centered workshops the primary goal of which is networking experts from different fields of competencies, the identification, refinement and distribution of *boundary objects* between communities, expert networks and knowledge repositories. They are responsible for the development of an inter-functional and inter-disciplinary network of relationships and thus are contact persons for the brokering of contacts (Probst et al. 1998, 363) both, within and outside the organization.

6.1.2.7 Knowledge sponsor

Knowledge sponsors and *knowledge champions* are people who are excited about the idea of knowledge management, commit themselves to this effort and want to help to make the effort a success without taking on a formal role or responsibility as KM staff.

A *knowledge sponsor* is a senior executive of the organization implementing knowledge management who identifies with the KM concepts, publicly shows enthusiasm about the project and is likely to invest in or support knowledge management projects (Earl/Scott 1999, 31, Schoen 2000, 119). The knowledge sponsor secures the budget for KM initiatives, networks with other knowledge sponsors and might even encourage employees to take on formal KM roles, e.g., subject matter specialists or knowledge integrators (Baubin/Wirtz 1996, 143). In the same category fall so-called *network chairs*, senior managers who facilitate the KM process (Ezingeard et al. 2000, 811). The term network chair points to the support that is expected from the sponsor which is to help knowledge workers to network.

6.1.2.8 Community or network manager

There are a number of roles that have been suggested with respect to (virtual) communities or networks of experts in organizations[302]. Examples are (Pór 1997, 2, Wenger 2000, 220, Henschel 2001, 59f, Kim 2001, 177):

- *greeter*: welcomes new members and introduces them to the community,
- *host/facilitator*: encourages and moderates discussions,
- *editor/cybrarian*: is responsible for topics and contents,
- *cop*: enforces the community rules,
- *teacher*: educates the members of the community,
- *recognized expert*: also called thought leader upholds and dispenses the community's knowledge,
- *event-coordinator*: plans and organizes events,
- *supporter*: answers questions about the system(s),
- *boundary spanner*: connects the community to other communities and acts as broker and translator,

302. For a definition and discussion of the concept of communities see 6.1.3.3 - "Communities" on page 180.

- *keeper of organizational ties*: maintains links with other organizational units, in particular the official hierarchy,
- *care-taker*: cultivates social relationships,
- *system administrator*: is responsible for hardware, software and security of the community server,
- *account administrator*: administrates accounts, privileges and authentication of the members of the community,
- *architect*: starts social relationships, develops social networks and optimizes the community structure considering the feedback.

Although these roles might be assigned to a number of members, it is likely that a small core group of approximately two to six members who initiated the community take on all of these roles so that each of the members of the core group is responsible for a number of roles. There are also several roles responsible for the management of the community which are distinguished in analogy to the roles defined for the management of business processes (Neumann et al. 2000, 275ff, Schoen 2000, 117ff):

Community/network owner. A community owner is a senior manager or even a member of the board of directors who is responsible for the communities. As communities per definition are not (directly) goal-oriented collectives of people, the role of the community owner is to *sponsor* the community, provide budgets and support for time, travel and technologies (e.g., storage capacity for community homespaces) and promote the community topic (also Raab et al. 2000, 244).

Community/network manager. This is regularly a role that is attributed to the originator of a community, sometimes split to a small group of people who initiated the community. This person or this core group is responsible for the functioning of the community, has the "last word" in the set up of policies and norms, e.g., about participation in the community, its organization, about themes and topics, the discussion style etc. Sometimes the community manager is supported by one or more *community assistant(s)* who e.g., answer questions about the community, its topics or the ICT used to support the community. A community manager coordinates the activities in a community, however, he or she is not responsible for all types of leadership that are necessary in a community, such as networking, facilitation, documentation, retention of expertise, learning, inquiry, management of boundaries or organizational ties[303].

Community/network moderator. A moderator supports discussions in communities, e.g., provides summaries about threads of discussions, links and organizes contributions or encourages contributions from experts outside the community. Often, community moderators are responsible for many communities so that they

303. See Wenger 2000, 220; see also the community roles distinguished above.

can cross-post contributions from one community to another one that might stimulate discussions elsewhere.

Within the group of the members of the community or network, *experts, active or key members* on the one hand and (passive) *members* on the other hand can be distinguished (Schoen 2000, 118). The key members are the organization's experts in the community's topic and thus are responsible for answering the questions which are posed by the members of the community (Raab et al. 2000, 245). This distinction, however, introduces a quasi-hierarchy in the community which can be counter-productive to the free flow of ideas.

The formal definition of roles with respect to communities changes the informal nature of these collectives of people and sometimes turns communities into official networks of experts. These might even get tasks assigned which temporally changes them into a team. However, members of a team might stick together after the team assignment was finished as a community showing once again that the boundaries between teams and communities are vague.

6.1.2.9 Mentor

Mentors are persons responsible for the development of new talent and for instilling their own tacit knowledge in new employees through a kind of "informal apprenticeship" (Leonard/Sensiper 1998, 127). *Mentoring* is based on the Greek mythology (Kram 1988, 2) and can be defined as a deliberate pairing of a more skilled or experienced person with a lesser skilled or experienced one, with the agreed-upon goal of having the lesser skilled person grow and develop specific competencies (Murray/Owen 1991, xiv). Generally, relationships between younger and older adults that contribute to career development are also called *sponsor*, *patron* or *godfather* relationships (Kram 1988, 3). Mentoring can be an interesting addition to other human resource development programs and are valuable for both, the mentor and the mentee (Antal 1993, 453).

In Japan, this kind of relationship has got a long tradition as the *sempai-kohai principle* (e.g., Probst et al. 1998, 299). Every newly recruited employee in Japanese organizations, the younger so-called kohai, is assigned to a mentor, an older, teaching sempai. Many Western organizations (and also universities!) have taken over this principle that is used to reduce the time needed for the young recruited to take over all the tricks and know-how from the older employees (for case studies see e.g., Antal 1993). Mentoring functions can be divided into *career functions*, such as sponsorship, exposure, visibility, coaching, protection and challenging assignments, as well as *psychosocial functions*, such as role modeling, acceptance-and-confirmation, counseling and friendship, which enhance sense of competence, identity and effectiveness in a professional role (Kram 1988, 22ff).

Mentoring also faces major obstacles, e.g., due to an organizational culture that is not supportive, work design or incentive and reward systems (Kram 1988, 160ff). The complexity of cross-gender and/or cross-cultural mentoring relationships requires special attention (Kram 1988, 105ff, Murrell et al. 1999). International mentoring might play an active role in developing cross-cultural competen-

cies in international networks, e.g., in multi-national organizations (Antal 1993, 453ff).

6.1.2.10 Coach

A different form of a paired relationship is *coaching*. The coach, an internal or external consultant specially trained in psychology, interacts with a member of the organization in order to improve the performance or motivation of the latter (Staehle 1991, 874f). Coaching is a form of consulting in between psychotherapy (therapeutic interventions) and training and often extends beyond work-related aspects to a more holistic "consulting for living" (e.g., Roehl 2000, 202f), but nevertheless can be a useful instrument to remove or at least make visible knowledge barriers that can be attributed to (negative relationships between) individual employees.

6.1.2.11 Knowledge skeptic

A knowledge skeptic is a person hostile to knowledge management in general and/or the implementation of a knowledge management effort in particular. As many knowledge management efforts need a "critical mass" of participants who buy in the idea and on the other hand knowledge skeptics might jeopardize the success of the efforts, it is important to identify doubters in order to convince them so that they participate in or at least do not oppose the effort.

6.1.2.12 Coordinator for knowledge management

Many organizations might employ their formal organizational structure and assign responsibility to their—line and project—managers or one particular employee within each organizational unit in order to roll out KM initiatives. Thus, a *coordinator for knowledge management* is assigned responsibility to coordinate the implementation of KM within one particular organizational unit. Typical responsibilities are:

- to ensure that knowledge processes are carried out within their area of responsibility and
- to oversee that the knowledge created within their unit is harnessed and spread across organizational units.

Typical organizational units that might be assigned responsibility for KM are a business or service process, a functional unit or a project. For example, Ernst & Young appoints one professional per larger assignment (= contract between Ernst & Young and a customer) as the assignment knowledge manager who is responsible for the knowledge process and the capturing of knowledge generated in the assignment (Ezingeard et al. 2000, 811).

6.1.2.13 Knowledge worker and participant

As mentioned before[304], *knowledge work* requires that knowledge is continuously revised, considered permanently improvable, not as truth, but as a resource (Willke

304. See chapter 1 - "Motivation" on page 1.

1998, 21). As opposed to traditional professional work, the expertise required for knowledge work is not basically acquired during one single and long-lasting learning period, but has to be constantly revised, extended, reflected and adapted. Knowledge workers require a distinctly different management style than more traditional professions: little direction and supervision, instead more protection and support by "covert leadership" (Mintzberg 1999). Knowledge workers are the primary target group for a KM initiative.

Generally, *participants* are all persons that are affected by KM initiatives. Participants are distinguished from *users* with respect to the application of KMS because of their active involvement into the functioning of KMS. Thus, participants actively play roles such as knowledge creators, developers, integrators, providers or authors, as active members of work groups, teams or communities, contributors in newsgroups, commentators, refiners and evaluators of organization-internal and -external knowledge elements, knowledge brokers and distributors etc.

Knowledge workers as well as participants can be classified according to their *level of expertise*. Many authors in the realm of knowledge management differentiate between *knowledge providers* and *knowledge seekers* or *knowers* and *not knowers*[305]. As most of them do not refer to a theoretical basis, it remains unclear according to what criteria a participant could be selected as "knowing" versus "not knowing". It is also unclear to what extent the classification of "knowing" is topic- and context-dependent, especially concerning the granularity of such classifications. Moreover, a mere two-fold distinction seems to be too crude to guide KM activities.

Thus, in the following five levels of expertise are distinguished which are based on a model on the development of expertise well-received in the literature (Dreyfus/Dreyfus 1986, 16ff). The model describes the development of expertise as applied to unstructured situations for which there is no set of facts and factors which fully determine the problem, the possible actions and the goal of the activity (e.g., patient care, business forecasts, social interactions). It stresses the importance of implicit knowledge for expert problem solving. The central hypothesis is that in the step-wise course of becoming an expert thinking is reorganized qualitatively which means that expert knowledge is organized differently from explicit knowledge about facts and rules. Thus, teaching means to subsequently lead the learning person from an analytic via a planning to an intuitive way of problem solving. A central concept is "power of judgement" as a holistic way of pattern recognition which is highly adapted to contexts. Thus, the qualitative adaptation of the person's organization of knowledge means a replacement of knowledge about facts and rules with a (large) number of practical cases which are used as patterns to intuitively judge the adequate actions required in a specific situation. The five steps are briefly described in the following (Dreyfus/Dreyfus 1986, 19ff):

305. See e.g., Glazer 1999, 177ff for a model to measure the knowing subject, the knower.

1. **Novice:**
   When novices observe an expert they are overwhelmed by the complexity of a situation so that they are not able to imitate an expert. In the first stage of learning, novices are provided with non-situational or context-free *attributes* and *rules*. These do not reflect the total situation, they ignore the total context and they do not require the novice to understand the total structure of the situation. The novice analyzes a situation by spotting single attributes and selects actions according to the rules remembered. The attributes are not implicitly integrated, but explicitly focused and summed up.
2. **Advanced beginner:**
   The advanced beginner has extensive practical experience in the domain. Thus, he or she can use more context-free attributes in his or her judgement of the situation and uses more complex rules to determine actions. The most important difference to the novice's problem solving is the use of so-called *aspects*. These are situational or context-specific attributes that the advanced beginner has encountered in a greater number of "similar" practical cases. The selection of actions is now not only based on context-free rules, but also on context-specific *guidelines*. However, the problem solving can still be characterized as not integrated as there is no conscious examination of configurations of attributes. The single attributes and aspects are considered as being of equal value and the advanced beginner should take into account as many attributes and aspects as possible. The number of attributes and aspects increase to a point where the learner is confronted with an overwhelming number of elements to be considered.
3. **Competent:**
   Central skill differentiating competent from the two levels before is the potential to analyze a situation with the help of a perspective. The person is able to plan consciously and thoughtfully. *Goals* and *plans* increase the complexity of the analysis, but reduce the complexity of the situation because not all attributes and aspects have to be considered anymore. Conscious, analytical problem solving is maximized on this level of expertise. Actions are selected with the help of a *perspective* which the actor decides on. As a consequence of the subjective selection of a plan, he or she will feel responsible for his or her actions (emotional involvement). This is different from the two levels before as actions were taken by strictly applying rules and guidelines and unwanted results could be attributed to inadequate rules or guidelines. Learning is supported by the analysis of situational case studies which require the selection of a perspective and the decisions derived by the application of the corresponding rules and guidelines.
4. **Skillful master:**
   The central new skill in this stage is the ability to perceive situations as a whole as opposed to observing single attributes and aspects of a situation. This means holistic recognition of similarities of current situations with situations the master encountered before. The master has a "mental library" of *typical situations* perceived using a specific perspective. New situations are perceived from a specific

perspective without consciously selecting it. Relative importance of attributes and aspects in the problem domain is not analyzed consciously anymore. The situation rather presents itself accentuated to the master, he or she intuitively expects which situations could follow the current situation. Actions are still selected consciously on the basis of *maxims*. These maxims are heuristic principles that relate a certain action to a configuration of attributes and aspects. The master consciously selects those actions with a proven record of success in the type of situation. Summing up, the master perceives the problem character of a situation and the general direction in which he or she has to act without conscious efforts. The detailed planning of actions is still a conscious effort.

5. Expert:

At this stage, every specific situation that the expert encounters will automatically trigger the *intuitively appropriate action(s)*. Experts not only store perspective-based types of situations but associations of types of situations with corresponding actions. Situations are grouped in a way so that they require the same decisions and actions. They are stored in such a number that they cannot be verbally described. Thus, the expert does not process atomic facts logically, but perceives holistic similarities between the current situation and situations encountered before without having to take into account isolated single elements. Strategic planning does not occur anymore at stage 5. The expert can handle situation after situation without strategic planning in a way that can be described as "goal-oriented without conscious goal-setting". The experts' knowledge is best analyzed with the help of story-telling. The expert should report critical situations holistically together with the context in which they occurred, the subjective assessments of the situations and the actions taken.

Table B-8 shows the five levels of the model with those elements of problem-solving highlighted which determine the central shifts between the stages.

TABLE B-8. Model of the acquisition of expertise[a]

skill level	components	perspective	decision	commitment
1. novice	context-free	none	analytical	detached
2. advanced beginner	*context-free and situational*	none	analytical	detached
3. competent	context-free and situational	*chosen*	analytical	detached understanding and deciding; *involved in outcome*.
4. proficient/ skillful master	context-free and situational	*experienced*	analytical	*involved understanding*; detached deciding
5. expert	context-free and situational	experienced	*intuitive*	*involved*

a. According to Dreyfus/Dreyfus (1986, 50)

Experts differ from novices substantially with respect to problem-solving (Mietzel 2001, 277ff). Experts not only have more profound area-specific knowledge but also apply so-called schemes to analyze situations which allow them to consider more information about a problem quicker than novices. Experts are also quicker in deciding between relevant and irrelevant information than novices due to the automation of a large number of cognitive processes. This automation might also be disadvantageous, though, if experts experience difficulties to adapt to new problem settings or to accept new and revolutionary ideas or ways of problem solving. Experts spend more time to analyze the situation in difficult problem settings, are different from novices in their selection of problem solving strategies and are more able to control their cognitive processes than novices (Mietzel 2001, 278ff).

The application of this model and the consideration of the differences between experts and novices in particular has substantial consequences for the design of KMS. This is especially true for KMS functions such as *personalization*, system-supported *recommendations* and *collaboration*. Novices not only require a different presentation of knowledge elements than experts which means that personalization of KMS should not only reflect a participant's role, but also his or her skill level with respect to the topic (dynamic, context-dependent personalization).

The various skill levels also suggest that in some cases novices who search the KMS for information on whom they could ask personally for help might need support by intermediates—participants just one or two skill levels above their own, not experts who would require much more effort to reflect their decisions so that novices could learn from them. KMS in that case should present knowledge elements developed by intermediates as well as links to intermediates rather than experts.

Experts on the other hand might be best "teachers" for knowledge workers at the skill level *proficient* and possibly *competent*. Accordingly, tutorials and peer-to-peer learning deserves much more attention than the single-minded focus on experts teaching and answering questions of the rest of the employees. Also, communities might be designed with skill levels in mind. Some communities might intend to bring together people with skill levels not to far from each other so that perspective, decision and commitment are not too different. Other communities might intend to bridge the various skill levels and focus a topic independent of the experiences a person has made up to that point.

6.1.2.14 Knowledge partner and stakeholder

As knowledge management is a cross-functional effort, the KM team needs *partners* or allies in the implementation of such an effort. Earl and Scott identify HR professionals and IS executives as the main partners of CKOs in their survey of 20 CKOs in the US (Earl/Scott 1999, 32).

Stakeholders are those individuals, groups and networks of individuals in the environment of an organization who influence the organization's operations directly or might influence them in the future. In the ILOI study, 11% of the organizations reported to systematically manage relationships to stakeholders in order

to improve the handling of knowledge (ILOI 1997, 25, 27). Examples for stakeholders of KM are:

Functional departments. Functional departments are the primary customers in many KM initiatives. Participation of representatives of functional departments in design and implementation of KMS is considered crucial as a positive attitude towards the KM initiative, a supportive organizational culture, is the most important success factor for KM[306].

Business partners. In a time when organizations more and more integrate their value chains with suppliers, wholesalers and retailers to provide better services to customers, these business partners supposedly hold extensive knowledge which is of interest to the organization. Thus, business partners may also become knowledge partners that jointly innovate and develop ideas for products and services.

Senior management. Senior management has to support the KM initiative not only with sufficient funding but also by giving a good example, by "living knowledge management" and by acting as knowledge champions coordinating KM-related issues throughout the organization and eventually by helping to reduce cross-functional KM barriers.

Human resource management. Personnel training and education remains an important promoter for organizational learning. Many authors suggest that an apprentice watching a skillful master is the best way to transfer implicit knowledge. However, only 45.5% of the organizations surveyed by the APQC considered themselves as effectively using apprenticing for knowledge sharing whereas 22.7% said they were ineffective in this respect. Apprenticing in fact was the least effective instrument for knowledge sharing as perceived by these organizations[307]. The more e-learning and KM grow together, the more learning will be decentralized and traditional personnel training and education will be integrated in the organization's KM initiative.

IT department. The organization's IT unit is responsible for the organization's ICT infrastructure and thus also for the implementation of ICT to support the KM initiative, the KM platforms and KMS. Even though KM units and the CKO are usually separated from the IT department, they have to work closely together in order to develop an integrated ICT solution that supports the intended organizational instruments to improve an organization's way of handling knowledge.

Data management. Data management handles a substantial portion of the infrastructure on which KMS are built. Data management is responsible for the quantitative portion of the enterprise knowledge base. Data-related tasks, such as data warehousing, data analysis, management of interfaces or data management for the

306. See section 5.3 - "Success factors, barriers and risks" on page 132.
307. See APQC 1996, 58; see also section 10.1.1 - "APQC" on page 439.

Web (Maier et al. 2001) are closely connected to the technical administration of KMS.

Public relations. This group handles the organization's official communication to stakeholders and the public, e.g., the organization's Web presence. Thus, the KMS appearance—and access to contents—has to be coordinated with the official communication (e.g., the organization's corporate identity). Public relations also often maintains a large network of experts in all kinds of fields potentially relevant for knowledge-related tasks.

Research and development. R&D as well as technology and innovation management are often the core groups in an organization that apply KM instruments and technologies first. They handle the bulk of organizational innovation. On the one hand, they are a major knowledge provider for the rest of the organization, but on the other hand they also need to be connected to the knowledge flows generated in the operative business processes. A KM initiative has to consider the R&D processes and KMS have to be integrated with the ICT systems that are used by this organizational unit.

Universities and research institutions. Universities and (partly state-funded) research institutions are important external sources for innovations, ideas, prototypes and concepts that might be turned into successful products and services, but also for new ground-breaking theories and approaches that might substantially influence organizations. Thus, universities can be important knowledge partners for organizations and many cooperations between universities and private organizations have already proven successful. However, in the Fraunhofer study cooperations with universities were ranked last of a list of instruments used for knowledge acquisition (Bullinger et al. 1997, 24). Thus, it seems that there is potential for universities to play significantly enhanced roles in knowledge management. Some examples are:

- *moderation of communities*: Universities might provide a platform for the exchange of ideas, moderate discussions and networking of experts in the field, periodically distill trend reports out of community interaction, evaluate and assess developments. Communities of innovation not necessarily have to be tied to traditional research disciplines. Interdisciplinary communities might be more successful in the assessment of trends and developments. As universities usually have a good network infrastructure, it might be a good idea for them to provide such services with the help of ICT systems supporting electronic communities,
- *incubator for start-ups*: Universities might act as an incubator for start-up organizations turning good ideas into products and services profiting from the geographical vicinity to research labs and students,
- *translation and explanation of new ideas:* Universities might install interdisciplinary groups or teams (e.g., linguists and natural scientists) that take on the linguistic re-formulation of ideas and concepts so that a broader community (e.g., of organizations, but also of customers) can understand them, provide

theme-oriented ontologies, structures and glossaries and visualize networks of terms, definitions and examples which could help organizations to organize their knowledge,

- *educating talent*. The education of talent not necessarily has to be restricted to students of more or less one age group. In a society postulating life-long learning, universities might also engage in executive education. Distance education and tele-learning might provide a technological basis on which such programs could be built without excessive costs.

This list of ideas is not complete. It is meant to indicate in what ways universities might apply KM instruments or KMS, so that they can continue to act as important knowledge partners for organizations.

Strategic alliances and relationships. In recent years, it has become popular for organizations in need of knowledge (about markets, technologies etc.) to look for strategic alliances and relationships or even to take over other organizations that promise to hold the competencies needed instead of developing them on their own. In the APQC study 68.2% of the organizations considered themselves to make effective use of strategic relationships in terms of knowledge sharing. Only 6.8% considered themselves ineffective in that respect[308].

This list shows that knowledge management is not only a true cross-functional initiative in an organization that has relations to many other organization-internal units, but is also an important initiative spanning the boundaries of organizations that has relations to organization-external units. As these units have their own initiatives to improve knowledge-related goals as well, coordination between all these initiatives is often quite a challenging task. Thus, it seems appropriate that in many organizations it is not an individual that is solely responsible for this coordination task (e.g., a knowledge manager), but a community of interested stakeholders from various organizational units who can act as linking pins. This eases the burden on the head of the KM initiative.

6.1.3 Groups, teams and communities

There are a number of terms used to describe organizational phenomena of people working together: work group, project team, virtual team or community among others. Groups can be characterized according to the amount of direct interaction between members of the groups (work groups, virtual groups), the size (small groups, dyads, big groups), the intimacy of interactions (primary groups, secondary groups), the relation to the individual membership (ingroups, outgroups), the relation to organizational tasks (instrumental groups, socio-emotional groups), the relation to the organizational structure (formal groups, informal groups) etc.[309]. Groups have long been recognized as the most important unit for the development

308. See APQC 1996, 58; see also section 10.1.1 - “APQC” on page 439.
309. See e.g., Staehle 1991, 242ff, Wiswede 1991, 166f, Wiswede 1992, 738.

and sharing of knowledge and numerous forms of group structures have been proposed in the literature that cover both, permanent group-oriented redesigns of the organizational structure (e.g., semi-autonomous work groups), additions to the organizational structure (e.g., committees) and temporary groups (e.g., the German concept Lernstatt which models learning in analogy to the shop floor called Werkstatt). Examples are:

- *semi-autonomous* or *self-managing work groups* (Bartölke 1992, Schreyögg 1999, 243ff),
- *multiple overlapping groups* (linking pins, cross-function and cross-linking groups, Likert 1961, Likert 1967, 50),
- *committees* (Mag 1992),
- *quality circles* and the German concept *"Lernstatt"*[310] (Deppe 1989, Zink 1992),
- *learning laboratories* (Leonard-Barton 1992b, Lehner 2000, 203ff),
- *learning networks* (Wilkesmann 1999, 217ff),
- *technology groups* (Rehäuser/Krcmar 1996, 31),
- *best practice teams* or *clubs* (North 1998, 39f).

In the following, the three concepts most widely used in KM, i.e. groups, teams and communities, will be discussed in detail and used to illustrate three different organizational entities. The organizational design of collectives is important as competencies are regarded as networked capabilities of individuals[311].

6.1.3.1 Work groups

In modern organization theory, there is a multitude of approaches that concentrate on the work group as the main unit of analysis and try to improve the employees' motivation and as a consequence efficiency and effectiveness of organizational work (e.g., Eppler/Sukowski 2000). For knowledge management, the work group is one of the most important units as most of the knowledge creation and sharing has its origin within a work group. In the following, one example for a modern organizational conceptualization of the work group will be discussed in order to give an indication of the manyfold ways of organizing work groups in organizations. Other examples for specific work-oriented organizational instruments supporting knowledge management are e.g., separate organizational units specialized for learning (learning laboratories), quality circles or learning journeys (e.g., Roehl 2000, 182f).

Under the concept *"semi-autonomous work group",* a bulk of literature has been produced that suggests to increase the autonomy and responsibility of work groups

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310. The term "Lernstatt" draws the two terms "Lernen" (learning) and "Werkstatt" (shop floor, factory) together. The "Lernstatt" concept is a model of work in small groups developed in German companies in the 70s (Deppe 1989, 82ff) and primarily aims at the training of social skills in small groups (Zink 1992, 2132).
311. See Probst/Raub 1998; see also section 5.1 - "Strategy and knowledge management" on page 93.

in order to overcome some of the problems of the traditional Tayloristic organization system[312]. The problems result from the dominance of hierarchical control mechanisms and the lack of autonomy. A semi-autonomous work group can be defined as a small group in the context of an organization which is responsible for related work packages that it has to fulfill and which holds decision and control privileges previously assigned to higher hierarchical levels (Bartölke 1992, 2385).

One of the most important lessons learned from the experiments with semi-autonomous work groups (e.g., at Volvo in the 80s) was that employees' motivation is coupled to the responsibility that is assigned to them as a group or as an individual. The consequence for knowledge management is that the handling of knowledge is a sensitive part of an employee's work environment. Thus, a KM initiative and also the design of KMS should take into account the individuals' responsibility for his or her own knowledge. On the group level, this might mean that work groups should be held responsible for their handling of knowledge. This argument is further developed in the scenarios in part D.

6.1.3.2 Project and virtual teams

The term "team" has been around for quite a while. Although there are many different views and definitions of this term, there is common agreement that team members have to trust each other, to coordinate work among themselves, to understand each other's importance for the task and to hold each other accountable. This is especially true for virtual teams (Jarvenpaa et al. 1998). Team members are therefore interdependent. (Potentials for) synergy is an important reason to create a team. Thus, due to the efforts required for coordination, a team cannot consist of too many members (some authors speak of up to 25, Katzenbach/Smith 1998, 45).

Goals must be the same for all members and should be clearly stated, measurable and understood by the team members. Members of a team have to commit substantial efforts to a team which limits the number of teams one individual can participate in. Teams are quite stable organizational entities with respect to their members, but they are temporary phenomena with a given task to fulfill. After completion of the task, team members split up, either return to their original work group, participate in a new team or the team as a whole takes on a new task.

To sum up, a team is a small group of individuals committed to common, clear, measurable, short-term goals. This requires their coordinated and interdependent effort for which they hold themselves mutually accountable. Teams get together for a finite amount of time (Ferrán-Urdaneta 1999, 129, Katzenbach/Smith 1998, 45ff). Teams play multiple roles with respect to knowledge management and can be responsible for a wide variety of tasks (Kleingarn 1997, 203ff):

- *top management teams*: are responsible for design and coordination of the learning organization,
- *process teams*: perform sub-processes of organizational learning,

312. See Bartölke 1992, 2385ff and the literature cited there, other approaches are e.g., job enlargement, job rotation, job enrichment.

- *service teams*: support other teams,
- *problem solving teams*: are responsible for the development of solutions to complex problems,
- *coaching teams*: coordinate and optimize the communication between all the other teams.

In the ILOI study, multi-functional project teams and quality circles are suggested as an instrument for knowledge management (ILOI 1997, 22). In these teams, so the hypothesis, members with different perspectives, which are due to different functions, experiences and training, exchange ideas about problems and possible solutions of the daily work processes. 54% of the organizations responding to the ILOI study had multi-functional project teams and quality circles in place and 78% had this instrument or were planning to use it in the near future (ILOI 1997, 16, 22).

Teams, together with work groups, are the most commonly used setting for the exchange of experiences in organizations. In the ILOI study, 80% of the organizations used group and team work for the exchange of experiences and another 66% of the organizations reported to use groups to build experiences and exchange implicit knowledge (ILOI 1997, 33, 35). In the APQC study, 81.8% of the organizations said they were effectively using cross-functional teams for knowledge sharing (APQC 1996, 58). These examples show how multi-faceted group and team work can be resulting in different types of knowledge that is easily shared within such a setting. Consequently, ICT tools to support a "project memory" are needed (Weiser/Morrison 1998).

6.1.3.3 Communities

In recent years, the term community has been widely used and accepted to describe a form of organizational entity which is propagated as a premium instrument for knowledge sharing and management. The number of community-related terms in use shows the wide variety of forms and conceptualizations of communities that have been suggested in the literature or established in organizations recently. Examples are:

- *community of practice*[313],
- *community of interest*[314],
- *community of knowledge practice*[315],
- *(informal) networks*[316],
- *knowledge community*[317],

313. Brown/Duguid 1991, Lave 1991, Lave/Wenger 1991, Wenger 1998a, McDermott 1999b, 1999c, Allee 2000, Nickols 2000, Storck/Hill 2000, Wenger/Snyder 2000, Henschel 2001, Lesser/Everest 2001.
314. Armstrong/Hagel 1995, 131.
315. Amidon 1998, 51ff, 1999, 83ff.
316. Charan 1991, Krackhardt/Hanson 1993, Rehäuser/Krcmar 1996, 27.
317. Borowsky 2000, Botkin 2000, 39ff and 93ff, North et al. 2000.

- *strategic community*[318],
- *communities in cyberspace*[319],
- *computer-supported social network*[320],
- *(geographically) distributed community of practice*[321],
- *electronic community of practice*[322],
- *on-line community*[323],
- *virtual community*[324],
- *virtual transaction community*[325].

Networks have always existed in organizations, e.g., as *advice* networks, *trust* networks, networks of *friends*, networks of *shared interests* and *communication* networks (also Krackhardt/Hanson 1993, 106f). Their systematic consideration has lead to the use of the term community.

The latter seven terms stress the important role of ICT to support interaction in communities that probably would not exist or stay alive without these technologies. On-line interaction supports a variety of social ties, not only within virtual communities, but also as an additional medium for "real-life" communities (Wellman/Gulia 1999, 181ff). Despite the limited social presence in on-line interactions, strong, supportive community ties (either initiated on-line or in real life) can be maintained and possibly the number and diversity of weak ties can be increased as well (Wellman/Gulia 1999, 185).

The term community has been in use as a central concept in sociology for a long time describing a major form for the organization of social life since nomadic groups ceased to wander and settled down (McKee 1969, 200), a "living organism" (Tönnies 1922, 5[326]) rooted in family relationships. The term has been used to describe other forms of collectives of people living together characterized by intimate, cooperative and personal relationships, for example villages, cities, guilds, religious communities and confessions (Tönnies 1922, 21ff).

As with most terms borrowed from everyday language, the term community as a sociological concept displays a number of facets and sociologists are not entirely consistent in their use of the term (Schnore 1967, 84). Some authors have questioned the utility of the term for sociological research due to its vagueness (Schnore

318. Storck/Hill 2000.
319. Kollock/Smith 1999.
320. Wellman/Gulia 1999, 169ff.
321. Hildreth et al. 2000, 31ff.
322. McLure Wasko/Faraj 2000.
323. Armstrong/Hagel 1996, Cothrel/Williams 1999, Kollock 1999, 220ff.
324. Rheingold 1994, Armstrong/Hagel 1995, Donath 1999, Wellman/Gulia 1999, Hummel/Lechner 2001; for an example of a virtual community that is well supported with ICT see Beinhauer et al. 1999.
325. Schubert 1999, 32ff.
326. Tönnies, a German sociologist, used the German word *Gemeinschaft* (community) in contrast to the word *Gesellschaft* (society) which denotes impersonal and independent relationships (Tönnies 1922).

1967, 87ff) and in newer textbooks on sociology the central importance of the term has faded (e.g., Wiswede 1991, 227, Turner 1994, 179ff, Tischler 1996, 537f).

From an organizational perspective, communities have been around for hundreds of years e.g., as networks of self-employed craftsmen fulfilling both a social and a business function (Wenger/Snyder 2000, 140). The term community denotes a large group of collocated people who satisfy the safety, economic and social needs of its members (e.g., Tönnies 1922, 23ff, Schnore 1967, 84ff, Smelser 1981, 144f, Ferrán-Urdaneta 1999, 129).

Over time, the term community has been used not only for geographical communities, but also for so-called social-psychological communities like the community of scientists or, more generally, *professional communities* in which case the term refers to shared interests or to the distinctive traits of a group of people (Schnore 1967, 91, McKee 1969, 200, Smelser 1981, 144) or the *community of interest* in which the psychological viewpoint of shared interests, characteristics, or association is stressed and the geographical viewpoint of a requirement of co-location of the community's members is neglected (e.g., Schnore 1967, 90ff).

What is new about communities as viewed here is that the term is now also applied for groups of people within an organizational setting (e.g., within companies), so they are different from the guilds in the Middle Ages or the professional communities (e.g., of scientists) in more recent days. In this new meaning the term *community of practice* was coined by Lave and Wenger in their studies about the relationships between masters and apprentices and the situated learning processes among apprentices (Lave/Wenger 1991, 91ff). Learning in this view took place as *legitimate peripheral participation* of novices in *communities of practice* of apprentices and masters.

This conceptualization views learning as situated activity. Learners inevitably participate in communities of practitioners in which mastery of knowledge and skill requires newcomers to move toward full participation in the sociocultural practices of a community (Lave/Wenger 1991, 29ff). The roles of teachers and learners are dynamic so that novices and especially apprentices who have participated in the community for a while also act as teachers for their peers. A community in this view is a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities (Lave/Wenger 1991, 98). Practice is the source of coherence of a community due to mutual engagement, a joint enterprise and shared repertoire (Wenger 1998a, 72ff). Shortly after, Brown and Duguid developed this concept further based on an ethnographic study of the workplace practices of service technicians extensively documented by Orr (Brown/Duguid 1991, 41ff). Box B-5 gives an exemplary definition of the term community.

This common core is shared by all communities, although actual communities differ widely and stretch from Lave and Wenger's face-to-face, highly interactive communities of practice of apprentices and masters within an organizational setting over electronic communities of transaction that share a buying or selling need to virtually all areas of social interaction, e.g., virtual communities of fantasy

where people relate to each other in purely fictional settings (fantasy role play games, multi-user dungeons[327])[328].

A community is a set of relations among persons, activity, and (social) world, a long lasting, informal group, composed of a number of people who join the community voluntarily with common interests, common work practice and/or common objectives that satisfy some of their individual needs, with low coordination but with many weak ties among members, where no member is critical for the survival of the group or the accomplishment of common objectives (Lave/Wenger 1991, 98, Ferrán-Urdaneta 1999, 130, Henschel 2001, 49). Communities in organizations are characterized by responsible, independent action, a relatively informal organizational entity in a usually fairly structured environment of defined roles and processes (Storck/Hill 2000, 64) and by self-management. Communities bring people informally together that share expertise and motivation for a joint enterprise (also Wenger/Snyder 2000, 139).

BOX B-5. **Definition of community**

Communities can be characterized by a number of *dimensions*. Table B-9 contains a list of dimensions and shows how diverse actual implementations of this concept can be[329]. The large number of dimensions used to characterize communities once again show the heterogeneity of this concept. In the following, the focus will be on communities within organizational settings. The two terms that come closest to this perspective are *communities of practice* in Lave and Wenger's or Brown and Duguid's view as well as the term *knowledge community* as used by Botkin to denote a group of people who share the interest to jointly develop, share and apply knowledge (Lave/Wenger 1991, Brown/Duguid 1991, Botkin 2000, 93ff). As opposed to Lave and Wenger, Botkin's knowledge communities can be founded or developed intentionally[330] and their existence is visible throughout the organization. This points to the dimension *degree of recognition by organization*.

327. Multi-user dungeons or dimensions or domains (MUDs) are play and conversation spaces in the Internet that offer synchronous modes of communication and are based on fantasy role games, see Götzenbrucker/Löger 1999, 3.
328. See Lave/Wenger 1991, 91ff, Armstrong/Hagel 1995, 131. For a list of examples of virtual communities that gives an overview of the heterogeneity of this concept see Schubert 1999, 207ff.
329. Descriptions of the poles or several items on the dimensions are given where they are not self-explanatory.
330. Botkin suggests to view the development of knowledge communities as an entrepreneurial project (Botkin 2000, 93) and to view the whole organization as a portfolio of knowledge communities that act like small, dynamic firms (Botkin 2000, 110ff).

TABLE B-9. Dimensions of communities

dimension	values
size	*small*: fewer than 20 people *medium*: between 20 and 100 people *large*: more than 100 people
degree of activity	*active*: the community is perceived as a flourishing platform for interaction between its members, regular active (electronic) meetings take place, contributions are made etc. *inactive*: members' interests (temporarily) shift away from the community which might not serve well as a platform to satisfy its members' needs
degree of personal interaction	*small* amount of person-to-person communication *large* amount of person-to-person communication
equality of participation	*unequal*: a large number of passive members just listens to the communication in the community; a core group is clearly identifiable *equal*: small number of passive members; the level of activity is spread across the members; most members share about the same level of activity
cohesion	*strong ties*: members are highly emotionally involved and identify with the community and its goals; membership to the community is valued highly by its members *weak ties*: members are not highly involved in the community's activities; membership is not valued highly; most members do not identify with the community and its goals
focus on topic/theme	*focused* on topic *not focused* on topic
fragmentation	*no sub-communities,* activity solely on the community-level *sub-communities exist*, but activity primarily on the community-level *activity primarily in sub-communities* *activity solely in sub-communities*
language	*shared professional language*: members of the community share a professional background and language that provides context for the exchange of ideas and knowledge *no shared language*: no such shared context exists; this might be the starting point for cross-functional communities in organizations and for developing a common language
existence of an explicit agenda[a]	*explicit agenda* exists *no explicit agenda*

TABLE B-9. Dimensions of communities

dimension	values
degree of anonymity	*anonymous*: members do not know each other and do not disclose their identity *pseudonymous*: the members' identity is known to a community moderator or manager *identified*: members' identities are open to all members; every member has to disclose his/her identity when joining the community *varying*: it is up to the members whether they disclose their identity or not
openness	*open*: to all the members of the organization or even to the public *restricted*: to a selected group of people, e.g., with a certain background, history, role or position within an organization or in any organization (e.g., professional communities)
homogeneity of members' backgrounds	*unidisciplinary*: members have similar educational and/or professional background *multidisciplinary*: members stem from various disciplines, especially with respect to functional areas, e.g., engineers, salespeople *interdisciplinary*: members come from a wide variety of fields, e.g., business, engineering, biology, computer science and psychology for a bioinformatics community
degree of moderation/ management	*chaotic*: community develops entirely self-regulated; there are no explicit community rules and no member of the community is responsible or entitled to moderate the process *strongly moderated*: by a community manager who sets and/or executes rules about e.g., membership, behavior and contributions
reach/extension[b]	*local-interest* community *language-specific* community *multilingual, unbounded* community
degree of recognition by organization[c]	*unrecognized*: invisible to the organization and sometimes even to the members *bootlegged*: only visible informally to a circle of people *legitimized*: officially sanctioned as a valuable entity *strategic*: widely recognized as central to the organization's success *transformative*: capable of redefining its environment and the direction of the organization
stages of development of the community[d]	*potential*: people face similar situations without the benefit of a shared practice *coalescing*: members come together and recognize their potential *active*: members engage in developing a practice *dispersed*: members no longer engage intensely, but the community is still alive as a force and a center of knowledge *memorable*: the community is no longer central, but people still remember it as a significant part of their identities

TABLE B-9. Dimensions of communities

dimension	values
ICT support	*unsupported*: "real" community, members are collocated or meet regularly face-to-face *weakly supported*: the emphasis is on person-to-person meetings, but ICT is used to keep the relationships between the meetings. examples are mailing lists or listservers *strongly supported*: ICT support is an important aid and gains visibility; community has its own homespace, advanced communication tools, but occasionally meets person-to-person *virtual community*: the community exclusively relies on ICT support for the communication of its members who normally do not meet person-to-person at all
reference to organization/ company	*restricted to business unit*: members belong to the same business unit *across business units*: communities cut across business units, e.g., when cross-functional teams want to keep in touch with each other after a completed project *organization-centered*: the core group of the community consists of members of the organization, but externals are welcome, e.g., business partners, researchers etc. *unbound*: members of the community come from a variety of organizations, e.g., in professional communities
needs addressed[e]	*fantasy and entertainment* *relationship* *history and geography* *interest* *transaction*
profit orientation	*commercial*: either members of the community, e.g., to increase their bargaining power, or the community owner, e.g., through advertising, have commercial interests[f] *non-commercial*: the community serves the non-commercial needs and interests of its members (e.g., exchange of knowledge and experiences, social interests, entertainment)

a. See also Wenger/Snyder 2000.
b. Reach or extension restricts the group of potential members of the community besides the formal access restriction as discussed before, e.g., due to local interests or the use of a single language.
c. See Wenger 1998b, 3.
d. Stages of development characterize phases that differ by the number of members, by activities, form, intensity of interactions (Wenger 1998b, 2) and by opportunities for organizational support (Allee 2000, 9ff).
e. This classification applies especially to virtual communities (Armstrong/Hagel 1995, 130f, 1996, 135f, Hagel/Armstrong 1997, 18ff).
f. For business models of commercial virtual communities see Schubert 1999, 176ff.

However, whereas Lave and Wenger implicitly assume that communities are first founded and then might be positively sanctioned by the formal organization, it might also be the other way round. The foundation of communities might also be inspired by the formal organization. Intelligent tools might automatically recommend a number of employees with similar interest profiles and professional backgrounds into a community. No matter whether communities are viewed as an emergent phenomenon, whether they are fostered by the organization or their foundation is inspired by the organization, other characteristics of communities remain unchanged, for example the voluntary membership, longevity, common interests and relative informality. Communities are *different from teams* with respect to the following dimensions[331]:

Size. A community often consists of more members than a team, usually more than 25 members (Ferrán-Urdaneta 1999, 129f). Intensely collaborating communities rarely have more than 50 members (Brown/Gray 1995, 81). However, due to ICT support, e.g., in the form of newsgroups, forums, discussion lists or chat, there are also much larger, basically virtual communities such as ISWORLD with approximately 3,000 members. Often, there are a large number of passive members and a small number of active members. Even free riders are sometimes tolerated[332].

Goals and tasks. Communities aim at goals that are accepted by all members and are anchored in the satisfaction of (some of) the individual goals of its members. Thus, it is not an externally attributed task that is fulfilled by a community, but the sole reason for its existence is to create benefits for its members in their individual task fulfillment.

Form of membership. Members are often loosely integrated into the community and the community is self-organized in the sense that it defines its own work processes and decides on its own about accepting new members as opposed to teams for which the members are selected by managers. Individuals become members voluntarily, their involvement depends on their own initiative. Members of a community may not interact among one another or even know each other, but still they will recognize each other's membership to the community (Ferrán-Urdaneta 1999, 129). Members of a community should feel that they belong to the community, they should be committed which makes the community a (partial) kind of "home" or "social net" for its members. Still, as not all members have to be active participants, individuals can be members of many communities at the same time. Depending on the intensity of participation, the following forms of membership or levels of participation can be differentiated (Wenger 2000, 218f):

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331. See e.g., Ferrán-Urdaneta 1999, 128 and the sociological theories as cited there; see also Smith/Kollock 1999, Wenger/Snyder 2000, 141ff.
332. See also Kollock 1999 for a more thorough discussion of the economics of virtual communities.

- *passive access*: persons external to the community who have access to institutionalized knowledge that the community publishes,
- *transactional participation*: occasionally persons contribute to the community or use services of the community without being a member,
- *peripheral participation*: members of the community who quite passively participate in the community e.g., because they are newcomers or because the topics discussed are not at the center of their interests and/or current work practices,
- *full membership*: participate in and contribute regularly to the community and are acknowledged as experts in the community,
- *core group*: a small group of people is at the heart of the community, works intensively for the community and takes on responsibility for the design of the community (e.g., rules, norms, organizational issues).

Relation to formal organization. Authority relationships are not organizationally determined, but evolve over time. "Knowledge leaders" (Storck/Hill 2000, 68) are identified to whom members of the community turn when they have a particular knowledge need. Interaction, coordination and the dependence of the community from single members is weaker than in the case of a team. Formal organization takes on the role of a sponsor of the community rather than integrating it into normal management processes (and reporting). Communities complement existing organizational structures rather than replacing them (Wenger/Snyder 2000, 139).

Lifetime. Usually, communities do not have a predefined lifetime, but are long-lasting organizational phenomena. Communities generally are not dependent on single members, they outlive individual members (Ferrán-Urdaneta 1999, 130). As it is passion, commitment, and identification with the members' expertise that holds a community together rather than project milestones and goals as in the case of a (project) team, communities last as long as there is interest (by the core group) to keep the community alive (Wenger/Snyder 2000, 142).

Table B-10 summarizes the most important differences between work groups, teams, communities and informal networks. The comparison shows that communities are most similar to informal networks with which they share many characteristics (goal/purpose, lifetime, size) and in fact formal networks might easily develop into communities if they open up for new members and gain more visibility in organizations.

In certain contexts, communities seem to produce considerable *benefits* for the organization. The following benefits result from several case studies on communities[333]:

333. See e.g., Allee 2000, 8, North et al. 2000, 52f, Storck/Hill 2000, Wenger/Snyder 2000, 140f, Lesser/Everest 2001, 38.

Efficient instrument for knowledge sharing. Within the community knowledge is shared efficiently, both, tacit knowledge as well as more tangible knowledge assets. This is partly due to the fact that communities are long-lasting organizational phenomena which helps and motivates members to develop mutual trust. Additional facilitating factors are diversity in membership, a limited requirement for formal reporting which creates a "secure space" for exchanging ideas and reflection processes that consolidate what was learned in e.g., a meeting or a trait in a newsgroup discussion. As communities are often cross-functional with members belonging to different business units, the knowledge shared between community members is also spread throughout a bigger circle and even organization-wide. Broad participation also supports that knowledge is transferred into business units and from business units back to the community (Storck/Hill 2000, 66, 70).

TABLE B-10. Communities compared to other forms of collective organization[a]

goal/purpose	membership	ties	lifetime	size
community				
serve needs of its members, e.g., develop capabilities, exchange knowledge	members select themselves	passion, commitment and identification with the group's expertise	as long as there is interest in maintaining the group	can be large or small; in large communities there are a large number of passive members
work group				
formal, organizational design goals: e.g., perform value adding activities, deliver a product or service	everyone who reports to the work group's manager	job requirements and common goals	until the next reorganization	tend to be small; all members actively contribute in the group
(project) team				
accomplish a specified task within a certain amount of time	employees assigned by (senior) management	the project's milestones and goals	until the project has been completed	can be large or small; contributions of members vary widely
informal network				
collect and pass on business information; build trust and social relationships	friends and business acquaintances	mutual needs	as long as people have a reason to connect	can be large or small; depending on individuals' needs

a. This table is based on Wenger/Snyder 2000, 142.

Communities are also important instruments to provide context for the sharing of explicit knowledge as can be found in knowledge repositories. This is especially

true for practical skills the transfer of which requires interaction and a shared work practice (Henschel 2001, 282f). Communities might take on responsibility for a portion of the organization's knowledge repository and thus make sure that the contents documented actually serve the community's needs. As a consequence of the increased efficiency in knowledge sharing, the organization's reactions to customer needs could be quicker and more and better ideas for products and services could be generated (Lesser/Everest 2001, 38). In some cases, the effects might even lead to the start of new lines of business (Wenger/Snyder 2000, 140).

Driver for the implementation of a business strategy. If a community's agenda is aligned with an organization's strategy, it can be a useful instrument for the implementation of a strategy. Problems encountered can be resolved, different perspectives can be consolidated and the dynamic adaptation of a strategy to new (internal and external) developments (e.g., technological changes) can be supported. In this case, communities can act as change agents that create a drive that spreads throughout the organization (Wenger/Snyder 2000, 140 report two cases illustrating this potential).

Better motivation for learning and developing. Since communities are formed around individual needs and participation is voluntary, its members are usually highly motivated to learn from each other. Communities can create a distinctive culture conducive to innovation, individual learning and development of personal skills and knowledge which result in deeper internalization of learning. Learning as part of a group is considered more effective than learning alone as learning depends on the availability of peers and their willingness to act as mentors and coaches as much as it does on masters (Storck/Hill 2000, 70, Wenger/Snyder 2000, 141). The ability to learn of a community of practice is variable depending on the diversity, cohesion, the intensity of interaction and communication as well as the identity of a community (Henschel 2001, 278).

Improved development and exploitation of core competencies. Since communities are more visible than networks, it might be easier for the organization to identify core competencies and capabilities, to foster their development within communities, to diffuse practices more rapidly and thus to exploit competencies throughout the organization. Communities might also help to build a common language, methods and models around core competencies (Allee 2000, 8).

More influence on implementation of joint goals. Communities have more influence on decisions than a single individual. As the community exists in addition to the formal organizational structure, proposals of the community yield greater external validity than those of a single business unit. Since members often stem from different business units and conflicts are resolved effectively within the community, it is less likely that proposals are born out of particular interests of a single business unit with goals conflicting to other business units. Authority and influence of communities often extends beyond its boundaries and reduces additional review

and decision making in the business units. Communities thus provide an instrument to share power and influence with formal organization (Allee 2000, 8).

Instrument to recruit and retain talent. Since a community can act as a virtual "home" for people who share interests, it can be an instrument to help organizations to recruit new people and to retain them (Wenger/Snyder 2000, 141). Thus, organization-internal communities can create a barrier to leave the organization. They can also create a motivational factor to entry if the community has an exclusive image and potential employees are promised that they can join such an exclusive "club". However, the opposite might be true if communities span organizations. In this case, communities serve as a "home" no matter on whose payroll its member is. In this case, it might even stimulate employees to join a different organization as the social network is easily transferable. Still, even in this case, the knowledge might as well stay with the company as it can be embedded in a larger group of people and thus retained in the community as no single individual is crucial to the survival of the community. Employees that left the organization might even still be willing to contribute towards the organizational goals in certain cases because the network is still alive.

Improved learning curve for new employees. Once recruited, employees have to quickly learn to use the methods, models and tools that have to be applied in the newcomer's position in the organization, get an overview about the knowledge network in an organization and thus links to experts and their competencies.

Provide homes for identities. As communities are not as temporary as teams and as communities are organized around topics or shared interests they can provide a platform, a social home for like-minded people in which they can develop their identities which have been found to be a crucial aspect in organizational learning (Wenger 1998b, 4, Allee 2000, 8).

Even though benefits can hardly be measured, there is broad agreement about the positive effects of this concept in organizations. The successful application of the community concept is dependent on a number of factors describing the concrete situation in an organization. A number of authors have tried to elicit *success factors* that positively influence the benefits of a community. Even though communities are essentially emergent and self-organizing organizational phenomena, the formal organization can be supportive of communities in order to profit from the concept. Examples for success factors are[334]:

Interaction format. Although face-to-face meetings are not a prerequisite for the functioning of a community, most communities work this way (Storck/Hill 2000, 68). Face-to-face networking builds trust which is necessary for efficient knowl-

334. See e.g., Storck/Hill 2000; for guidelines how to foster communities see also McDermott 1999b, 1999c, Cothrel/Williams 1999, 56ff.

edge sharing and subsequent use of electronic communication technologies. Within the community openness should be stimulated, e.g., by the establishment of a "zone of safety" that builds trust. Immediate feedback is considered important.

Common vocabulary. Communication between members of the community is facilitated if they already share a common vocabulary (e.g., through similar experiences from training and education in large organizations). Otherwise it is advisable to provide background context for people to understand each other.

Redundant media and channels. Communities need a variety of forums, multiple ways to connect and share knowledge, e.g., events and meetings, newsgroups, mailing lists, chat server, tele-conferencing, application sharing, on-line training, yellow pages or Web space (also Cothrel/Williams 1999, 59). ICT supports additional channels and can provide an important means of communication for the community, especially if members are geographically dispersed.

Reflection. Work processes should be defined which include reflection circles that review knowledge created and what was learned during community activities.

Pull versus push. Knowledge sharing in communities should react to concrete and current knowledge needs and thus respond to people pulling insights rather than pushing knowledge to people.

Sponsoring. Communities need a supportive environment in order to grow and be beneficial to an organization. A sponsor, usually a non-member who is a senior manager in the organization acts as a champion for the community, motivates employees to actively participate, helps with organizational and ICT issues (e.g., rooms for meetings, home space in an Intranet), convinces management about the importance of self-organization in a community and talks to supervisors who are not in favor of their subordinates joining the community etc.

Support and moderation. Most communities will never be entirely self-sustaining and just exist because of the contributions, motivation and commitment of its members. Communities require continuos support from both, formal and especially informal roles[335]. The time and effort invested required to maintain a community is even higher than the effort taken to build the community in the first place[336]. Support not necessarily is restricted to formal roles, but includes the systematic search for and support of members who could take on informal roles (Cothrel/Williams 1999, 59f).

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335. See also section 6.1.2.8 - "Community or network manager" on page 167.
336. In an empirical study of 15 on-line Intranet, Extranet and Internet communities, about two thirds of the respondents responsible for managing or coordinating the community believed that the ongoing effort to maintain the community had increased compared to the initial effort to set up the community (see Cothrel/Williams 1999, 58).

Trustful organizational culture. An organization's culture can either support or prevent informal networks, such as communities. A trustful organizational culture, a communication as well as a cooperation culture (Frey 2000, 81ff), is the basis for effective knowledge sharing in general and in communities in particular. The organizational culture can hardly be actively influenced, though, and thus can rather be viewed as a requirement than a success factor[337].

Relation to formal organization. Linkage to formal control structure should be minimized (Storck/Hill 2000, 72). The community should establish its own processes and rules which should be continuously improved. However, it would certainly help if the topics discussed in the community were of strategic importance to the organization (McDermott 1999b, 6f) and would be valued and supported by providing time, resources, encouragement, and guidance, e.g., by a community support team (McDermott 1999c, 6), and by connecting the community to people and other communities that might be beneficial and/or profit from the relationship (Wenger 1998b, 5).

As mentioned, communities vary considerably in terms of e.g., size, social structure (e.g., authority relations), interaction format, existence of an explicit agenda, relation to formal organizational structure or formality of the work processes it defines (see e.g., the cases illustrated in Wenger/Snyder 2000). What they do have in common is that its members share their knowledge in a way that is less rigid and formally structured than in traditional organizational units like work groups or teams. Usually, a core group provides intellectual and social leadership.

Given their informal nature, communities are not easily installed, managed nor integrated within an organization. Communities are considered "emergent" and thus cannot be "created" (Brown/Duguid 1991, 49). However informal this organizational entity is, it does benefit from cultivation (Wenger/Snyder 2000, 143). As their nature is different from traditional organizational units, *"management" of a community* is a matter of:

Helping to found a new community. The aim is to bring together the "right" people and generate enthusiasm for the community to be founded. Key task in the foundation phase of a community is to define its domain and its linkage to organizational goals.

Providing an infrastructure conducive to communities. This comprises both, an organizational and an ICT infrastructure. The ICT infrastructure consists primarily of communication systems that support collectives of people, such as listservers, mailing lists, multi-point video conferencing tools, and community home spaces. Home spaces serve as portals for communities and as an instrument to advertise the community, to help to show progress towards joint goals and to exchange documents. The organizational infrastructure covers official sponsoring, supporting the

337. See also section 6.4 - "Organizational culture" on page 221.

community financially (e.g., budgets for community events), facilitating (e.g., through a separate knowledge management unit), helping to overcome obstacles and linking the community to related organizational activities and to other communities etc. (see also Wenger/Snyder 2000 for examples of organizational infrastructure).

Measuring the value of a community. The value of a community is assessed differently from the value of traditional business units. The effects of community work are often delayed and also the results are generated within traditional organizational units (e.g., work groups, project teams) so that they can hardly be attributed to communities. Organizations overcome that problem by regularly interviewing community members and collecting success stories which often already illustrate higher benefits than efforts made for keeping up a community (e.g., Wenger/Snyder 2000, 145).

Wenger and Snyder report two cases of the successful implementation of communities which show different styles of formal commitment by senior managers. They hypothesize that different styles of formal commitment to communities can be effective when aligned with the organization's culture (Wenger/Snyder 2000, 145).

Ferrán-Urdaneta compares teams and communities in terms of their effectiveness to support KM activities. He hypothesizes that as teams are designed for highly interdependent tasks they should serve interdependent KM tasks such as knowledge creation better than communities that are looser forms of group work than teams (Ferrán-Urdaneta 1999, 131f).

Communities in turn should be more effective in supporting those KM tasks that require a large group of people, e.g., legitimizing or distributing knowledge (Ferrán-Urdaneta 1999, 132).

However, one can assume that these hypothesis are neither supported for all kinds of knowledge nor for all kinds of communities. Ferrán-Urdaneta shows for encultured knowledge that communities might more effectively create that kind of knowledge than teams (Ferrán-Urdaneta 1999, 132). Also, communities will be more effective in legitimizing knowledge if, and only if, there are experts in the community who (a) can and are willing to endorse this knowledge and (b) the reputation of whom is acknowledged by the whole (or a large part) of the community. In this case communities will need effective instruments to determine who is expert in what topics, otherwise "wrong" knowledge might be endorsed by the "wrong" people.

In the case of knowledge sharing, communities might be more suited than teams for that kind of knowledge the sharing of which does not profit from the interdependent nature of teams. In many cases, the sharing of knowledge cannot be fully separated from the creation of new knowledge. Thus, a concrete knowledge exchange might show elements of both, teams being more effective than communities in parts of the task and communities being more effective than teams in other parts.

To sum up, it will be necessary to categorize knowledge and its relation to the members of teams and communities in order to be able to determine which structure will be more effective. All three concepts discussed here in detail—work groups, teams and communities—as well as other forms of collective organization as mentioned in the beginning of this section are effective, complementary platforms for knowledge-related tasks (also Wenger/Snyder 2000, 142), although as shown here every concept has strengths in different areas. Collectives of people are the most important unit of analysis for research and practice of KM. Their design, support with organizational and ICT instruments, and fostering will determine success of a KM initiative to a large extent.

6.2 Instruments

As explained in the definition of KM[338], the implementation of knowledge strategies requires systematic interventions with the help of instruments, either person-oriented, product-oriented, organizational or ICT instruments. Section 6.2.1 reviews a number of case studies of KM measures to give examples of what actual KM initiatives in organizations aim at, gives a definition of the term KM instrument and classifies KM instruments. Sections 6.2.2 and 6.2.3 present three selected classes of KM instruments in more detail.

6.2.1 Definition

Even though the terms KM instrument, KM project, KM initiative and KM measure are widely used, there is hardly any concrete definition of any of these terms. A large number of measures has been proposed as part of case studies in KM which also comprise more traditional person-oriented measures well-known in HRM, e.g., programs for personnel development, content-oriented measures well-known in data base theory that revolve around the use of (simple) meta-data, organizational measures well-known in organization science, e.g., job rotation, job enrichment or ICT measures well-known in MIS, e.g., the use of data bases, email or Groupware. Several case studies deal with the introduction of KM in organizations and describe what instruments were used. Table B-11 lists some examples of case studies that have been found in the literature[339].

KM instruments target different goals and consist of several measures that have to be aligned and supplement each other. Most of the instruments described in Table B-11 comprise organizational as well as technological measures. Thus, it is useful to review a human-oriented and a technology-oriented perspective on KM instruments before aiming at a comprehensive definition of KM instrument.

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338. See section 4.1 - “Knowledge management” on page 21.
339. See e.g., Chase 1997b, Güldenberg 1997, Davenport/Prusak 1998, Probst et al. 1998, Sveiby 1997, 1998, Bach et al. 1999, 267ff, McCampbell et al. 1999, 175ff, Antoni/Sommerlatte 2001, Eppler/Sukowski 2001, Mertins et al. 2001, Davenport/Probst 2002, Riempp 2004, 253ff, Jennex 2005, see also section 10.2 - “Case studies” on page 447.

Human-oriented definition. Instruments for knowledge organization are intervention tools that are describable, get deployed purposefully in a way that is traceable for an observer, have a clear knowledge orientation and are still relatively independent of the respectively organized knowledge (Roehl 2000). This definition has its roots in organizational psychology and sociology. The implementation of knowledge strategies is seen as a purposeful intervention into the way an organization handles knowledge. Having a clear knowledge orientation distinguishes KM instruments from other tools that help in an intervention into an organization, but remains unspecific about what exactly knowledge orientation is. In the case of ICT, knowledge orientation can be expressed by specific "intelligent" functions and specific content, with content being the most important part. Knowledge refers to contextualized information in an ICT context. Thus, KM instruments have to provide context in order to show knowledge orientation. Finally, a KM instrument in this view has to be general, spanning knowledge domains rather than being domain-specific.

TABLE B-11. Proposed instruments and supporting measures

instrument	measures
best practice sharing	a new organizational structure with several centers of excellence, an information system containing best practices and the adoption of benchmarking and models
case debriefings	several information systems including yellow pages and a case data base; new roles like knowledge stewards, coordinators and advocates and organizational rules
community of experts, interest, practice, purpose	establishing roles, e.g., moderator, subject matter expert, boundary spanner; foster networking between experts (community of experts), employees working on (community of practice) or interested in a topic (community of interest) or working towards a common goal (community of purpose)
competence management	definition of a skill tree and scales; establishing a procedure for assessing target and actual skills, rules for accessing skill profiles; implementation of a skill management system, expertise directory, yellow pages
content management (CM)	establishing a CM team consisting of roles responsible for design, structure, quality management and administration; definition of CM processes, implementation of a CMS
corporate and team culture management	corporate culture: off-shore meetings, expert meetings and debriefings; team culture: new team structures, informal interviews and an education program
documentation/ evaluation of customer feedback	establishing a new team and regular meetings; creating templates and organizational rules

TABLE B-11. Proposed instruments and supporting measures

instrument	measures
documenting tacit knowledge, identifying and integrating external knowledge	a new organizational unit; document management system, access to an online encyclopedia, lessons learned enforced through a workflow management system and "in-a-nutshell" learning videos
expert advice	a formal procedure installed in order to guarantee quick responses to (urgent) requests for knowledge which are given by (subject matter) experts within a defined time frame, supported by some form of forum or other content management system
externalization of knowledge	career plans, incentive systems, 360° evaluation, an electronic document management system and yellow pages, the introduction of so-called Intellectual Capital Teams that review new documents
idea and proposal management	is a formally defined procedure that targets all employees of an organization individually in order to get suggestions for improvements which are then selected, implemented and rewarded
knowledge maps	consistent access to customer, product and process knowledge with the help of organizational rules and visualization tools
lessons learned	establishing a lessons learned coach and a method for systematic harvesting of lessons learned in projects at defined project steps; consists of organizational rules, document templates and an IT system
technology-enhanced learning	also called e-learning, uses ICT in order to support learning processes. The emphasis is on organization-wide solutions including new roles, e.g., trainer, coach, tutor, learning processes that take pedagogical and didactical expertise into account and a learning infrastructure, e.g., consisting of an authoring tool and a learning content management system.
terminology management	establishing the role of a terminology manager, a process of meta-data and ontology management, a terminology management system for semantic integration of data sources

Technology-oriented definition. Knowledge management tools are technologies, broadly defined, which enhance and enable tasks along the knowledge life cycle, e.g., knowledge creation, codification and transfer. As with any tools, they are designed to ease the burden of work and to allow resources to be applied efficiently to those tasks for which they are most suited. It is important to note that not all knowledge tools are computer-based. Pulling these two perspectives together leads to the definition in Box B-6.

(1) Only parts of the valuable knowledge assets exist in explicit form as documented, electronically accessible knowledge. Therefore, KM instruments have to consider person-oriented measures. Organizational measures are implemented e.g., as rules, roles, procedures and newly or re-defined processes that describe how to deal with ICT systems. Last, but not least this book focusses those KM instruments that are enabled, fostered or substantially supported by ICT. (2) Clearly defined means that any proposed instrument has to clarify what measures and tools are involved so that it is possible to decide if an observed phenomenon in an organization matches this definition. (3) KM instruments have to be purposefully deployed within an organization, usually within the frame of a systematic intervention with the help of a KM initiative. That includes defining knowledge-related goals and respective measurement. Organizational knowledge base reflects people's skills, the contents as well as (ICT) tools and systems in an organization that support handling of knowledge.

A KM instrument is (1) a collection of organizational, human resources and ICT measures that are aligned, (2) clearly defined, (3) can be deployed purposefully in an intervention into an organizational knowledge base in order to achieve knowledge-related goals, (4) target contextualized information as object of intervention and (5) are independent of a particular knowledge domain.

BOX B-6. **Definition of knowledge management instrument**

(4) Knowledge orientation of the KM instrument can only be accomplished if the contents of the ICT systems are "knowledge-prone", thus being contextualized information instead of only data. An example is a data base containing experiences, lessons learned or best practices together with links to people who have made these experiences and/or experts in the domains that are described (knowledge) as opposed to a data base holding telephone numbers of employees (data). Embedding information into context is crucial[340]. In ICT systems, it can be achieved by assigning appropriate meta-data and systematic management of a taxonomy or ontology to help users to integrate information into their personal knowledge bases[341]. (5) Finally, a KM instrument should be independent of a specific knowledge domain and can be targeted at any topic or (core) competence of an organization.

Figure B-24 organizes some important KM instruments that have been proposed in the literature and are applied widely in organizations.

Even though KM instruments have been defined as comprising person-oriented, product-oriented, organizational and ICT measures, actual KM instruments usually target (1) either individuals (person) or collectives (organization) along the dimension organizational level and (2) knowledge as object, in the form of a product or

340. See also the characteristics of KMS stated in section 4.3.2 - "Definition" on page 86, especially the one discussed in the sub-heading "Context" on page 87.
341. See section 7.7 - "Semantic integration" on page 374.

knowledge in a process-oriented, encultured form, i.e. practices, processes or routines. All example KM instruments are supported by ICT.

Person. Person-oriented KM instruments primarily aim at knowledge that is provided by, managed by or bound to individuals, e.g., personal experiences or routines, ideas, proposals, self-managed ad-hoc learning processes or meta-knowledge about individual skills.

Organization. Organizational KM instruments target knowledge that is created together, shared, integrated, validated, legitimated or committed by many employees and thus is bound to social systems. Social systems in organizations are described with the help of the formal organization design, especially business and knowledge processes supported by good or best practices, knowledge maps, knowledge process reengineering and process warehouses, projects and work groups supported by case debriefings and lessons learned as well as the informal organization, reflected by communities and knowledge networks. Semantic content management provides the infrastructure for knowledge processes whereas learning processes are systematically supported by technology-enhanced learning.

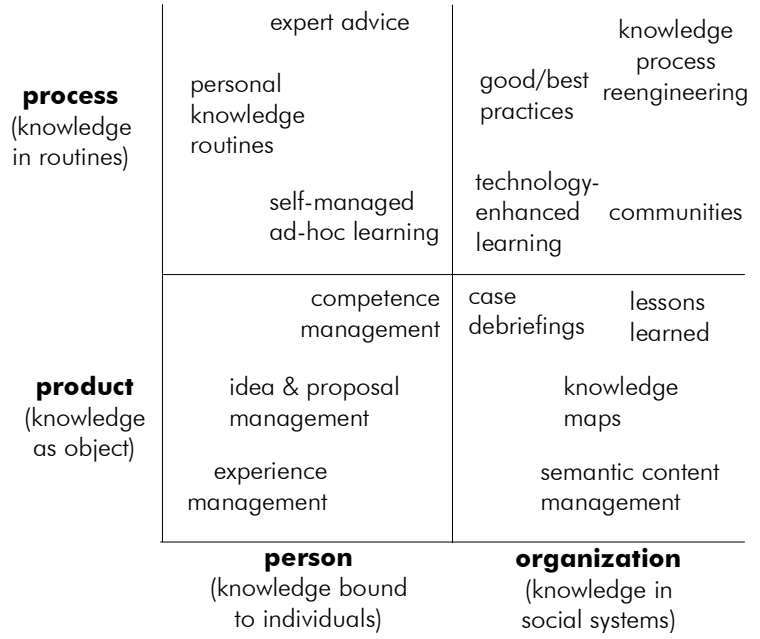

FIGURE B-24. Knowledge management instruments

KMS aim in general at providing a platform for KM and in particular foster the implementation of knowledge strategies with the help of a defined set of KM instruments. In the following, the identified instruments are described structured

into KM instruments that target knowledge as a product (section 6.2.2) versus those that target knowledge as a process (section 6.2.3).

6.2.2 Product-oriented instruments

Documented knowledge certainly is of high importance with respect to the design of KMS. On the one hand, product-oriented KM instruments target personal knowledge, such as personal experiences, ideas and proposals or skills descriptions. On the other hand, documented knowledge can be spread across multiple sources and requires identification and visualization with the help of knowledge maps as well as integration which is supported by ontologies. Ontologies also aid the management of semantic content. While this instrument targets electronically available content as potential knowledge sources throughout the organization, there are two instruments that specifically establish the systematic handling of inter-subjective knowledge with commitment, i.e. case debriefings and lessons learned.

Personal experience management. The implementation of experience management systems eases documentation, sharing and application of personal experiences in organizations. These systems have to be integrated into the daily work practices of employees in order to be accepted. Several approaches exist that support capturing of experiences, e.g., information mapping, learning histories or microarticles (Willke 1998, 107ff) that help employees to document and structure experiences. On an organizational level, systematic management of personal experiences enables a company to solve recurring problems more effectively. However, there are some barriers which prevent the documentation of experiences or reuse of already documented experiences. Foremost, time required for documenting experiences is a critical factor because it imposes additional efforts on employees. Therefore, organizational measures are required that provide time tolerances and keep the effort as low as possible. Simultaneously, sufficient context of the experience has to be provided. ICT solutions help to automatically detect context. Personal barriers, e.g., insufficient willingness to share knowledge or to apply knowledge created by other employees (not-invented-here-syndrome) have to be considered by measures like trust management and incentive systems.

Idea and proposal management. Most organizations systematically collect ideas and proposals for improvements put forward by their employees. In Germany, such instruments are called *organizational proposal system* (Betriebliches Vorschlagswesen). These are formally defined processes that handle those ideas and proposals that have been submitted by individual employees. A group of experts reviews the proposals and evaluates them in a committee. If the idea or proposal is selected, it is then implemented and the employee is rewarded, mostly financially. A template can help employees to structure their ideas and proposals, an automated workflow can identify appropriate experts for reviewing the proposals. From an ICT perspective, a data base system as a minimal solution can be used to store the proposals. Semantic content management can help interpret the proposals, e.g., with a glos-

sary for acronyms and special terms probably not known by reviewers of different areas of expertise.

Competence management. Competence management supports systematic analysis, visualization, evaluation, improvement and usage of competencies held by individuals in organizations. Competence management comprises expertise locators, yellow and blue pages as well as skill management systems, also called people-finder systems. Skill management comprises an information system that makes skill profiles accessible, learning paths that have to be defined for each employee and that have to be updated together with skill profiles. A central skill ontology, also called skill tree, has to be defined that provides context for all existing, required and wanted skills in the organization. Training measures have to be offered. Skill management systems are often not limited to information about skills, their holders and their skill levels, but also contain information about job positions, projects and training measures in which employees learned, used and improved their skills. Yellow and blue pages are directories of organization-internal and -external experts respectively. Profiles of the experts together with contact details are listed according to a number of knowledge domains for which they might be approached. Information about employees' skill levels and degrees of expertise can be used e.g., to connect people, to staff projects, to filter and personalize KMS contents and functions.

Semantic content management. Semantic content management refers to managing meaningfully organized content, i.e. documented knowledge embedded in a context. The term *semantic* in this case means that content is well-described with the help of meta-data that assigns meaning and structure to the content and that these descriptions are machine-interpretable and can be used for inferencing[342]. Semantic content management extends document management and enterprise content management into integrated document and content management. The instrument is certainly tightly related to an IT solution, but there have to be rules that guide definition and use of semantics, monitoring external knowledge sources for interesting content that should be integrated, developing an appropriate content structure as well as publishing of semantically enriched documents in the system. Semantic content management also allows for "smart" searching, collaborative filtering and can be integrated with competence management in order to handle interests used to connect people with the help of the joint analysis of semantic content and skills.

Knowledge maps. Different types of knowledge maps that can be used in order to aid access to knowledge, knowledge sources or to knowledgeable persons. Central goal in this instrument is the creation of corporate knowledge directories which visualize existing knowledge in organizations and support a more efficient access

342. See also sections 7.7.2 - "Meta-data management" on page 379and 7.7.3 - "Ontology management" on page 387.

to and handling of knowledge. The main objects of mapping are experts, project teams, networks, white papers or articles, patents, lessons learned, meeting protocols or generally document stores. In the following, the individual types of knowledge maps are discussed in detail.

Knowledge source maps visualize the location of knowledge, either people (sometimes also called knowledge carrier maps) or information systems and their relation to knowledge domains or topics. They can be further classified into knowledge topographies to identify gaps, competence maps to find experts and pointer systems that directly link from challenges within a process to a contact that can assist. *Knowledge asset maps* visualize also the amount and complexity of knowledge that a person or system holds.

Knowledge structure maps show the relationship between different knowledge domains or topics and should not only visualize that there is a relationship, but also explain the type of relationship. Formal definition of knowledge structures results in ontologies and is an important instrument for the integration of diverse knowledge sources[343].

Knowledge mapping can also be used in order to highlight knowledge processes, especially processes of knowledge development and application. These maps are combinations of process models and knowledge carrier maps. *Knowledge development maps* visualize processes or learning paths that can or have to be performed by individuals or teams in order to acquire certain skills. *Knowledge application maps* describe what process steps have to be performed in what situation at what step in a business process, e.g., who should be contacted for a second opinion.

Lessons learned. Lessons learned are the essence of experiences jointly made and systematically documented by members of the organization in e.g., projects or learning experiments. In a process of self-reflection, e.g., at the end of a project milestone, also called after-action reviews, or at the end of a project, also called project debriefings, the project members jointly review and document critical experiences made in this project (Probst et al. 1998, 209f). Lessons learned can also aid individual self-reflection about one's own experiences, but primarily aim at joint reflection that explicates know-how gathered in a team and learning from the experiences of others (also Haun 2002, 318). Lessons learned are thus the product of a formal process that involves a collective of project members who share, discuss, reflect, verify as well as integrate their experiences and finally commit to them. This process can be moderated by a lessons learned coach. Templates can be created that support a structured documentation of experiences and help the team to include important context information. An information system can aid this process and store and provide access to all documents containing lessons learned. A subject matter expert could review the documents and further enhance them by referencing other documents, projects or people. Rules support integration of the lessons

343. See sections 6.6.3 - "Knowledge modeling" on page 257 and 7.7.3 - "Ontology management" on page 387.

learned instrument into standard project processes and can also enforce that project managers study lessons learned documents before starting a new project.

Case debriefings. Whereas lessons learned aim at systematically eliciting experiences made by teams in projects, case debriefings target experiences documented by work groups in business processes. Generally, the term case can be applied to a wide variety of phenomena about which knowledge is documented. However, from a business process-oriented perspective, a case is an instance of a business process with an explicit connection to a customer. Thus, this instrument focuses knowledge that has been gained in specific, interesting cases encountered during operative work in business processes. In extension to business process definitions that abstract from the specifics of individual cases, case-oriented knowledge can enrich a process warehouse.

As the knowledge is assigned to specific business processes, templates and rules can be developed that structure the types of cases that can be encountered and helps to document case knowledge. As with lessons learned, coaches can help employees to document case knowledge and the experiences can be reflected in the work group that is responsible for the business process (commitment by work group) or by process managers (legitimation by supervisor). From an ICT perspective, several information systems, particularly a case data base system and, in formally structured environments, case-based reasoning systems aid retaining, searching and retrieving case knowledge.

6.2.3 Process-oriented instruments

Whereas product-oriented KM instruments target different types of documented knowledge in the sense of objects that can be accessed and reused not unlike information objects, another group of KM instruments aims at knowledge in a process-oriented form. This includes (1) retaining knowledge in a process-oriented form, e.g., personal knowledge routines, good or best practices, (2) directly targeting the design of knowledge and learning processes, e.g., expert advice, knowledge process reengineering or technology-enhanced learning or (3) informal organizational routines that aim at improving individual learning, e.g., self-managed ad-hoc learning or the sharing of knowledge in communities or knowledge networks. Even though some of these instruments also involve knowledge in an objectified form, e.g., communities might have a community home space, the primary focus is on supporting processes of handling knowledge, rather than documenting knowledge in a content or container fashion.

Personal knowledge routines. Even in knowledge work, certain knowledge-oriented activities can be partly routinized[344]. Knowledge routines thus comprise existing, allowed, recommended or prescribed partly routinized activities of

344. The concept of routinization is based on activity theory (Engeström 1993) and is explained in section 6.6.2 - “Activity modeling” on page 250.

knowledge work. The routines can be structured and made available for reuse by e.g., knowledge brokers. Bundles of knowledge management services[345] might partly support routines. Knowledge routines can be structured according to Schultze's (2000) informing practices into routines for

- expressing knowledge, supported by templates, integration and contextualization activities,
- translating knowledge, acquiring knowledge from inside and outside the organization, integration, validation and activation activities for knowledge of diverse sources,
- monitoring, getting an update on and awareness for current activities in an organization with respect to a process, a project or a topic and
- networking, supported by collaboration technologies and by competence management[346].

Even though knowledge routines are personal in the sense that employees individually manage their own routines, the ICT infrastructure can support the individual reuse of routines. Organizational instruments can also aim at managing the transition process from personal knowledge routines to team, work group or unit best practices.

Self-managed ad-hoc learning. This KM instrument reflects a specific type of personal knowledge routine that is only stressed here because of the supposed tremendously increasing importance of individual, ad-hoc, self-managed learning processes, particularly the ones on the job, directly at the workplace. The instrument can provide systematic support for personal learning processes, e.g., with the help of structuring and offering learning objects, learning paths and reflecting on learning activities by peers and experts within the organization or even crossing these boundaries. It can thus be part of comprehensive technology-enhanced learning instruments that are implemented in an organization.

Expert advice. Expertise is often readily available, particularly in larger organizations, but meta-knowledge about who knows what is the bottleneck for an efficient and timely solution to knowledge problems. The instrument expert advice establishes a formal procedure that enables employees to pose requests for knowledge. A template structures questions and ICT, e.g., a forum, can provide support for quick accessibility to the unanswered questions. Semantic content management might even be used to scan open questions and draw the attention of appropriate experts to the questions. Standard operating procedures for expert advice might differentiate between ordinary requests which are answered as soon as possible and urgent requests for which handling is guaranteed within an agreed time frame, e.g.,

345. See sections 7.3.1 - "Knowledge management service" on page 302.
346. Integration, validation, contextualization and activation activities have been found in case studies by Eppler (2003, 82ff). Examples are listed in section 7.2.5 - "Quality of contents" on page 299.

24 hours. Responses are given by whoever believes to have a solution to the posed problem. In case of urgent requests and if no response is submitted within a certain time frame, the question is relayed to an identified (subject matter) expert. The instrument requires primarily organizational measures, but can also be supported by a forum or other content management system.

Technology-enhanced learning. Supporting or enhancing learning through ICT has a long tradition. The variety of approaches that has been developed is reflected by terms such as distance education, distance learning, tele-learning, programmed instruction, computer-based training, hypertext-, hypermedia- or Web-based training and blended learning. E-learning emerged at the end of the 1990s together with the wide-spread use of the Internet and other such terms like e-business or e-government. E-learning is ICT-supported learning with the help of multimedia or hypermedia contents that are online accessible for the learner backed by functions that enable communication between learners and teachers as well as among learners. This definition emphasizes that multimedia contents need to be provided online and together with functions that enable interaction, though e-learning is often used in a broader sense as comprising other forms of electronically supported learning. Technology-enhanced learning is a more recent term that emphasizes that learning is not automatized with the help of technologies, but that learning processes are supported and fostered by technologies. Newer approaches stress the importance of reusable learning material in the form of learning objects, the role of collaborative technology in interactive learning processes between teachers, coaches and learners as well as between learners themselves, adaptive, adaptable and personalizable learning solutions as well as a situation-oriented deployment of learning technology in on-demand, workplace or ambient learning solutions.

The instrument is traditionally not targeted as a KM instrument due to the fact that despite numerous attempts to bridge the gap between the two intuitively strongly related fields of e-learning and KM, they are still quite separated in research and practice (Le et al. 2006). Whereas e-learning as well as the related field of personnel development within human resource management have their foundations in (learning) psychology, (media) didactics and (learning) pedagogy and emphasize the importance of structural (by preparing learning material) or personal guidance, KM envisions an organizational memory or organizational knowledge base into which the individual's knowledge is supposed to be made explicit and which is the basis for (more or less unguided) knowledge transfer[347].

This separation is not only the case in the research environment, but also in business practice. In large organizations, e-learning and KM are institutionalized in different organizational units, information systems as well as attitudes towards handling knowledge. A more formal, elaborate and resource-intensive training approach with pre-defined courses contrasts a less formal, leaner approach, e.g., “harvesting” knowledge in projects and directly handing it on to an unspecified tar-

347. See section 7.2.1 - “Types of contents” on page 282, Maier/Schmidt 2007.

get group without much effort put into validating it, didactically refining it or examining success of the learning processes.

Due to the fact that both, KM and e-learning are approaches that intend to improve construction, preservation, integration, transfer and (re-) use of knowledge and competencies, the latter is integrated here as a KM instrument being well aware of the fact that one could elaborate much more on distinguishing a variety of different approaches within e-learning that might be considered as individual KM instruments in their own right[348].

Good/best practices. Lessons learned target project experiences and their reasons, but ideally make no statement about how processes should be adapted considering these experiences. The sharing of (good or) best practice is an approach to capture, create and share experiences in a process-oriented form as e.g., procedures, task flows or workflows. This term in a wide meaning denotes "any practice, knowledge, know-how or experience that has proven to be valuable or effective within one organization that may have applicability to other organizations" (O'Dell/Grayson 1998, 167). As managers might argue about what exactly is "best" in a practice, several organizations use different levels of best practice, e.g., (1) good (unproven) idea, (2) good practice, (3) local best practice, (4) company best practice, (5) industry best practice (O'Dell/Grayson 1998, 167). These categories reflect the scope in which the corresponding practice has proven to be valuable or has been selected as the best in a bunch of candidate practices. Thus, the categories might be structured along the structural organizational design into team/work group best practice, unit best practice, subsidiary best practice, company best practice, group[349] best practice or industry best practice.

So-called best practice teams are permanent institutions within an organization's networking infrastructure. They provide guidelines about what constitutes good or best practices and support identification, transfer, implementation, evaluation and improvement of practices (O'Dell/Grayson 1998, 161). Goal is continuous process improvement, so employees have to be encouraged to make suggestions for good practices. Best practices ultimately may lead to redesigned standard operating procedures, core and support business processes and knowledge processes.

Communities. Community management[350] targets creation and fostering of communities or knowledge networks. Communities differ from knowledge networks with respect to who initiated their foundation. Communities are founded by like-minded people (bottom-up) and can at most be fostered by the organization. Knowledge networks are established and legitimated by management (top-down). However, organizational and ICT measures to foster communities are the same as

348. Examples are development of courses with certification, peer or informal learning or self-managed, ad-hoc learning.
349. In the sense of a group of companies belonging to the same concern, e.g., the BMW Group.
350. See also section 6.1.3 - "Groups, teams and communities" on page 177.

the ones used to support knowledge networks. Communities per definition can not be controlled or externally induced. However, organizations can provide employees with time and space to share thoughts, establish IT tools, e.g., community builder or home spaces, blackboards, Wikis or other forms of specifically designed content management system that support exchange of thoughts and create new roles like community managers that help keeping discussions going and look for important topics that should gain management attention.

Knowledge process reengineering. Knowledge process reengineering (KPR) aims at redesigning business processes from a knowledge perspective. The term references the field of business process reengineering (BPR) that aims at fundamental (process innovation) or evolutionary (process redesign) changes of business processes in organizations with the goal to increase organizational effectiveness. In addition to traditional BPR instruments, knowledge-intensive business processes are partially improved by KPR. The focus is on designing knowledge processes that connect business processes, defining cooperation scenarios, improving communication patterns between employees, as well as on "soft" skills or an organizational culture supportive of knowledge sharing (Davenport et al., 1996). Business processes are modeled with the help of modeling techniques. The models are stored in model bases. The model base can be expanded so that it handles not only knowledge about the process, but also knowledge created and applied in the process. This is termed process warehouse which can be used as a foundation for systematic knowledge process reengineering. Examples for contents in process warehouses are exceptional cases, case-based experiences, reasons for decisions, checklists, hints, frequently asked questions and answers, potential cooperation partners or suggestions for improvements.

6.3 Process organization

This section discusses knowledge management tasks (section 6.3.1) which can be combined in knowledge management processes (section 6.3.2).

6.3.1 Knowledge management tasks

Generally, there are a lot of approaches that view KM as a life cycle of knowledge tasks or a complex organizational "function" that designs, implements and evaluates a set of knowledge management tasks. Goal of knowledge management is to improve these tasks in the sense of organizational effectiveness and performance. The list of tasks provided in the literature comprises a large number of knowledge-related tasks. Examples are[351]:

- creation, building, anticipation or generation;
- acquisition, appropriation[352] or adoption;
- identification, capture, articulation or extraction;
- collection, gathering or accumulation;
- (legally) securing;

- evaluation or validation;
- conversion;
- organization, linking and embedding;
- formalization;
- storage;
- refinement or development;
- distribution, diffusion, transfer or sharing;
- presentation or formatting;
- application, deploying or exploiting;
- review, revision or evolution of knowledge.

In the following, a subset of these tasks will be described that deals with, involves or is supported by KMS and, at least at the current state of practice, is carried out by a person or a collective.

Knowledge identification. Main goal of knowledge identification is to make the organization's knowledge assets visible. These are for example the employee's skills, networks of experts, organizational competencies, but also the knowledge sources, such as data and document bases. Knowledge identification not necessarily stops at organizational boundaries and thus might also comprise the identification of industry best practices, competencies of experts and consultants outside the organization, on-line data bases as well as literature, such as books, magazines, studies and reports and thus provides the basis for *knowledge acquisition*. Once knowledge is identified, it can be organized, published and distributed in order to be applied wherever it is useful (reuse). Knowledge identification is a permanent task as skills and competencies evolve. A KM initiative might also start with an effort to identify the organization's core competencies and thus provide an initial knowledge structure that evolves as it is used to organize knowledge. Some authors use the term *capturing of knowledge* (e.g., Nissen et al. 2000, 25) which reflects knowledge identification as well as documentation (or codification) and storage. This task is basically supported by (knowledge) modeling and mapping technologies[353].

Knowledge acquisition. Knowledge is acquired from outside the organization. There are numerous alternatives for this task that mainly fall into three categories.

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351. Wiig 1988, 104ff, Albrecht 1993, 86ff, Schüppel 1996, O'Dell/Grayson 1997, 11, Ruggles 1997, 5ff and 77ff, Allweyer 1998, 39f, Choo 1998, 18ff and 105ff, Davenport/Prusak 1998, 115ff, Mentzas/Apostolou 1998, 19.3, Probst et al. 1998, Rey et al. 1998, 31f, Tuomi 1999, 341ff, Bhatt 2000, 17ff, Nissen et al. 2000, Pawlowsky 2000, 115ff, Roehl 2000, 154ff, Alavi/Leidner 2001, 115ff, Bhatt 2001, 71ff, Mertins et al. 2001a, 3f; see also section 4.1.4 - "Definition" on page 52.
352. Tuomi uses the term appropriation to denote the generation of knowledge that is available within the society but which is new for the learner, in this case the organization (Tuomi 1999, 342).
353. Section 7.4.3 - "Discovery services" on page 322.

The first category contains the permanent or temporary *engagement of experts*, e.g., the hiring of talent and experts, the engagement of professional services companies, the development of joint ventures, strategic alliances, virtual organizations, the merger with or the acquisition of companies that hold competencies required.

The second category of alternatives is to gain *access to documented knowledge*, e.g., in the form of scientific and practitioner literature, e.g., patents, licenses, books, journals, reports, access to on-line data bases of professional information service organizations.

The third category is the *participation in knowledge-related events and processes*, e.g., conferences, workshops, meetings, fairs, exhibitions, research projects, benchmarking groups, industry organizations or industry best-practice groups, etc.

Whereas the first category is predominantly either a matter of strategy and corporate planning or a matter of HR management, the second and third categories are targeted and organized systematically by the KM initiative in many organizations.

Knowledge creation. Complementary to *knowledge acquisition* knowledge is created within the organization which provides e.g., new skills, ideas and improved organizational processes and competencies. Knowledge creation is also called *knowledge construction*. Knowledge is primarily created due to processes of individual and collective learning that cannot be "managed" but supported not only with the help of specialized R&D units and projects, but also with instruments that support creativity, e.g., by providing room for ideas and interaction and tolerate errors throughout the organization, and last but not least a creativity-supporting organizational culture. Examples for ICT supporting knowledge creation are creativity support functions provided in GSS and Groupware[354].

Knowledge organization. Once a knowledge element is created, it can be linked to other knowledge elements. Knowledge is valued by individuals or by collectives, e.g., communities and thus selected for documentation and storage. The main product is an organizational knowledge structure, an ontology, a knowledge map or a set of these instruments. After the initial set up of a knowledge structure which is part of a concerted effort of knowledge identification, it is updated or extended each time a new knowledge element requires an alteration of the structure. The knowledge structure is visualized with the help of knowledge mapping technologies[355]. Thus, knowledge elements can be classified and integrated into the existing knowledge structure, linked to other knowledge elements etc.

Knowledge publication. The process of publishing knowledge that can then be distributed to knowledge seekers using push and pull technologies is one of the most widely researched area of KM. Knowledge publication involves the *codification of knowledge*, i.e., in a general sense, putting knowledge in various forms that

354. See section 7.1 - "Technological roots" on page 273.
355. See section 7.4.3 - "Discovery services" on page 322 and section 7.4.4 - "Publication services" on page 326.

can be stored and thus retained, leveraged and transferred (Ruggles 1997, 6). In Nonaka's terms knowledge publication is a form of *articulation* or *externalization* (Nonaka 1991, 98f, Nonaka 1994, 18f) This can be documentation and formalization of knowledge using AI or more traditional technologies, but also structuring and organizing it. As with most tasks in knowledge management, knowledge can be published in various degrees of centralization such as entirely centrally e.g., by a KM department or a group of knowledge brokers or decentrally directly by the participants or both. In the latter case, the *release of knowledge elements*—the formal approval or institutionalization—is an important step in the publication process. In this case, knowledge documents are submitted to an expert or a group of experts in order to be reviewed so that quality and organization is maintained. Knowledge publication is supported e.g., by content management systems or Web publishing systems[356].

Knowledge distribution. Knowledge distribution is also called knowledge diffusion, dissemination or transfer. It comprises the systematic processes of bringing knowledge to the employees who need it (knowledge push) as opposed to knowledge search and retrieval that comprises knowledge being searched for by the employees (knowledge pull). Both knowledge tasks together primarily support *internalization* of knowledge (Nonaka 1991, 98f) at the receiving end of the push and pull processes. Another alternative forum for knowledge distribution applied widely by large organizations, such as Ernst & Young, Siemens and Daimler-Chrysler, is a so-called organization-wide *knowledge fair* (Davenport/Prusak 1998, 190f). In this fair, all groups, teams and communities that work on KM-related projects can exhibit their work. All employees interested in KM can visit the fair, collect material, network, meet experts and thus knowledge is distributed. Technologically, knowledge distribution is not only supported by knowledge push technologies such as Listservers or information subscriptions, but also by the whole set of learning support technologies: e-learning platforms and learning management systems[357].

Knowledge search and retrieval. Search and retrieval is initiated by the participants (knowledge pull). The boundaries are not clear-cut, though, because it is also the participants' initiative that is required to start information subscriptions e.g., by providing an interest profile or sending an email to a listserver. In most cases, participants will search for knowledge on their own. However, there might also be roles (e.g., knowledge broker) that are specialized in professionally searching the organization's and external knowledge assets and thus provide a value-added search service. Knowledge search and retrieval can be supported by knowledge maps which are the results of the task *knowledge organization*, by recommendations and comments of other participants and experts (recommendation systems) and by search engines[358].

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356. See section 7.4.4 - "Publication services" on page 326.
357. See section 7.4.6 - "Learning services" on page 331.

Knowledge application. Application or usage of knowledge is the ultimate goal of knowledge management[359]. Knowledge that is created or acquired and then organized, published or otherwise distributed should be reused wherever it is useful. Knowledge is applied e.g., in projects or business processes. However, a number of *barriers* prevent participants from applying knowledge not created within their organizational unit, most of which are psychological factors, such as fear from lowered own status of expertise, resistance to change, cultural and language barriers (e.g., Probst et al. 1998, 269ff). Organizational instruments have to be applied in order to lower these barriers and create incentives for the reuse of knowledge not invented in the respective organizational unit. The application of knowledge also provides feedback for *knowledge evolution*. All KM technologies ultimately aim at a support of the application of knowledge, especially search and retrieval systems and all visualization systems that provide context for a translation of the knowledge into the current application situation.

Knowledge evolution. Knowledge evolution comprises all tasks that aim at an improvement of already existing knowledge. Participants might comment existing knowledge in order to assess its usefulness or in order to report experiences with its application. Subject matter specialists might refine knowledge, translate it, summarize it, provide additional context, explain terms and definitions or repackage it for the use by different groups of users, e.g., novices as opposed to experts or functional departments as opposed to IT. Also, knowledge decentrally published by participants might be evaluated by knowledge quality management that assures the quality of the content and the documentation. Another important task assures that the knowledge is timely, relevant and actualized. Knowledge evolution can be supported e.g., by workflow management functionality (quality management) and by automatic checks of links and document expiration dates.

Knowledge deletion & archiving. Irrelevant or outdated knowledge has to be systematically removed from the organization's active knowledge base, such as outdated reports, dead links or obsolete themes and topics. The selection of the knowledge to be deleted or archived is an important task as otherwise the organizational knowledge base is cluttered with outdated or even wrong documents, links or structures making it less efficient for employees to retrieve the knowledge needed. As deletion and archiving can be viewed as special forms of knowledge evolution, it can be supported by the same ICT technologies than mentioned before.

Knowledge selling. Knowledge selling is the counterpart of *knowledge acquisition*. In many organizations knowledge products and knowledge services can be offered on the market. Examples are patents, licensing, consulting services, reports and studies. More recently, especially professional services companies also demand fees for access to their KMS and knowledge bases (e.g., McKinsey & Co.,

358. See section 7.4.3 - "Discovery services" on page 322.
359. Application of knowledge sometimes might mean not to take any action.

Ernst & Young). The task knowledge selling comprises securing results of organizational R&D as well as the management of appropriability of profits which can be subject to bargaining, e.g., with business partners, such as customers, suppliers or distributors, and employees[360].

Collaboration. Collaboration aims at a transfer and joint application of knowledge by direct interaction within a collective of participants. It is closely related to *socialization* (Nonaka 1991, 98f). Collaboration is primarily supported by interactive KMS and maps of skills and experts, yellow pages, skills directories, expert finder, generally by synchronous communication and collaboration tools and Groupware[361].

Knowledge (management) processes in the sense of service processes for core business processes in a process-oriented organizational design require the combination of several of these KM tasks and their embedding in or connection to the organization's business processes (Remus 2002, 118ff).

6.3.2 Knowledge management processes

Generally, process management refers to the explicit design and management of business processes, an approach that has received wide attention since Hammer and Champy's best-seller on business process reengineering (Hammer/Champy 1993). In the course of the development of a variety of approaches to implement BPR concepts, a number of modeling methods and ICT tools have been developed. These methods and tools support the explicit design of business processes and of information and communication systems supporting these business processes (e.g., on the basis of workflow management systems)[362]. Recently, there have been a number of attempts to integrate process management and knowledge management reported in the literature[363]. The term *process* is used with respect to knowledge management in at least the following three connotations:

Knowledge-intensive (operative) business process. This term denotes a business process that relies substantially more on knowledge in order to perform the development or production of goods and services than a "traditional" business process (Allweyer 1998, 44). Knowledge-intensive business processes can either be core processes or service processes. Most process-oriented KM approaches propose to concentrate KM efforts, activities and instruments on the improvement of the (most) knowledge-intensive business processes (e.g., Remus 2002, 108). Depending on the individual organization's core competencies, every type of business pro-

360. See section 5.1.1 - "From market-based to knowledge-based view" on page 94.
361. See section 7.4.5 - "Collaboration services" on page 327.
362. See section 6.6.1 - "Process modeling" on page 240.
363. Examples are Davenport et al. 1996, Allweyer 1998, Warnecke et al. 1998, Föcker et al. 1999, Schreiber et al. 1999, Warschat et al. 1999, Weggemann 1999, 223ff, Bach 2000, Merali 2000, Nissen et al. 2000, Hoffmann et al. 2001, Abecker et al. 2002, Dämmig et al. 2002, Remus 2002, Maier/Remus 2001, 2002, 2003, Strohmaier 2003.

cess is a potential candidate for a knowledge-intensive business process. An example of a typology of business processes distinguishes between operating processes and management & support processes[364]. Operating processes are (1) understand markets and customers, (2) develop vision and strategy, (3) design products and services, (4) market and sell, (5) produce and deliver products and services, (6) produce and deliver for service organizations and (7) invoice and service customers. Management & support processes are (8) develop and manage human resources, (9) manage information resources and technology, (10) manage financial and physical resources, (11) execute environmental, health and safety management program, (12) manage external relationships, (13) manage improvement and change. Determining the type of knowledge-intensive business process might be useful to decide what kind of KM instruments could be applied to improve the business process (Heisig 2002, 62).

There have been several approaches to operationalize knowledge intensity. Examples are vague goals and outputs that cannot be entirely planned, process complexity, i.e., many branches, parallel or iterative subprocesses, long duration, many variations and/or exceptions in the business process, weak structure, many qualitative decisions, many persons, experts, organizational units, disciplines involved, the need for highly valuable skills and competencies, complex relationships to other processes, the diversity and uncertainty of inputs and outputs, the share of data, information and knowledge-intensive products and services as part of inputs and outputs etc.[365].

Knowledge process. A knowledge process refers to a dedicated service or support process which supports the flow of knowledge within and between knowledge-intensive operative business processes, e.g., due to the systematic collection, refinement, storing and distribution of knowledge[366]. Examples for knowledge processes are:

- the *submission process* for new knowledge elements, also called the *knowledge asset creation process*, might start in a project, be evaluated by a community, reviewed, refined and linked by a subject matter specialist and finally several

364. This typology is based on Porter's ideas of the value chain and was primarily developed by the American Productivity and Quality Center, URL: http://www.apqc.org/free/framework.cfm and http://globalbestpractices.com/ (see also Abecker et al. 2002, 8, Heisig 2002, 62).
365. .E.g., Eppler et al. 1999, Goesmann 2002, 61ff, Heisig 2002, 56, Nägele/Schreiner 2002, 29, Remus 2002, 108ff).
366. There is no agreement in the literature concerning the definition of knowledge process. For example, Allweyer (1998, 44) uses the term "knowledge process" to denote both, knowledge-intensive business processes as well as "specific" knowledge processes the main aim of which is to process knowledge. Bach (1999, 65) uses the term "knowledge management process" for separate processes to support knowledge management, e.g., knowledge distribution or development of knowledge. Many authors also do not distinguish between the terms knowledge process, knowledge task, knowledge function or knowledge activity (see also section 4.1.4 - "Definition" on page 52).

submissions might be turned into a new methodology by an expert team (e.g., Schubert 2000, 7),

- the *search process* identifies and connects several steps of a search for knowledge elements and/or experts,
- the *knowledge acquisition process* defines the acquisition and establishment of organization-external knowledge sources,
- the *knowledge push process* handles the creation of participant-specific interest profiles and the subsequent direction of news, new knowledge elements as well as links to events, meetings and/or experts that are potentially interesting for that participant,
- the *community management process* fosters the establishment and moderation of communities,
- the *maintenance process of the organizational knowledge base* deals with continuous improvement of the KMS, both, technically and organizationally, and also comprises the refinement, repackaging, replacement, deletion or archiving of knowledge elements.

Knowledge management process. The KM process can be viewed as a kind of "meta"-process (Hoffmann et al. 2001, Staab et al. 2001, 5) that is responsible for the implementation of the KM initiative, the design of organizational and ICT instruments as well as for knowledge controlling and knowledge process redesign. In other words, the knowledge management process administers and steers the knowledge cycle in an organization and comprises goal setting, implementation and evaluation of the organization's KM initiative (Probst et al. 1998, 54ff).

Figure B-25 shows an example of a typical knowledge process which can be formally defined in an organization as a service process.

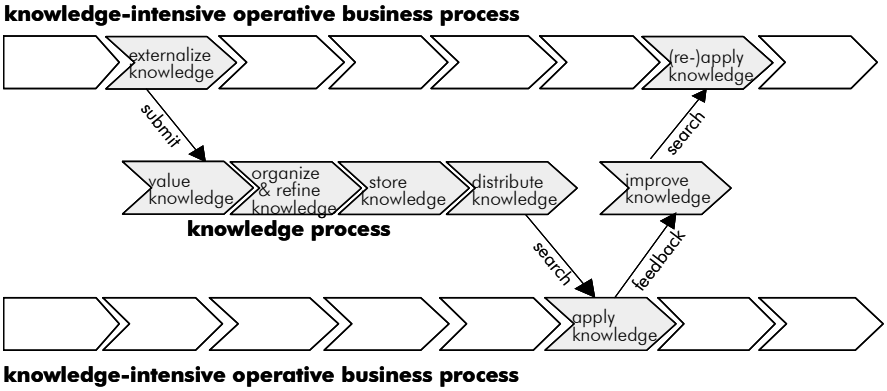

FIGURE B-25. Knowledge process and knowledge-intensive business process[367]

367. This figure is based on Remus 2002, 121.

The knowledge process starts with the creation of knowledge within a knowledge-intensive business process. The knowledge created is then first valued, e.g., by a subject matter specialist, a knowledge broker or a community. The subsequent step adds value to the knowledge in that it is e.g., classified, structured, formatted, linked to other knowledge elements or contextualized. Then, the knowledge might have to be stored, no matter whether the knowledge element is a document or a link to an expert. Then it is distributed to participants that are potentially interested (knowledge push) or it is retrieved in the course of a search initiated by participants (knowledge pull) before it can be applied either within the same business process or, as depicted in Figure B-25, in a different business process. The experiences made during the application of knowledge are then collected as feedback and used to improve the knowledge so that it is kept actual and relevant, links to participants who have recently applied the knowledge can be updated and the degree to which it has proven successful in application can be evaluated systematically. This cycle of search, application, feedback and improvement can be repeated and involve several business processes.

A comparison of the approaches to a process-oriented knowledge management provides the following levels of intervention which are targeted by these approaches (also Remus 2002):

- *goals and strategy*: KM goals, KM strategies, relations to business goals[368],
- *organization*: design of organizational structure, tasks, processes, roles, projects etc.,
- *culture*: organizational culture, group cultures, national cultures,
- *themes and topics*: taxonomies, knowledge structures, ontologies, types of knowledge, especially process-oriented knowledge,
- *participants and communities*: human resource management, community management, incentives and motivation, personalization,
- *instruments*: KMS, services, organizational and technological infrastructure,
- *environment*: markets, business models, business partners, business processes.

However, none of the approaches so far considers all of these levels[369]. There is still some way to go until the well-established methods and tools for business process reengineering in general and business process modeling in particular[370] can be applied with KM in mind.

Two typical situations for the implementation of process-oriented KM concepts can be distinguished (see Figure B-26)[371].

1. *Process management initiatives*: These are initiated by an organizational unit or project responsible for process management and expand their perspective

368. See also section 5.1.3 - “Process-oriented KM strategy” on page 108.
369. See the detailed comparison provided by Remus 2002.
370. A well known example for a method for process modeling frequently used especially in German organizations is the event-driven process chain supported by the ARIS toolset (see URL: http://www.ids-scheer.de/); see also section 6.6 - “Modeling” on page 237.
371. See Maier/Remus 2002, Remus 2002.

towards KM. Examples are modeling business processes to improve process visibility or analyzing business processes in terms of knowledge process reengineering (KPR) (Allweyer, 1999) The documentation, monitoring and controlling of business processes are often supported by a process management system and documented in a process warehouse. The process warehouse can be expanded with KMS functions in order to manage not only knowledge about the process, but also knowledge created and applied in the process. Process visibility is often the starting point for business process reengineering. In addition to more traditional BPR instruments, knowledge-intensive business processes are partially improved by methods such as KPR. KPR often focuses on the communication structure between employees, on "soft" skills or an organizational culture supportive of knowledge sharing (Davenport et al., 1996).

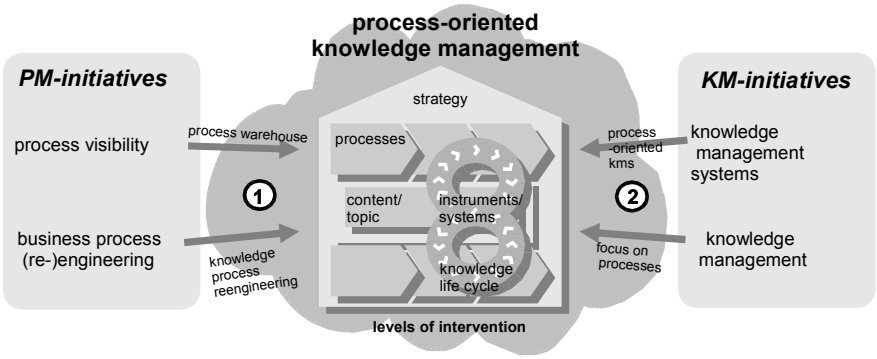

FIGURE B-26. Starting points for process-oriented knowledge management[372]

2. *KM initiatives*: The other situation is a KM project with a strong focus on (knowledge-intensive) business processes. One typical starting point would be the implementation of a KMS to support one or more business processes. An example is to customize commercial KMS (i.e. KM portals, KM suites) so that they support processes specific to the organization, e.g., the R&D process. Besides this technology-driven approach, a more comprehensive KM initiative sets a stronger focus on the organizational design, especially processes. It implements KM instruments, such as content management, lessons learned or employee yellow pages. In a process-oriented view, these KM instruments would be designed and implemented as knowledge processes or lead to a redesign of knowledge-intensive business processes.

Summing up, the integration of process orientation and knowledge management provides for a promising research direction for knowledge management. The implementation of process-oriented KM strategies can either start from a process management or from a knowledge management initiative and comprises the com-

372. Source: Remus 2002, 205.

bined assignment of instruments from both fields to knowledge and business processes on the levels of intervention strategy, (process) organization, contents, instruments and systems. Vendors of KMS will have to consider business and knowledge processes and their realization in e.g., process-oriented navigation structures, contextualization, profiling and filtering tools, and the implementation of knowledge processes with the help of workflow components of KMS. In the following, an example shows how process-oriented KM strategies can be implemented.

6.3.3 Example: Process-oriented KM

The following example reviews a project to implement KM for the transaction business of one of the five largest German universal banks[373]. Transaction banks offer services to handle the securities business and payment transactions. Traditionally, transaction banks were developed as organizational units of large universal banks in order to fulfil back office tasks. Generally, back office tasks have no direct interaction with customers. Recently, transaction banks have been outsourced so that they can offer their services independently on the market. Continuous quality management (QM) is required to handle operative risks and massive amounts of transactions. In this situation, a new project was set up that should extend QM in order to improve knowledge sharing within and between the core business processes of the organizational unit. The project was initiated on the basis of positive experiences gained in a QM project which used business process modeling techniques.

The project team consisted of members of quality management, process management and representatives of functional departments. Additionally, workshops and interviews brought in ideas from human resource management, experts in functional departments and representatives of the IT unit. These workshops and interviews were supported by one of the master students of the Dept. of Business Informatics III at the University of Regensburg for which the author worked during that time. The conceptualization was supported by the author and by Remus who also consulted the bank on a regular basis.

Firstly, some knowledge goals were defined. Besides typical knowledge goals, like *improve knowledge transparency*, *reduce knowledge losses* or *improve training of newly recruited employees*, the project also emphasized the strong link to business processes. Typical process-oriented goals were *improve knowledge flows within business processes*, *improve process visibility* or *document knowledge relevant for tasks in business processes*.

Some of the business processes involved in this project had already been modeled in the preceding QM project. After initial workshops to evaluate practical approaches to introduce KM, the project team decided to apply a process-oriented KM approach. One of the central ideas was to design a reference model which was used as a blueprint for the subsequent implementations of process-oriented KM in

373. A previous version of this section was presented in Maier/Remus 2003.

decentral units. The project team designed a landscape of reference processes and activities. Process owners could then adapt their business processes with the help of these reference processes. All relevant business processes will be "equipped" with KM activities. Currently, the design of reference processes has been completed and one business process has been selected as a pilot for the implementation. In the following, some of the main activities performed on the four levels of intervention strategy, contents, instruments/systems as well as organizational design will be discussed. Thus, the example gives a complete account of the implementation of a process-oriented KM.

Strategy. The transaction bank represents a strategic business unit of the universal bank. The critical success factor and also the core competence of this unit is to control operative risks. The business strategy of the transaction bank has been derived from the general business strategy of the universal bank. This strategy is primarily resource-oriented. Market-oriented factors will be considered because the transaction bank plans to extend its operations to include customers external to the universal bank. Until then, the resource-based view plays a crucial role in the definition of knowledge goals. There was no explicit KM strategy. Instead, the project was defined by the knowledge goals described above and approved by the business unit's executives. Project management was handled by an organizational unit called quality management.

Contents. The relevance of documenting process knowledge had already been realized during the QM project. In the KM project, process knowledge was not only seen as codified knowledge, embedded in documents like process models, but also embedded in the heads of employees working in these processes. Nevertheless, there was a strong focus on codification. Access to implicit knowledge was supported by expert directories. Neither communities nor networks of experts were supported. Consequently, knowledge about processes was identified, collected and explicated in the form of process models. Then, these process models guided the identification of knowledge created and applied within the processes which was also collected and explicated in a knowledge audit. Actual and planned supplies of knowledge were analyzed and assigned to the tasks in the process model. The knowledge structure was derived from the results of the knowledge audit. As mentioned before, processes can provide part of the context that is important for the interpretation and construction of process-relevant knowledge. This context was documented in two forms. Firstly, a topic tree was used to classify and structure knowledge elements relevant to the processes. Secondly, knowledge elements were linked to tasks in processes in the knowledge audit.

Instruments/systems. The project considered a number of typical KM instruments, in this case *skill management*, *content management*, *lessons learned*, *best practices* and *communities/knowledge networks*, as well as an instrument related to *process management* (see Figure B-27).

The continuous knowledge life cycle represented the most important guideline for the identification and design of KM activities and KM processes. KM activities and the instruments were assigned to each other and visualized in the form of an activity landscape. Figure B-27 shows a portion of the activity landscape. The arrows show the relationships between the activities and consequently between the instruments. For example, the KM activities *address knowledge* and *push knowledge* were assigned to the KM instrument *communities/knowledge networks*. With respect to the classification of instruments, there were human-oriented and technology-oriented instruments, but no instruments bridging the gap. The definition of processes integrated both types of instruments.

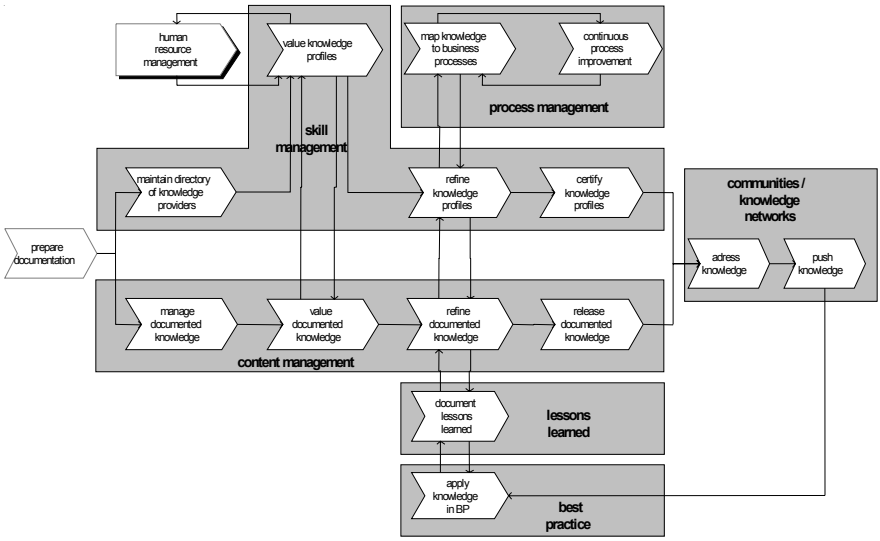

FIGURE B-27. Activity landscape with knowledge management instruments[374]

Organizational design. The structural organizational design in terms of new roles and responsibilities was quite lean due to resource restrictions. Organizationally, the integration between process and knowledge management was accomplished by holding process managers responsible for the operative business processes and at the same time for supervising KM activities in their processes. Also, the new role *knowledge broker* was introduced being responsible for the newly designed KM activities within the business processes. A role which supervises the connections between different business processes like a *network manager* who could link experts across process boundaries was planned, but not yet established. Knowledge processes were defined considering the following guidelines which was a new per-

374. Source: Maier/Remus 2003, 17

spective for the transaction bank: Knowledge had to be the primary process output. Specific KM roles were required for specific tasks in knowledge processes.

A knowledge audit was carried out for those business processes which were intended to be equipped with KM activities in order to identify process outputs and the knowledge requirements of the business processes. The results of the audit were used to define the interfaces between knowledge processes and business processes and/or to embed KM activities in business processes. The KM activities shown in Figure B-27 were combined to the four knowledge processes depicted in Figure B-28: (1) *document knowledge*, (2) *distribute knowledge*, (3) *improve knowledge usage* and (4) *apply knowledge*. The latter was embedded in the business processes.

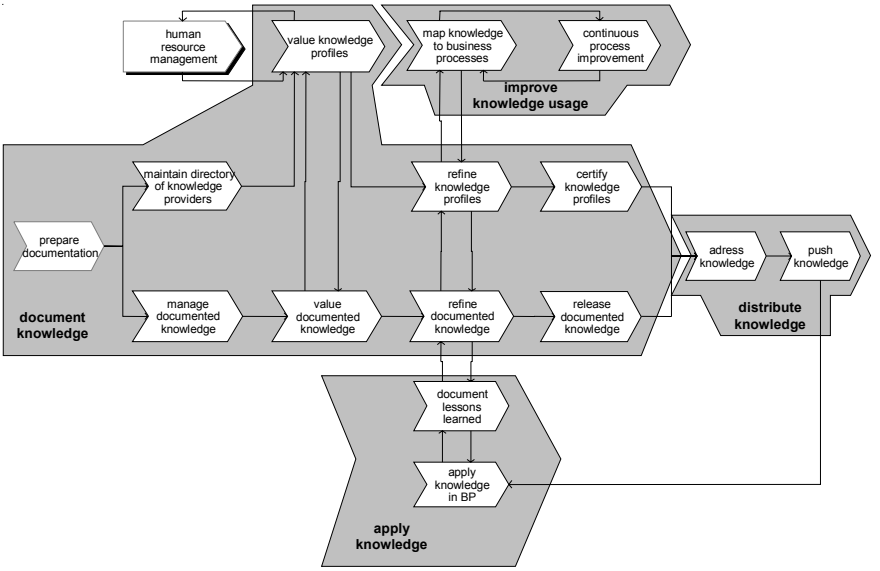

FIGURE B-28. Definition of knowledge processes[375]

The knowledge processes had to be defined on the basis of the assignment of KM activities and instruments (activity landscape). A typical example was the process *document knowledge* which combined the two instruments *content management* and *skill management*. This strong relationship is based on the thesis that content should not be disconnected from persons who create or apply it. In this case, skill profiles were used to filter contents in order to avoid information overload.

Figure B-28 presents only a portion of the entire process landscape of the transaction bank which also has interfaces to other processes, e.g., strategic manage-

375. Source: Maier/Remus 2003, 19

ment, human resource management, the operative business processes or innovation and technology management.

Lessons learned. The example represents a typical KM starter scenario[376] with a core group enthusiastic about the approach, with restricted resources, only a couple of KM roles and basic ICT infrastructure supporting KM. The implementation of a process-oriented KM approach profits from the successful preceding process management project because business processes had been modeled extensively before. Process owners were already used to adapt reference processes. The primary focus was at first on content management and an entirely centralistic approach. However, the implementation of the reference processes will be carried out decentrally.

The fact that the KM initiative started in a nucleus, a core group that designed the reference processes, positively contributed to the success of the initiative because quick wins could be shown in one selected knowledge-intensive business process and the measures taken were targeted at real business needs and not at abstract knowledge visions. Still, the transaction bank focuses too strongly on a codification strategy and neglects the potential benefits of integrating instruments of a personalization strategy, such as communities and networks. The project tried to avoid the creation of new KM positions and roles, e.g., a subject matter specialist or a network manager. These additional roles are deemed necessary for a comprehensive rollout of the KM approach. Also, the project will have to adapt the existing KMS infrastructure and extend the reference processes with KMS functions.

6.4 Organizational culture

In this section, first the term organizational culture is reviewed and problems of its measurement are discussed (section 6.4.1) before the focus is set on willingness to share knowledge, the dimension which will be investigated in the empirical study (section 6.4.2).

6.4.1 Definition

There is considerable discussion about the notion of organizational culture. For starters, there is no general agreement on what the term organizational culture describes (Drumm 1991, 164). The term is used in a variety of ways: as a *metaphor*, as an *objective entity* that refers to the organization as a whole or a *set of behavioral and/or cognitive characteristics*[377]. Organizational culture manifests e.g., in artifacts, language, symbols, norms of behavior, heroes, stories, myths, legends, beliefs, values and attitudes, ethical codes, basic assumptions or the organization's history.

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376. For a detailed description see section 17.1 - "Knowledge management starter" on page 599.
377. See Brown 1998, 7ff for an overview of definitions and a classification of approaches.

However diverse the approaches to organizational culture are, there is a certain common core that is connected with the term. The corresponding research is yet another interdisciplinary field, just like knowledge management (Schreyögg 1992, 1526). Organizational culture

- is an *implicit phenomenon*,
- is "lived" and thus *natural and obvious* to the members of the organization,
- comprises *collective orientations and values* that impact the individual's behavior,
- is the result of a *learning process* about how the organization has dealt with the internal and external environment,
- provides *patterns* for the selection and interpretation of behavior and thus provides orientation in a complex world,
- is handed on in a *social process* (socialization).

One exemplary *definition* of organizational culture is as follows: "organizational culture refers to the pattern of beliefs, values and learned ways of coping with experience that have developed during the course of an organization's history, and which tend to be manifested in its material arrangements and in the behaviors of its members" (Brown 1998, 9). Organizational culture thus is a pattern of basic assumptions that have worked well enough to be considered valid, and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to problems of external adaptation and internal integration (Schein 1984, 3).

Organizational culture in general greatly influences how an organization handles knowledge. These effects can be *functional*, e.g., reducing the need for rules and regulations, accelerating decision making and implementing or reducing the amount of work required for supervision, or *dysfunctional*, e.g., a tendency towards a "closed system" that locks off developments in the rest of the world, a lack of flexibility, emotional barriers, collective avoidance of new ideas (Schreyögg 1992, 1531f) as well as dysfunctional communication between and within groups (Frey 2000, 74ff).

A KM initiative therefore has to consider an organization's culture in the decision about the organizational instruments as well as the design and implementation of KMS. There is considerable debate in the literature about whether cultural change can be planned ("*cultural engineers*") or not ("*culturalists*") with yet another group in between that accepts the idea of a planned change in the sense of the initiation of a generally open process of change (Schreyögg 1992, 1534f). The perspective held by the team responsible for the design and implementation of a KM initiative can be anywhere along that dimension. This perspective or understanding of the role of the intervening team greatly influences the selection of the organizational, ICT and other instruments[378].

378. See also Roehl 2000, 253ff for a discussion of implicit assumptions of interventions into an organization's knowledge organization.

Cultural change might also be one of the goals of the KM initiative, e.g., to improve the openness towards new ideas which is often seen as a requirement for a successful management of knowledge (e.g., Rosenstiel 2000, 153f). Interventions as part of a KM initiative might have a profound impact on the organizational culture.

The assessment or *measurement* of organizational culture is a serious problem. In principle, the actual values and assumptions of people about other people, time, space and goals are a lot less observable than official statements about values and indicators, such as stories, symbols, language, clans (Schein 1984, Drumm 1991, 166). Thus, it is unavoidable to investigate the notion of organizational culture indirectly. In the following, the focus will be on one single dimension of organizational culture which is investigated as part of the empirical study presented in part C: willingness to share knowledge[379].

6.4.2 Willingness to share knowledge

Certain aspects of organizational culture can promote or hinder the handling of knowledge in an organization. Von Krogh introduces the concept of *care* which influences knowledge creation (von Krogh 1998). Care is conceptualized to include the following five dimensions (based on Mayeroff and Gaylin, cited from von Krogh 1998, 137f):

- *mutual trust*: Trust compensates for lack of knowledge about other people and is necessary in order to ensure that people can help each other – to give and to accept help.
- *active empathy*: Empathy means that a person can understand another person's situation, interests, skill level, history, opportunities and problems, "active" describes the situation when a person proactively seeks to understand another person.
- *access to help*: Having access to help means that a person needing help is able to find it directly.
- *leniency in judgment*: This dimension of care is especially needed when members of the organization experiment with new solutions and produce errors; leniency means that these errors are not judged harshly which would possibly prevent future experimentation.
- *courage*: Courage means that members of the organization voice their opinions and give (real) feedback as part of a process to help each other.

Von Krogh argues that the process of knowledge creation in an organization is heavily dependent on the level of care (von Krogh 1998, 143). A low level of care leads to individuals "capturing" their knowledge and "transacting" it with expected returns in mind. Thus, individuals gain only limited feedback from others as their

379. The interested reader will find a host of literature on organizational culture. Examples are Schein 1984, Hofstede et al. 1990, Drumm 1991, Sackmann 1992, Schreyögg 1992, Schein 1996, Brown 1998, Frey 2000, Rosenstiel 2000 and the literature cited there.

knowledge creation occurs in a rather isolated way and as they have no interest to share their knowledge. Knowledge sharing is based on expected returns as the members of the organization minimize the risk of sharing non-legitimate knowledge. The opposite – a high level of care – leads to "bestowing" and "indwelling" – individuals creating knowledge in a supportive environment with strong feedback from other individuals which in turn are integrated into "real" teams. Sharing is an accepted way of helping the team to grow.

Apart from a culture-oriented KM strategy focusing on improving care in an organizational context, the level of care has to be considered when designing a KM strategy. Additionally, care is thought of as a concept moderating the effects of a KM strategy on the handling of knowledge. Nonaka and Konno suggest the *concept of Ba* to enhance knowledge creation. They distinguish four types of Ba which reflect the four stages of knowledge conversion (Nonaka/Konno 1998, 45ff):

- *originating Ba*: This is the world where individuals share feelings, emotions, experiences, and mental models. It supports *socialization* and thus the sharing of tacit knowledge between individuals.
- *interacting Ba*: Interacting Ba means selecting people with the right mix of specific knowledge and capabilities for a project team, task force, cross-functional team. The individuals' mental models and skills are converted into common terms and concepts through dialogue. Thus, interacting Ba reflects the *externalization* phase and thus turning implicit into explicit knowledge.
- *cyber Ba*: This type of Ba describes a virtual space of interaction, supported by ICT systems such as KMS, tele-conferencing or group support systems. It targets the *combination* phase, that is combining explicit with explicit knowledge.
- *exercising Ba*: Focused training with senior mentors and colleagues should support learning by continuous self-refinement. Thus, exercising Ba concentrates on the *internalization* phase that turns explicit to implicit knowledge.

The concept of Ba in general strongly aims at enhancing care in organizations and shows a way to operationalization for different settings of knowledge creation. However, there are still considerable challenges ahead concerning the measurability of such constructs and the effects of the application of organizational and especially ICT instruments on the level of care or the amount of *Ba* in an organization.

From the perspective of the socio-cultural rules employed to guide the sharing of knowledge in an organization *four types of environments for knowledge sharing* can be distinguished (Geißler 1999, 56f):

1. Law-and-order model:

In the law-and-order model, power, rights and privileges determine the practice of sharing knowledge. The power system in an organization standardizes the distribution, sharing and handing-on of knowledge. There is a clear distinction between those who are informed and those who are not. As the power system is subject to organizational design, management prescribes the "ideal" form of the organizational knowledge base in the law-and-order-model. Power is used to enforce this ideal form.

2. **Family culture model:**

   In the family culture model, the sharing of knowledge is determined by interpersonal sympathy and antipathy as well as traditional, unwritten moral obligations. Solidarity ensures that all members of the "family" share the knowledge. As there is no standardization, a family member is at the mercy of the other family members to share in the family's knowledge. The consequence is that there are all kinds of group relations that lead to informal standardization of knowledge and the way of knowledge sharing specific to groups. This eases sharing within groups and hinders sharing between groups.

3. **Market model:**

   In this model, knowledge is considered a resource the value of which is determined based on supply and demand. As opposed to the law-and-order model, it is not the flows of knowledge that are designed with respect to their contents, but the framework in which the market transactions (here: the exchange of knowledge) take place has to be guaranteed. Thus, organizational "deregulation" replaces traditional principles of organization such as privileges and rewards. Deregulation means for example establishing property rights for knowledge, improving transparency through standardization of knowledge and enforcing standards for the quality of knowledge.

4. **Discourse model:**

   In the discourse model, the goal is to achieve "objective" truth, material, normative findings as well as to achieve consensus about the valuing of these findings. The process of the development of knowledge is based solely on the power of convincing arguments. A discursive standardization of the organizational knowledge base thus requires that the members of the organization make their usually divergent mental models explicit, share them and unify them in an ongoing process of exchanging arguments.

These four types reflect *social rules of give and take* and are the main basis for the cultural dimension of sharing knowledge.

Another important factor that has to be considered in KM activities is the *degree of sensitivity of interest* (Frese/Theuvsen 2000, 32ff). This factor is partly influenced by the organizational culture, especially the relationship between the executives and representatives of the employees or unions and the openness of the employees towards organizational change. It is also partly influenced by laws and regulations such as the German "Mitbestimmungspflicht". The two ends of the dimension degree of sensitivity of interest are (Frese/Theuvsen 2000, 33):

- *high degree of sensitivity of interest*: a proactive management of potential conflicts in the course of change is necessary,
- *low degree of sensitivity of interest*: there is no need for conflict management.

KM initiatives have to take into account the sensitivity as it will strongly affect the success of KM measures. In general, KMS and KM initiatives extend existing approaches to survey, supervise and investigate individual behavior which in Germany is regulated by data privacy law. Even in those cases in which regulations do

not apply (e.g., the tracking of the headers of emails contributed to newsgroups) employees might be sensitive to the organizations' activities[380].

All of these concepts describe cultural phenomena and their effects on KM. Clearly, in order to improve an organization's level of willingness to share knowledge, a high level of care is desirable. It is not as easy to decide upon the effectiveness of the four types of KM environments. The degree of sensitivity of interest finally shows that KM initiatives have to be careful about the instruments they apply. Employees or representatives of employees should be contacted early on in order to avoid organized resistance to the initiative. Several *instruments* were suggested to make care widespread and sustainable in organizational relationships (von Krogh 1998, 143) or, in more general terms, to instill an open culture:

- incentive system rewarding cooperation or behavior that shows care;
- mentoring programs;
- knowledge sharing and caring behavior as part of employee assessments and career management;
- trust, openness and courage as explicitly stated values;
- training programs in care-based behavior;
- project debriefings and other forms of learning-oriented conversations;
- social events and meetings;
- private contents in KMS that provide context for trusted relationships.

Apart from these rather general statements and hypotheses about a positive influence of incentives and motivational aids on an organizational culture more supportive of KM, systematic studies about the effects of such systems are rare up to now[381].

Measuring organizational culture is a serious problem and has to be assessed indirectly[382]. In the empirical study, the single dimension measured reflecting organizational culture is *willingness to share knowledge*. However, even this portion of organizational culture remains vaguely defined and empirical assessments are rare so far. The approach taken here consequently shows a trade-off between the requirements of cultural investigations on the one hand and the limited amount of effort that organizations are willing to spend on empirical studies on the other hand. The problem is either (1) to perform a rigorous *cultural analysis* which would have required to question or interview a representative sample of employees *per organization* participating in the empirical study and thus would have limited the sample to a handful of organizations at best or (2) to completely leave the organizational culture out of consideration.

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380. See the abundant literature, e.g., published in the German journal "Datenschutz und Datensicherheit, see also the journal's comprehensive Web site on the topic: URL: http://www.dud.de/.
381. See also Döring-Katerkamp 2002 who performed an empirical study on the use of incentives to improve motivation to participate in KM.
382. See section 6.4.1 - "Definition" on page 221.

The compromise taken here was to ask the person completing the questionnaire to answer a set of questions for that portion of his or her organization that the KM initiative was responsible for. As the interviews have shown many of the KM initiatives have studied cultural issues in their organizations, e.g., with the help of employee surveys, interviews and workshops. As a consequence, the respondents might have had a reasonable feeling about the situation in their organizations.

Also, the questions posed in the empirical study used instruments that have been empirically tested before as much as possible. The items used to measure this construct were taken from other studies which dealt with constructs similar to the ones used here. In the following, these studies are briefly described:

Mutual trust, knowledge and influence between line and IS organizations. Nelson and Cooprider developed three constructs measuring shared knowledge, mutual trust and mutual influence between the line organization and the IS organization of companies which in turn are supposed to influence IS performance (Nelson/Cooprider 1996, 416). In their study, key informants were used to assess the level of shared knowledge (5 items), mutual trust (3 items) and mutual influence (6 items). Nelson and Cooprider found that the level of shared knowledge is dependent on both, the level of mutual trust and the level of mutual influence between these organizational units.

Organizational learning culture inventory. Goodman and Darr developed nine items describing what they call the organizational learning culture inventory (Goodman/Darr 1998, 435). The nine items are: sharing of best practices in my office is highly rewarded, sharing of best practices with other offices is highly rewarded, open communications in my office, my office is innovative, sharing of best practices is frequently discussed, sharing of best practices is a major way to solve problems, high communication with other offices, high cooperation in this office, high cooperation between offices. These items are supposed to moderate the effect of computer-aided systems for enhancing organizational learning in distributed environments (Goodman/Darr 1998, 417 and 435).

In the empirical study, the following amalgamated set of items will be used:

- *mutual understanding* of work groups: employees know about the work of other teams/work groups (e.g., about problems, tasks, roles), employees value the achievements of other teams/work groups,
- *mutual trust* of work groups: employees trust each other across teams and work groups,
- *mutual influence* of work groups: influence of teams/work groups on important decisions of other teams and work groups,
- *mutual support* of work groups: employees help each other between teams and work groups,
- *communication between work groups*,
- *help within work groups*: employees help each other within teams/work groups,

- *willingness to learn*,
- *communication within work groups*,
- existence of *incentive systems for knowledge sharing*: material incentives (money), career opportunities dependent on knowledge sharing,
- *approval/acknowledgement of cooperative behavior*,
- *informal exchange of ideas* (e.g., in breaks, at company events, private),
- *design of the decision process*[383].

All in all, 17 statements were used in order to determine these items describing the willingness to share knowledge in an organization. The following hypotheses concerning willingness to share knowledge will be tested in the empirical study:

Hypothesis 9: Employees are more willing to share knowledge within than outside their work environment (group or team)

The "Not invented here" syndrome was frequently reported in the literature, meaning that individuals often show a negative attitude towards experiences made by individuals not known to them. This might also be reflected by a higher willingness to share knowledge within a work group or team as employees know each other better than between groups and teams. Teams or work groups might also often compete with each other. Communities might help to reduce these barriers, though, as common interests and thus an "experienced similarity" between its members might also lead to a higher willingness to exchange knowledge.

Additionally, it is also plausible that members of the organization have more opportunities to share knowledge within their traditional work environment than outside, say, privately or at company events.

Hypothesis 10: The higher the share of newly recruited employees is, the more knowledge exchange is taking place outside traditional work environments

Newly recruited employees need to build social networks within the organization whereas employees who have been with the organization for longer already have had time to build enough social relationships. Thus, newly recruited employees might be able and willing to devote more leisure time to their job engagements and might be eager to build social networks privately with colleagues. This is especially probable if newly recruited employees had to move prior to their new job engagement and thus had to leave parts of their social relationships. Additionally, a "generation factor" might also have the effect that more exchange takes place outside traditional work environments. A large part of newly recruited employees might be within their first couple of years of work, young and childless which might once again positively affect motivation to meet with colleagues outside traditional work environments[384]. The opposite might be true for employees that have already been with the organization for a long time. They have already built up suf-

383. The design of the decision process supposedly varies greatly within and between departments. Thus, it could only be analyzed in personal interviews, not as part of the questionnaire.

ficient social relationships with many of their peers. Maintaining these networks does not require the devotion of as much private time than for newly recruited employees.

More generally, the "right" mixture of experienced knowledge workers who have been with an organization for an extended period of time and thus have built up social networks to a large extent and knowledge workers new to the organization might be a good combination for effective knowledge management. The experienced knowledge workers are networked well and thus take care for a quick dissemination of knowledge in the networks as well as prevent "re-inventing the wheel" and take over knowledge developed anywhere else within the network (exploitation). The knowledge workers new to the organization might help to overcome possible barriers between different networks and integrate knowledge from outside the organization (exploration). The average age of the employees, the average time that they have been with the same organization (and the same department!) and the percentage of new employees per organizational unit might thus be important KM measures that are well worth being paid attention to (see also Sveiby 1997, 263).

Hypothesis 11: A high share of employees leaving the organization negatively affects willingness to share knowledge between groups and teams

In organizations that lay off a large part of their employees, usually the atmosphere suffers. Those employees that have to leave might not be motivated to hand on their experiences. Those employees that remain in their jobs might fear that they can be replaced easily if they share their knowledge. They might think that "knowledge is power" and sharing of that knowledge means to give up power. It is expected that this behavior is most obvious between groups and teams where social relationships are traditionally lower than within groups and teams. Within groups, employees might still be willing to share knowledge because the work group or team may offer a "social home" in times of unpleasant changes.

Hypothesis 12: In organizations with systematic knowledge management, willingness to share knowledge is improved

One of the first activities in most KM initiatives is to raise awareness throughout the organization about the potentials and benefits of sharing knowledge, to build trust between employees and to stress the importance of every employee's knowledge. Thus, these activities might already trigger a change of employees' attitudes towards knowledge sharing because they feel taken seriously (Hawthorne effect, see e.g., Schreyögg 1999, 45f) and because they want to share in the benefits of KM. Moreover, concrete KM measures and instruments might improve an individuals' ability to share knowledge which in turn might positively influence his or her

384. Recently, this effect has been repeatedly described in articles about start-up companies in the popular press (e.g. DER SPIEGEL). Start-up companies in many cases have been viewed by their employees (who are in their 20s and 30s) as a kind of "family" and boundaries between work and leisure time in many cases have become increasingly blurred.

motivation. Systematic KM can be measured in terms of KM expenses or the number of KM staff per participant as well as the share of employees with access to KM-related systems.

6.5 Other interventions

There are many other KM instruments which can be applied in order to improve the way an organization handles knowledge. Section 6.5.1 discusses some examples for interventions that do not directly involve design and implementation of a KMS, but are nevertheless interesting for enhancing the way of handling knowledge in an organization. Section 6.5.2 presents a the results of a project led by the author for an ICT professional services company which has changed office layouts and implemented an algorithmic solution to assign office space to consultants that takes KM issues explicitly into account.

6.5.1 Overview

The following examples show the wide variety of measures that can be taken as part of a KM initiative:

Architecture. Many positive examples of efficient knowledge sharing praise the kind of informal interaction of employees which takes place on the hallways, in the coffee kitchen, lounge or at lunch etc. An intelligent (physical) space management represents the knowledge flows and arranges the work spaces of those people close to each other who regularly work together (Probst et al. 1998, 226f). Space management can be highly effective and even prove more useful than the most advanced ICT system as good social relationships often are positively correlated with personal encounters. Examples for objects of space management are (North 1998, 264ff, Roehl 2000, 179): the size and sequence of offices, position of secretaries' offices, width and length of hallways, the design of office space and the arrangement of meeting space and meeting rooms. Recently, the virtualization of work spaces has changed requirements for architecture substantially as mobile knowledge workers demand to have a work environment as complete as possible wherever they are (e.g., Lippert 1997). These new requirements lead to new office forms such as nomadic offices, market offices, festival offices, just-in-time offices, non-territorial offices, project offices or so-called business clubs (Kern/Zinser 1997, 101f, Schnell 1997, 85f).

Personnel training and education. In the ILOI study, 83% of the organizations reported personnel training and education as the most important KM instrument for experiences (ILOI 1997, 35). In the Fraunhofer study training and education was also seen the most frequently used instrument for knowledge acquisition (Bullinger et al. 1997, 24).

Recruitment of experts. Organizations might also try to acquire knowledge from outside the organization on a permanent basis by recruiting experts in domains

needed (see Hiltrop 1999 for an overview of recent developments in recruitment). However, there are some fundamental difficulties that might arise:

- difficult to find experts and to assess expertise,
- experts are scarce, so that it might be difficult to recruit and retain them,
- difficult to integrate experts into the organization's knowledge networks, culture and processes.

These might be some of the reasons why the organizations responding to the Fraunhofer study rarely used the recruitment of experts for knowledge management when compared to other instruments like cooperations with business partners or personnel training and education (Bullinger et al. 1997, 24). Thus, many organizations tend to hire experts only temporarily or rely on consultants. This approach on the one hand might prove successful in many situations as credibility is often higher for external experts and organizational experts might be more willing to accept and reuse ideas from outside the organization than from within (e.g., Bullinger et al. 1997, 34). On the other hand, it might worsen the difficulties to integrate the experts into the organization's networks, so that core competencies can be built up.

Therapeutic intervention. Some authors suggest that some of the most important barriers to effective knowledge sharing can only be overcome with the help of a targeted therapeutic intervention (e.g., supervision, e.g., Roehl 2000). However interesting this concept might be, the organizational practice in many cases seems to remain quite sceptic about this approach. In the ILOI study, no respondent indicated to use therapeutic interventions as a KM instrument within their organization (ILOI 1997, 35). Nevertheless, in cases in which important knowledge barriers are due to specific interpersonal situations, it might well be that a targeted therapeutic intervention improves the handling of knowledge much more than the best combination of organizational and ICT instruments. Therapeutic interventions are out of the focus of this book[385].

6.5.2 Example: FlexibleOffice

This section provides exemplary insights into the wide range of alternative approaches to other interventions into an organization's way of handling knowledge. The section reports goals, solution and results of an industry project about the implementation of a flexible office solution with knowledge management in mind[386].

The project FlexibleOffice was motivated by the following main observations:

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385. The interested reader should consult literature in the realm of systemic organizational interventions. Examples are Königswieser/Exner 1999, for an overview of modern therapeutic methods to guide change processes in organizations e.g., Buchinger 1997, Scala/Grossmann 1997, for supervision, e.g., Pühl 1992, for the use of processes in large groups for organizational change processes, e.g., Königswieser/Keil 2000.

Mobility. Employees increasingly work outside their offices, e.g., at their customers' offices, on the road or at home. In the project, the average percentages of time spent outside the company were determined for all organizational units. It turned out that in one unit, employees spent on average almost 30% of their working time outside the company with a minimum of 14% and a maximum of 55%. This organizational unit was therefore chosen for the pilot study of the FlexibleOffice project. However, other organizational units also had average percentages of time spent outside the company between 14 and 18%, so that in a future step, it is planned to roll out the solution to other organizational units. Economically, the high portion of time spent outside the company leads to many empty offices and thus to inefficiencies in usage of office space. More efficient use of office space could allow for growth without the need to rent additional office space. From a KM perspective, distribution of employees over a number of offices inside and outside the company leads to inefficiencies in communication and knowledge sharing.

Project orientation. Office structures at the company reflect the traditional organizational structure and thus are arranged according to the organizational units built in the business system[387]. Typical for an IT company, projects play an important role and therefore the project system needs to be carefully considered. This company is characterized by a multitude of projects that span organizational units. Both, project managers and project team members suffer from the team being spread over a number of offices and would profit from the possibility to reserve a room for team members for a certain amount of time, e.g., for a project kick-off, for preparation of a milestone result or report, for finalizing a project or for documenting lessons learned.

Knowledge management. The increasing velocity with which new products and services are created, in this case standard software product and consulting services, leads to an also increasing importance of the knowledge base layer. This means that employees improve their competencies, are engaged in learning activities and co-develop themes that run across both, business system and project system, i.e. they span organizational units and also project teams. Flexible offices can systematically take into account the themes on which employees work that will hopefully be turned into successful projects in the future. As a consequence, workplace learning, knowledge transfer between employees working on the same theme as well as

386. This section reports the preliminary findings of a research project led by the author that was carried out together with the IT organization GISA, Halle (Saale) in the years 2005-2006. The project team comprised research assistants Florian Bayer and Stefan Thalmann as well as GISA representatives, particularly the CEO, Michael Krüger, as well as Hendrik Nitz, Michael Feustel and a large number of members of the organizational units who participated in the pilot study.
387. The denomination of organizational systems as business system, project system and knowledge base has been conceptualized as parts of the hypertext organization by Nonaka, Konno, Tokuoka, and Kawamura and presented in the journal *Diamond Harvard Business* in 1992 in Japanese (Nonaka 1994, 32ff), see also section 6.1 - "Structural organization" on page 158.

training of employees new to the job or the theme might be improved with such a solution.

Main goal of this project was to develop a hotelling software that considers mobility, project orientation and knowledge management. Specific characteristics of this software or differentials to standard hotelling software are that the assignment of a work place considers criteria such as project and theme overlappings between employees, preferences of employees and project managers. These criteria should lead to improved communication and coordination in projects, decreased search time, improved knowledge transfer, workplace learning and improved handover of projects between project teams and the organizational units responsible for operation and maintenance of the resulting application systems.

The project was carried out in two parts. The first part comprised the development of a feasibility study and a conceptual plan and the second part consisted of IT implementation and a pilot study to test the software.

In a first step, the situation at the partner company was studied in order to determine a sharing ratio, i.e. the number of employees divided by the number of work places. The investigation included

- literature analysis of relevant case studies[388],
- analysis of documents, e.g., floor plans, organizational structure diagrams, project management handbook,
- reports on times of absence, e.g., travel, holiday and home office days,
- self-reporting in a more detailed way with five employees compiling times being allocated to projects and customers, time spent on the work place, in other offices, meeting rooms, customers' offices etc. and
- personal interviews that helped to refine the information gathered above.

The collected data was used to determine the organizational unit that would be the first to profit from the flexible office (a unit with more than 80% project work), the sharing ratio (1.2[389]) as well as several rules, e.g., clean desk policy or limitations for booking a single work place.

Projects are the most important dimension in this organizational unit. They are prioritized which should also be considered in the assignment of employees to work places. Also, between 30 and 40 external persons are involved in many projects per year, who also need to be considered in the assignment of work places. For the theme dimension, existing skill directories oriented at customer demands as well as technologies by the primary IT partner organization could be reused. A communication analysis supported the importance of project (project system), team (business system) as well as theme (knowledge base layer) dimensions.

From a technical perspective, the flexible office required mobile phones, blackberries, UMTS network access for laptops as well as a remote access solution for

388. See the case studies reported in Zinser 2004.
389. This was the most popular sharing ratio that was found in the literature. This is due to the consideration that it is not cost savings, but KM-related goals that are of primary interest in this project.

home office and customer office access to company servers. The hotelling solution was integrated into the B2E (Business to Employee) information infrastructure on the basis of an employee portal.

The requirements and the conceptual plan developed in the first part of the project were then realized as a prototype software solution in the second part of the project. Seven projects, 35 team members and nine rooms were selected for the pilot study. These employees took over ownership of the FlexibleOffice project and closely and actively participated in the effort to refine both, the organizational and the technical part of the solution.

The prototype software solution consisted of

- input masks for project managers to reserve office space for their projects and for employees to submit their preferences, to apply for home office days and for fixed bookings of those work spaces that have not been assigned automatically,
- the core optimization component for the assignment of rooms,
- output components for visualizing the solution and for notifying employees of the booked rooms.

In the following, the core component is described in some detail. The booking process determines the optimal assignment of work spaces according to the predefined criteria for one work week. All reservations and preferences have to be submitted until Thursday evening in the week preceding the booking week. The results are forwarded to employees on Friday noon.

Criteria have been quantified and the optimization problem has been formalized with the help of standard methods of operations research. The utility function (score) that is optimized consists of a number of weighted factors:

Reservations by project managers. Project managers can reserve a room for one or more employees of a certain project. In case one employee is part of two projects for which managers have made a reservation, she will be assigned to the project with the higher priority. Due to hierarchical legitimation, reservations by project managers are treated separately as a kind of "K.O."-criterion.

Attractive rooms for important projects. Rooms are valued according to the attractiveness estimated by employees on a scale from one, i.e. very unattractive to ten, i.e. very attractive. A project score consists of a project category reflecting the importance of the project and its customer as well as a time-variant score dependent on the state of activity of the project, e.g., start, standard, near milestone, close to finish. These two parts give a project score between 1, i.e. less important project in standard mode, and 9, i.e. very important project in a "hot" phase. Multiplying room score by project score leads to results in which attractive rooms are assigned to important, currently highly active projects.

Project overlappings. This criterion values the relationships between employees with respect to their work in projects. Goal is to assign employees to a single room who share team membership in the same projects in as many cases as possible. Also, employees can submit a project preference stating that it is this project that

they will be working on mostly in the booking time frame. This means, that overlappings are exclusively considered with respect to the preferred project. If there are no project preferences, the following formula calculates project overlappings *po* between project team members *a* and *b*:

$$po_{ab} = \left(\frac{\sum_{i \in P} ps_{ai \wedge bi}}{\sum_{i \in P} ps_{ai}} + \frac{\sum_{i \in P} ps_{ai \wedge bi}}{\sum_{i \in P} ps_{bi}} \right) / 2$$

ps_{ai} is 0 if employee *a* is not on project $_i$ and is the project's score if *a* is on project $_i$. $ps_{ai \wedge bi}$ is the project's score if employees *a* and *b* are on project $_i$ and 0 otherwise. Project overlappings are only considered if $po_{ab} > 0.6$ because they are only thought to be relevant if there are sufficient and sufficiently important projects that employees share.

Theme overlappings. Similar to project overlappings, theme overlappings also consider the relationship between two employees according to the themes that they are working on. The assumption behind this is that employees working on similar themes should be assigned to the same room in order to improve knowledge sharing. Again, an employee can submit a theme preference, which in this case means that they would like to sit in a room with a person that has a higher skill level with respect to the preferred theme. In this case, overlappings are exclusively considered with respect to the preferred theme. In all other cases, theme overlappings *to* between employees *a* and *b* are calculated according to the following formula:

$$to_{ab} = \left(\frac{\sum_{i \in P} th_{(a \wedge b)i}}{\sum_{i \in P} th_{ai}} + \frac{\sum_{i \in P} th_{(a \wedge b)i}}{\sum_{i \in P} th_{bi}} \right) / 2$$

th_{ai} is 0 if employee *a* does not work on theme $_i$ and is 1 if *a* works on theme $_i$. $th_{(a \wedge b)i}$ is 1 if employees *a* and *b* both work on theme $_i$ and 0 otherwise. Theme overlappings are only considered if employees have an equal skill level or if *a* has a lower and *b* a higher skill level, but not the other way round.

Group overlappings. Employees can submit a preference for a certain work group. This means that they wish to work with other members of the preferred work group. The corresponding score for work group overlappings *wgo* reflects the number of employees in the assigned room that belong to the preferred work group.

Moving costs. The selected employees showed a strong preference for stability if changes are not too significant. This is why fictive moving costs have been introduced, so that small differences between criteria do not result in a large number of moves between offices without much effect on the utility function. Moving costs also consider room preferences that employees have submitted. Employees can submit a preference for a type of room, e.g., a single office, a room with specific

equipment, e.g., a beamer. If the new solution means a move into a room that the employee prefers, then there are no moving costs calculated. If the employee has to move out of a preferred room, moving costs are higher than in the standard case of no specific preferences for rooms.

The optimization problem is solved in two steps. In a first step, the following utility function is maximized in order to get a quick solution that considers the exclusive reservations by project managers. The mathematical problem can be solved with the simplex algorithm. The indices $_i$ and $_j$ in the two summarizing functions determine the matrix holding the decision variable X_{ij} meaning that x employees of project $_j$ are assigned to room $_i$. The only criteria that are considered in the utility function are the weighted multiplication of room attractiveness *ra* and project score *ps*, from which moving costs *mc* are subtracted. Thus, the utility function can be written as follows:

$$U = \sum_{(i \in R)} \sum_{(j \in P)} (X_{ij} \times (\alpha \times ra_i \times ps_j - \beta \times mc_{ij})) \rightarrow MAX$$

Constraints are as follows: elements of the decision variable have to be positive integers, each room has a limited capacity, no more than the number of employees that have been ordered by the project managers are assigned to rooms and projects requested as exclusive do not have to share rooms with other projects.

The second step considers all employees and rooms that have not been exclusively assigned in the first step. The weights of the criteria have been refined in a dozen rounds according to the preferences of the employees participating in the pilot study. The quadratic mathematical problem can be solved with a branch and bound algorithm. The utility function consists of two terms. The first term reflects a matrix of rooms and employees and the decision variable represents the boolean assignment of employee $_j$ to room $_i$ with 1 for assigned and 0 for not assigned. With this term, room attractiveness *ra* is maximized and moving costs *mc* are minimized. The second term reflects a three-dimensional matrix of rooms $_r$ and the relationships between employees $_a$ and $_b$. Thus, the decision variable is 1 if the corresponding two employees are assigned to the respective room and 0 otherwise. The term reflects the weighted[390] criteria project overlappings *po*, theme overlappings *to* and work group overlappings *wgo* which have been explained above. The utility function can be written as follows:

$$U = \sum_{(i \in R)} \sum_{(j \in E)} (X_{ij} \times (\alpha \times ra_i - \beta \times mc_{ij})) +$$
$$\sum_{(r \in R)} \sum_{(a \in E)} \sum_{(b \in E)} (X_{ra} \times X_{rb} \times (\gamma \times po_{ab} + \delta \times to_{ab} + \varepsilon \times wgo_{ab})) \rightarrow MAX$$

Constraints are as follows: elements of the decision variable have to be boolean, each employee is only assigned to one room and each room has a limited capacity.

390. Weights are written in Greek letters.

During the pilot study, all participating employees were asked to fill out short online questionnaires and project managers were interviewed on a regular basis. The results of this study show a typical u-shaped curve concerning user satisfaction with the solution. It started out with high hopes, then some problems with the prototype and also the criteria that had not yet been sufficiently refined led to a decline in satisfaction. However, in the last three weeks of the pilot study, the curves reflecting usability, improvements in communication, efficiency, learning and knowledge transfer all showed a positive tendency. One has to be careful in interpreting these results, though. On the one hand, some participants feared that a flexible office would mean a loss of their personal work space and of their relationships with colleagues. On the other hand, more and more employees in the IT company claimed their interest in participating in flexible office because of the supposed benefits that this would have on their personal productivity and development. Longitudinal studies are required to see whether these personal opinions can really amount to measurable improvements in the dependent variables of this study, namely communication, search efficiency, knowledge transfer, learning and, finally, organizational success.

6.6 Modeling

Models are representations of a selected portion of the perceived reality of an individual or a group of observers. Central to models are their structural, functional or behavioral similarities to the perceived reality (Lehner et al. 1995, 26f). Modeling is one of the key tasks that helps on the one hand to understand, analyze and improve business processes (business process reengineering), organizational structures in general and structures and processes of KM initiatives in particular. On the other hand, modeling supports the design, implementation and management of information systems, in this case of knowledge management systems.

Based on the model of tasks and flows in knowledge management[391], the design of KM initiatives requires the modeling of concepts for

1. *instruments*[392] that have been selected in order to implement the KM strategy and aim at the desired outcome,
2. *processes*[393], the organizational design in which those instruments are deployed, i.e. knowledge tasks and processes, the relationship to business processes, roles and responsibilities,
3. *persons*[394], capturing facts about people as the target group of the instruments, i.e. their profiles, skills, communication and cooperation in organizational units, project teams, networks and communities,

391. See Figure B-25, “Knowledge process and knowledge-intensive business process,” on page 214.
392. See section 6.2 - “Instruments” on page 195.
393. See section 6.3 - “Process organization” on page 207.
394. See section 6.1 - “Structural organization” on page 158.

4. *products*[395], knowledge as object in the sense of themes, the type of knowledge, meta-data, structures, taxonomies and ontologies,
5. *ICT*[396] tools and systems in support of KM, i.e. the KMS architecture that integrates interacting basic services that are composed into advanced KM services.

Figure B-29 shows the most important KM modeling concepts structured according to these four categories and their relationships. The importance of the three main modelling perspectives person, process and product is stressed in Figure B-29 by the shaded triangle that visualizes them as being connected in the middle layer. The strategy-oriented selection of KM instruments on the top determines the modelling efforts in the middle layer whereas the subsequent implementation of ICT forms the ultimate modeling goal and thus limits and streamlines the modeling effort. The five perspectives are connected by a number of concepts.

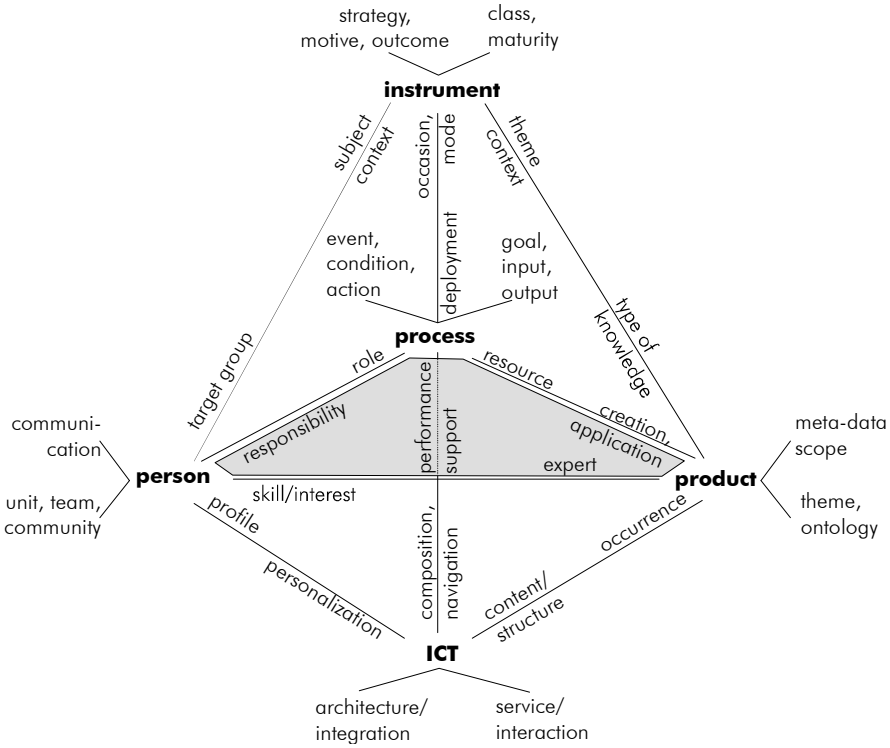

FIGURE B-29. Perspectives for modeling in knowledge management

KM instruments determine the target group in the person perspective and the type of knowledge focused in the product dimension. Processes on the one hand

395. See section 7.2 - “Contents” on page 281.
396. See section 7.3 - “Architectures and services” on page 302.

provide occasions for knowledge-oriented tasks and on the other hand are a primary vehicle for the implementation and deployment of KM instruments. In this view, person and product form subject and theme context for triggering KM instruments in the respective business and knowledge processes.

Persons are involved in processes by responsibilities for tasks and processes and roles that are assigned to tasks. Business and knowledge processes are supported by ICT tools and systems, especially KMS, in order to improve organizational performance. Also, processes can be used to guide composition of services and to aid navigation in ICT resources. Themes and topics in the product perspective are mapped to occurrences, e.g., documents or other resources that are stored in ICT systems. Structures, taxonomies and ontologies can be used as the primary structure of contents of ICT systems. Persons hold skills that are structured as topics and have interest in topics. Experts take care of certain topics in organizations, e.g., subject matter specialists. Processes and topics are connected by the knowledge resources, both in the form of skills and in the form of documents, that are required in business and knowledge processes and by the process context of knowledge, i.e. in which processes knowledge is created and applied, sometimes also called flow of knowledge. Identity management with the help of profiles and personalization techniques are used to support access of contents and services in ICT resources.

In a concrete KM initiative, modeling can be focused according to the two main directions of KM research, human orientation and technology orientation, and Hansen et al.'s (1999) distinction of KM strategies into a personalization versus a codification strategy[397].

In a human-oriented KM initiative, or a personalization strategy respectively, modeling focusses on the perspective person and its links to the product and process perspectives. Skills, interests, experts, roles, responsibilities, communication and social network analysis will be of interest to these KM initiatives.

In a technology-oriented KM initiative, or a codification strategy, modeling primarily is concerned with the product perspective and its relationships to ICT and process. The modelers model meta-data as well as ontologies and design architectures, services, contents and structures of KMS. Services are composed so that they can be deployed with the help of KM instruments to support performance in processes.

In a KM initiative aimed at bridging the gap between human orientation and technology orientation or between personalization and codification respectively, the process perspective is emphasized together with its relationships to the person, product and ICT resources perspectives. The design of knowledge processes and knowledge-intensive business processes with their roles and responsibilities, the types of knowledge created and applied as well as their support by ICT resources is as important as the design of the relationship between persons and ICT resources that supports profiling and personalization of ICT systems for KM.

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397. See also sections 4.1.4 - "Definition" on page 52 and 5.2.3 - "Generic knowledge management strategies" on page 129.

A large number of modeling approaches, methods and techniques have been developed in the literature. Examples are business process modeling, communication modeling, data modeling, data flow modeling, knowledge modeling or object-oriented modeling. Detailed descriptions of these and more modeling methods and techniques can be found in the literature[398]. This section reviews some of the modeling perspectives that have been proposed for KM and discusses their applicability for the design of KM initiatives that use KMS. These are process modeling and its extensions to cover aspects of KM (section 6.6.1), activity modeling, an approach to model ill-structured knowledge activities based on the activity theory (section 6.6.2), knowledge modeling (section 6.6.3) as well as person modeling, including user and role modeling, communication modeling and social network analysis (section 6.6.4). ICT are considered as resources that support or automate activities in process modeling methods, e.g., the execution of workflow definitions, as occurrences and media holding knowledge in knowledge modeling and as tools and systems that allow for profiling and personalization in person modeling. However, there is no specific section on the modeling of ICT resources in this book as existing methods, tools and techniques can be used for modeling this perspective, e.g., object-oriented modeling with UML.

6.6.1 Process modeling

Many organizations have applied concepts of business process reengineering (e.g., Davenport 1993, Hammer/Champy 1993) and a number of methods and techniques to support business process modeling have been proposed in the literature. There are a number of methods and techniques to support business process modeling discussed in the literature. As process modeling is a complex task that requires computer support in order to be an economically feasible approach, most methods are applied with the help of a corresponding tool. Examples are ADONIS (Junginger et al. 2000), the architecture of integrated information systems - ARIS (Scheer 1998, 2001), integrated enterprise modeling - IEM (Spur et al. 1996, Heisig 2002, 49ff), multi-perspective enterprise modeling - MEMO (Frank 1994, 2002), PROMET for process development (PROMET BPR) and for the process-oriented introduction of standard software (PROMET SSW, Österle 1995, 31ff), semantic object modeling - SOM (Ferstl/Sinz 1990, 1994, 1995) or business process modeling methods on the basis of the unified modeling language UML[399] (e.g., Oesterreich et al. 2003). These modeling methods are also called enterprise modeling methods because they integrate a number of perspectives on an organization, e.g., the data, function, organizational structure and the process perspective. Moreover, there is a number of frameworks and reference models for the definition of workflows that imple-

398. A good overview of techniques and modeling methods developed and applied in software engineering can be found in Balzert 2001.
399. UML, the unified modeling language, is a notation and semantics for the visualization, construction and documentation of models for object-oriented software development that has been standardized by the Object Management Group (OMG), URL: http://www.omg.org/.

ment business processes (see e.g., Kumar/Zhao 1999, WfMC 2007). The methods differ in formality, semantic richness and understandability. Basically, the modeling methods fall into two categories:

- methods that primarily aim at the design of organizational structures and processes with the resulting models being a tool for business process reengineering and improvement (e.g., ARIS) and
- methods that primarily aim at the design of information and communication systems, mostly on the basis of workflow management systems and using concepts of object-orientation in a process-oriented view of the organization (e.g., ADONIS or the modeling methods on the basis of UML).

The main challenge in the selection of a method for business process modeling is to balance understandability and ease of use on the one hand and preciseness and formality on the other hand. This is due to the fact that business process modeling is mostly used to design organizational structures and processes on an abstract level or to customize standard software, such as enterprise resource planning software, e.g., SAP R/3, basically by selecting the functions that have to be supported by the software. However, business processes can also be technically supported by workflow management systems which require a much more detailed description of business processes.

Recently, a number of authors have proposed extensions to business process modeling methods, notations or semantics that model (some of the) specifics of KM. Examples are:

ARIS-KM[400]. The architecture of integrated information systems was proposed by Scheer (1992) as a framework for the design and analysis of business processes and the design of information and communication systems in support of these processes. The extensions proposed to ARIS (Allweyer 1998) basically comprise the addition of (1) the object types *knowledge category* and *documented knowledge* and their relationships to activities, persons and organizational units, and (2) the model perspectives *knowledge structure diagram* that shows the relationships of knowledge categories and documented knowledge elements, *knowledge map* that maps knowledge elements to people and organizational units and *communication diagram* that shows which organizational units communicate with each other.

Business knowledge management. The business knowledge management framework, proposed by Bach and Österle (1999, 26), consists of the three layers (1) *business processes*, (2) *knowledge base*, that comprises KM roles, documents, systems and specific KM processes in the sense of service processes to business pro-

400. The ARIS method and toolset is widely used for business process management in the German-speaking countries. The extensions of ARIS for knowledge management are straightforward and pragmatic and yet can be regarded as being representative for many approaches to connect business process management and knowledge management. Therefore, the extensions to ARIS will be discussed in more detail below (see “Example ARIS for knowledge management” on page 245).

cesses, and (3) *knowledge structure*, i.e. the topics and categories of knowledge and their relationships. Topics are created and used in business processes, conceptualized as knowledge flows between business processes, stored in documents and systems, managed by KM roles, refined and distributed by KM processes, and thus mediate between the layers business processes and knowledge base.

The corresponding modeling method, PROMET®I-NET, is based on PROMET and aims at the design of an Intranet-based KM solution, mainly (1) the selection of business processes that use a substantial amount of (semi-) structured knowledge and/or involve a large number of locations which requires coordination and sharing of information, (2) the design of an information architecture which corresponds to the knowledge structure in the business knowledge management framework, (3) the design of an Intranet system architecture consisting of the tools and systems that provide the required functionality, e.g., for classification and structuring of information and knowledge objects, and personalization, and (4) the design of processes that manage the information and knowledge objects in the Intranet (Kaiser/ Vogler 1999).

GPO-WM. This method extends the integrated enterprise modeling method and is called the business process-oriented knowledge management method[401]. GPO-WM consists of a procedure model, a model-oriented audit instrument that helps to determine strengths and weaknesses of the current handling of knowledge in the business processes as well as knowledge-oriented criteria and heuristics, all aiming at the design of a process-oriented KM initiative. From a modeling perspective, the extensions comprise (1) new types of resources used in tasks within business processes, i.e. *explicit* (documents, data bases) and *implicit* (persons) *knowledge*, structured in *knowledge domains*, (2) the so-called *basic KM tasks*, i.e. create, store, distribute and apply knowledge, which are identified and analyzed for each activity in the business processes, and (3) *best practices* as elements of construction for a process-oriented KM initiative, e.g., yellow pages, communities-of-practice, customer voice or process-rally, that are linked to activities in business processes.

KMDL. The knowledge modeler description language KMDL is based on the communication structure analysis (KSA)[402] (Gronau 2003). The basic object types in KSA are *task*, *position*, *information* and *information flow*. These basic object types are extended in KMDL in order to cover knowledge-related aspects of knowledge-intensive business processes. The extensions build upon the distinction between explicit knowledge (in documents or data bases) and implicit knowledge (in people's heads) and Nonaka's processes of knowledge conversion, i.e. internal-

401. In German: "Methode des Geschäftsprozessorientierten Wissensmanagements" (GPO-WM, Heisig 2002)
402. Kommunikationsstrukturanalyse, KSA, developed by Hoyer 1988 (cited from Gronau 2003, 11f) in order to analyze information-intensive processes of office information and communication systems.

ization, externalization, combination and socialization (Nonaka 1991, 98f). Consequently, KSA was extended by the additional object types (1) *knowledge object* that covers implicit knowledge in addition to information objects covering explicit knowledge, (2) *person* as an individual that provides and/or seeks knowledge objects and (3) *requirement of a position* that comprises a knowledge object that a position or, more precisely, an owner of a position, must have in order to accomplish the task(s) that are assigned to the position. The four processes of knowledge conversion link information objects and demand and supply of knowledge objects. A consequent application of KMDL is only feasible at a rough level of detail due to the substantial complexity that a detailed study of the processes of knowledge conversion on the level of individual employees would bring. Additionally, KMDL proposes a procedure model that consists of the five activities (1) identification of processes, (2) detailed study with interviews and checklists, (3) modeling, (4) feedback from interview partners as well as (5) analysis of strengths and weaknesses and reporting. This procedure model and the modeling work with KMDL is supported by the tool K-Modeler (Gronau 2003, 23ff).

PROMOTE. The PROMOTE framework, i.e. process-oriented methods and tools for knowledge management, builds on the business process management systems (BPMS) paradigm (Hinkelmann et al. 2002, Karagiannis/Woitsch 2002). The PROMOTE framework consists of a procedure model, a method to design process-oriented KM instruments and a tool that aids the modeling process and is based on the ADONIS toolset. The BPMS procedure model that already covers business processes and process knowledge is extended by functional knowledge and its context. More specifically, the extensions to the BPMS method and ADONIS toolset comprise (1) additional steps in the procedure model, especially the *identification of knowledge flows* which consists of knowledge-oriented modeling of business processes, the description of *knowledge-intensive tasks* including the persons and the organizational memory[403] that provide the knowledge and the determination of *types of knowledge* required in these activities, e.g., functional, rule, experience or case-based knowledge, and the modeling of *specific knowledge processes* that are then linked to knowledge-intensive tasks in the business processes, (2) the new model types *knowledge process*, *skill model* and *topic map* and (3) a PROMOTE engine that executes the knowledge processes. Compared to methods that primarily aim at the design of organizational structures and processes, PROMOTE targets a finer level of detail with the analysis of knowledge-intensive tasks instead of whole processes and primarily aims at the design of KMS, specifically of workflow management solutions that are extended to cover knowledge processes. Consequently, knowledge processes are quite pragmatic and are limited to basic knowledge-related tasks, such as define search context, search for authors or combine results, which can be supported by KMS. PROMOTE provides contextual meta-data that

403. The term organizational memory is used here in the sense of organizational memory information system to cover all explicit knowledge that is accessible with the help of an information and communication system (Hinkelmann et al. 2002, 67).

describes knowledge elements according to the topics the knowledge element describes (link to topic map), the knowledge-intensive tasks in business processes in which the knowledge element is created or required (link to business process model) and the persons that hold the knowledge element (link to skill model and organizational structure).

Knowledge-MEMO. The Knowledge-MEMO framework builds on the multi-perspective enterprise modeling framework (MEMO) proposed by Frank (1994, 2002). MEMO offers a generic conceptual framework to capture common abstractions of organizations. MEMO consists of the three perspectives (1) strategy, (2) organization and (3) information system. Each of these perspectives is structured by the five aspects (1) structure, (2) process, (3) resources, (4) goals and (5) environment (Frank 2002, 3). Thus, MEMO provides 15 foci of organizational modeling. A single modeling language supports one or more of these foci, e.g., the structure aspect of the information system perspective corresponds to an IS architecture, a data model or an object model. Knowledge-MEMO uses MEMO's foci and extends the modeling concepts and languages considered in MEMO. Examples for extensions are intangible assets, core competencies or topics in the strategy perspective, abilities and skills in the organization perspective and explicit knowledge in the information system perspective (Schauer 2004). One of the focal points in Knowledge-MEMO is the organizational design of a secondary organizational structure, e.g., projects or communities-of-interest, their link to business strategy and their support by information systems[404]. Knowledge-MEMO also contains an evolution model that is used to classify organizations according to their achieved level of KM. The model represents the starting point for procedure models that aim at improving an organizational KM initiative and set the focus on certain perspectives and aspects in Knowledge-MEMO. With respect to other process modeling methods or frameworks, MEMO can be characterized as a meta-framework to which other modeling languages can be mapped.

These are only some examples of approaches to extend business process modeling methods to cover aspects of knowledge management. Further efforts have been made, e.g.,

- by vendors of business process management tools. Besides ARIS, there are a number of business process management tools that recently have extended the object types and model types used in their modeling suites as well as the integration of business process models into KM-oriented ICT solutions, e.g., enterprise portals. One example is the INCOME suite (Get-Process AG) that combines the INCOME process designer tool with a navigation tool called INCOME knowl-

404. The concepts of Knowledge-MEMO are still under construction and will be presented in Schauer 2004. However, some preliminary results target e.g., the integration of project management and business planning (Fraunholz/Schauer 2003), an object-oriented meta-model for KMS architectures (Frank 1999) or, more specific, enterprise-wide project memory and management systems (Frank et al. 2001).

edge browser. The process designer tool extends the multi-dimensional models used in business process design, e.g., goal hierarchies and critical success factors, process model, organization model, data model, resource model, product catalogue, by knowledge structures, skill maps and knowledge maps that assign knowledge topics with roles and resources. The knowledge browser then integrates the models developed in the process designer in a portal environment and uses them to access the organizational knowledge base[405],

- by researchers in the area of workflow management systems who propose to use the knowledge externalized during build-time and run-time of workflow management systems and to extend the workflow definitions by knowledge objects that are provided and searched for in the course of knowledge-intensive tasks. Examples are KnowMore, WorkBrain, Workware and the Workflow Memory Information System (WoMIS) that explicitly aims at modeling and implementing context in the sense of an organizational memory information system (OMIS) with the components of a traditional workflow management system[406].

The reasoning behind all these extensions is that many organizations went to the trouble of a detailed analysis and modeling of their business processes, e.g., in the course of a major reorganization, quality management programs or the introduction of the standard software SAP R/3. Consequently, business process models already exist and simply have to be extended by concepts such as knowledge structures, required and provided skills or knowledge maps so that the extended models can serve as a basis for KM-specific analysis and design tasks.

A detailed discussion of the numerous approaches and methods for business process modeling in general and their extensions to cover aspects of KM in particular can not be given in this book[407]. Instead, according to the goals of this book, the ARIS method is described with respect to its applicability for KM as an example for a widely used business process modeling method.

Example ARIS for knowledge management. ARIS, the architecture of information systems, can be viewed as a framework consisting of the five perspectives (1) data, (2) function, (3) organization, (4) control and (5) output. Within each of these perspectives, a number of object types can be combined with the help of a number of modeling notations. An example is the entity-relationship model that comprises entities and relationships as object types in the data perspective that model events, messages and data objects in the ARIS meta-model. The perspectives overlap so

405. The INCOME suite was originally developed by Promatis, Germany, URL: http://www.promatis.de/english/products/income_suite/index.htm/. Since February 2003, the Swiss company Get-Process AG is owner of the copyright for the INCOME suite and responsible for maintenance and development of the software, URL: http://www.get-process.com/.
406. See Wargitsch 1998 for the system WorkBrain, Goesmann 2002, 43ff and the literature cited there, see also Goesmann 2002, 166ff for the system WoMIS.
407. See e.g., Abecker et al. 2002, Goesmann 2002, 39ff, Remus 2002, 36ff and 216ff for a more detailed account of some of the approaches and modeling methods mentioned here.

that some of the object types can be used to join two or more perspectives. The ARIS framework integrates the five perspectives into one multi-perspective enterprise model and also offers a toolset that supports the design and navigation of ARIS models. So-called event-driven process chains are at the core of the integration in ARIS and bring activities, tasks or functions in a timely order, a chain of activities that are linked by events. Figure B-30 shows the ARIS meta-model with the five perspectives and the most important object types used to describe each of the perspectives. It also shows that the control perspective integrates all object types in an extended event-driven process chain[408].

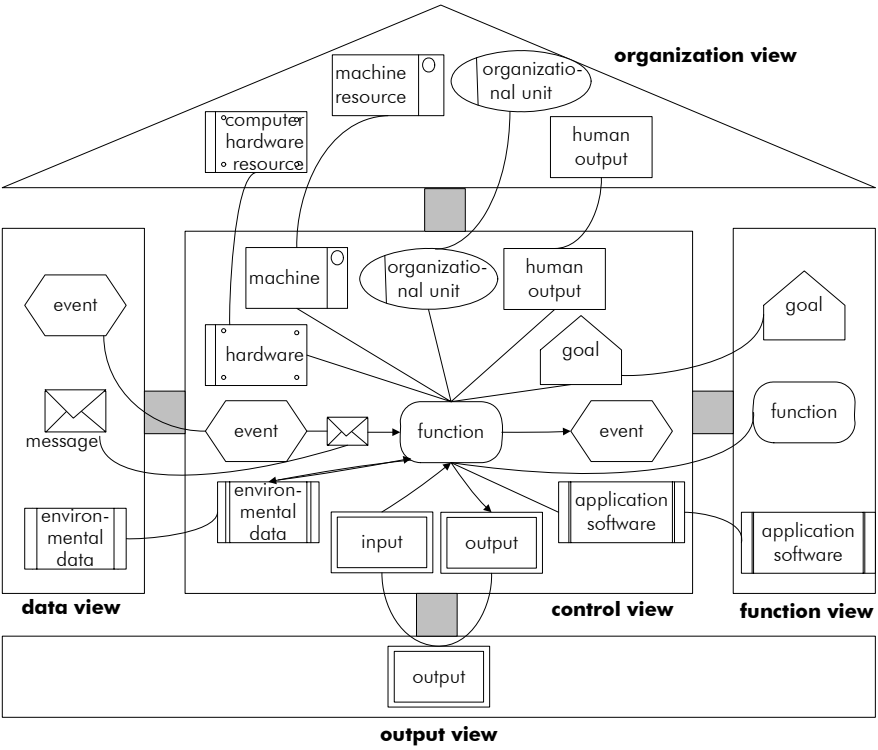

FIGURE B-30. ARIS meta model and perspectives[409]

The extensions to ARIS are relatively straightforward. The modeling method is extended by two additional object types, the object types *knowledge category* and *documented knowledge*. Knowledge categories as well as documented knowledge are treated like data objects and can thus be assigned to tasks in event-driven process chains. Figure B-31 shows an extended event-driven process chain that mod-

408. For a detailed description of ARIS see Scheer 2001.
409. Source: Scheer 1992, 22, Scheer 1998, 37.

els a portion of the core process of a typical small or medium-sized enterprise that makes dies and moulds[410].

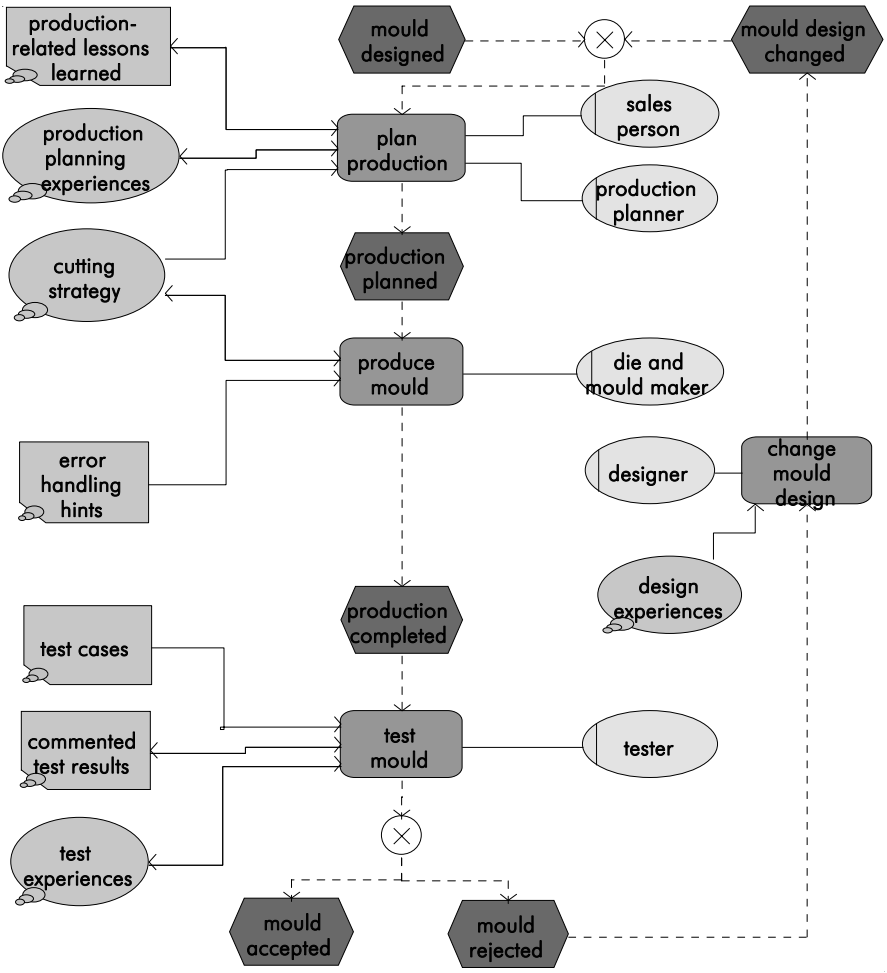

FIGURE B-31. Extended event-driven process chain with KM elements

The event-driven process chain is extended by a number of knowledge categories and documented knowledge. Also, ARIS is extended by additional model types within the existing perspectives, the model types (1) *knowledge structure diagram* in the data perspective, (2) the model type *communication diagram* in the

410. Figure B-31 to Figure B-33 show simplified portions of the models that were developed in the course of the EU project "KnowCom - Knowledge and Co-operation-Based Engineering for Die and Mould Making Small and Medium Enterprises" (KnowCom 2003).

organization perspective and (3) the model type *knowledge map* in the control perspective and (see Allweyer 1998).

ARIS knowledge structure diagram. Knowledge structure diagrams show the relationships (a) between knowledge categories and (b) between knowledge categories and documented knowledge. The diagram can be characterized as a simple form of knowledge modeling (see section 6.6.3). Thus, knowledge structure diagrams contain the object types *knowledge category*, *documented knowledge* as well as the object type *document* that visualize specific documents, e.g., text documents (see Figure B-32).

Additionally, knowledge structure diagrams assign documented knowledge to media and/or systems, e.g., to text documents that are stored in file systems or specific document, content or knowledge management systems[411].

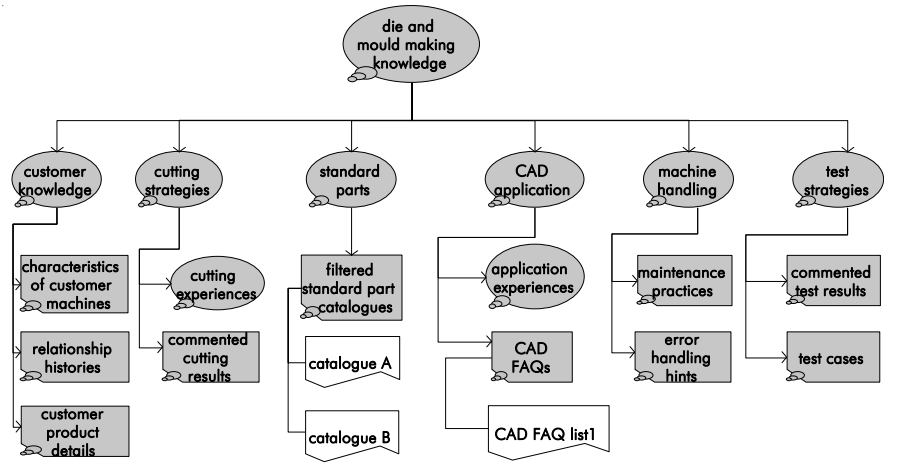

FIGURE B-32. Example for knowledge structure diagram in ARIS

ARIS communication diagram. Communication diagrams in ARIS visualize the communication links between organizational units and comprise the object type *organizational unit* and the object type *communication* (see Figure B-33).

The object type *communication* is labelled with the type of communication that characterizes the communication link. Organizational units are connected to communication with the help of a relationship *communicates with* that shows the direction of the communication. The relationship can be detailed according to what business processes a certain organizational unit communicates with another organizational unit.

411. The ARIS module "ARIS for Hyperwave" uses the knowledge structure diagrams and the assignments for the implementation of enterprise knowledge portals, e.g., by a translation into a description of folder structures and meta-data for the knowledge management system Hyperwave (URL: http://www.ids-scheer.com/).

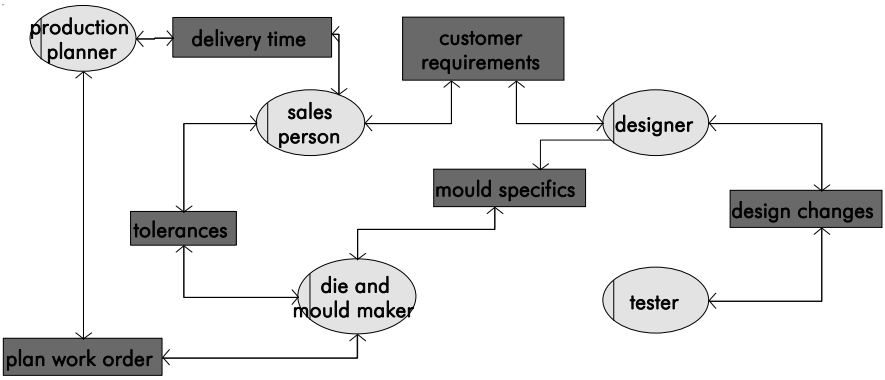

FIGURE B-33. Example for a communication diagram in ARIS

ARIS knowledge map. Knowledge maps in ARIS show which employees or organizational units hold what knowledge categories to what extent (see Figure B-34).

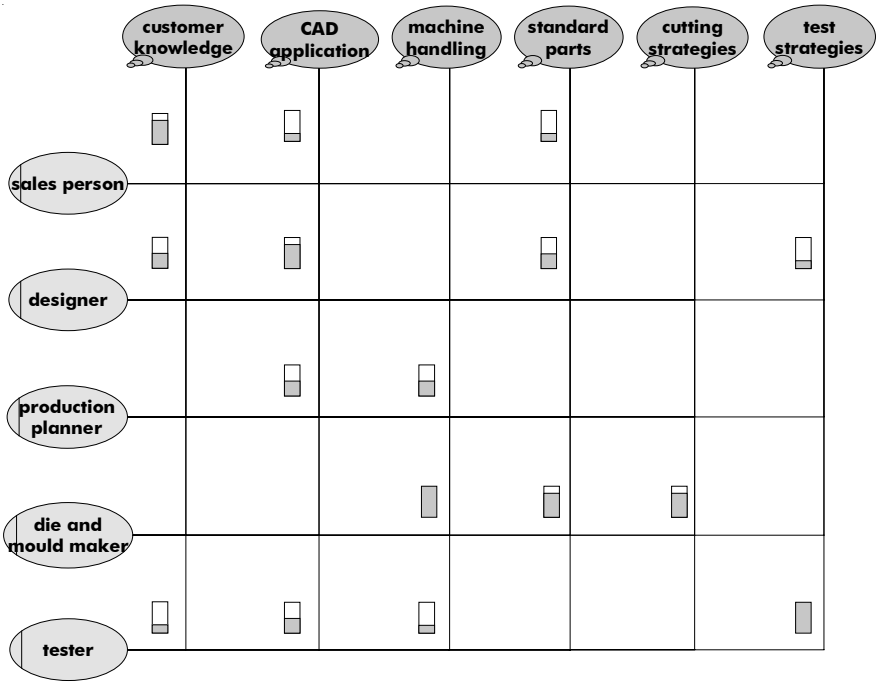

FIGURE B-34. Example for knowledge map in ARIS

ARIS knowledge maps therefore are a form of user/role modeling (see section 6.6.4). They take the form of a matrix that consists of the object types *person* and

knowledge category. The relationships between persons and the knowledge categories they hold are visualized by bars that show to what extent a person holds a certain knowledge category. Compared to communication diagrams, knowledge maps represent a finer level of analysis. Whereas ARIS communication diagrams are restricted to the level of organizational units and thus naturally a high level of aggregation, knowledge maps show the relationships between individual persons and knowledge categories.

6.6.2 Activity modeling

Knowledge always undergoes construction and transformation when it is used. The acquisition of knowledge in modern learning theories is not a simple matter of taking in knowledge, but a complex cultural or social phenomenon. Thus, some authors suggest not to model knowledge as an object with its connotations of abstraction, progress, permanency and mentalism, but of the processes of knowing and doing which take place in a *(socially-distributed) activity system*[412].

Figure B-35 shows the elements of a socially-distributed activity system[413]. These systems provide a new unit for the analysis of the dynamic relationships among individuals (called agents or actors), their communities and the conception(s) they have of their activities (the inner triangle in Figure B-35). These relationships are mediated by instruments and concepts (e.g., language, technologies) used by the agents, implicit or explicit social rules that link them to their communities and the role system and division of labor adopted by their community (the outer triangle in Figure B-35, Blackler 1995, 1036ff).

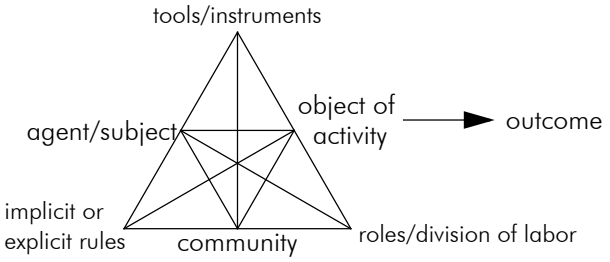

FIGURE B-35. Model of the socially-distributed activity system[414]

Table B-12 describes each of the elements used in the activity theory and gives some examples that help to understand the concepts.

Activities have a hierarchical structure (see Figure B-36): They are driven by common motives which reflect collective needs (Engeström 1999). They are accomplished by actions directed to goals coupled to the motives. There is a many-

412. Blackler 1995, Spender 1996a.
413. For a recent overview of activity theory e.g., Chaiklin et al. 1999.
414. The figure is based on Engeström 1987, Engeström 1993, 68, Blackler 1995, 1037, Engeström et al. 1999.

to-many relationship between activities and actions: an action could belong to multiple activities and the object of an activity could be reached by multiple alternative actions (Engeström 1999). Actions in turn consist of orientation and execution phase. The first comprises planning for action, the latter execution of the action by a chain of operations (Kuutti 1997). The better the model upon which planning is based fits the conditions, the more successful the action will be. Actions can collapse into operations, if the model is sufficiently accurate, so that no planning is necessary. Operations are executed under certain conditions and are the most structured part that is easiest to automate.

TABLE B-12. Elements of the activity theory[a]

element	description	example
object of activity	purpose and motives that define the reason why the activity exists and/or why the subjects participate in the activity	to learn how to write a scientific paper
agent/ subject	person(s) that perform(s) or participate(s) in an activity	Ph.D. student
outcome	intended and unintended results of the transformation process(es) performed in the activity	contributions to workshops and conferences, conference presentations, journal papers, contacts with colleagues
community	the collective of persons that are involved in the transformation process(es)	Ph.D. students, faculty, community of researchers in the discipline or area of research
tool/ instrument	material and immaterial instruments that are used in the activity	ISWORLD Web site, text processor, endnote tool, information systems, language, artifacts
role/division of labor	explicit and implicit organization of the relationships in the community	author, co-author, peer reviewer, referee, program committee, editor, publisher
rule	formal and informal norms, laws, regulations and principles that govern conduct, action and procedure in the activity and are imposed on the subject by the community	citation rules, conference/journal ranking, submission procedure, publication policy, ethics concerning plagiarism or double submissions

a. see also Engeström 1987, 1993, Engeström et al. 1999, Hasan/Gould 2003, 110.

An important feature of activity theory is the dynamic relationship between the three levels. Operations can again unfold into actions, e.g., if conditions change, as well as actions can become activities. Elements of higher levels collapse to constructs of lower levels if learning takes place. They unfold to higher levels if changes occur and learning is necessary.

Activity theory and process modeling have concepts in common, e.g., persons, resources, goals, but target different types of work practices. In the following, activity modeling and business process modeling are contrasted.

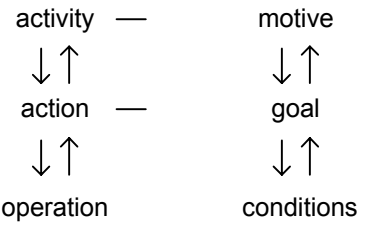

FIGURE B-36. Hierarchical structure of an activity[415]

Process modeling describes routine work solving structured problems that primarily aim at the exploration or application of knowledge. However, knowledge work does not fall into this category. Consequently, an alternative concept is needed to describe knowledge work. Still, processes describe the details of an organizational value chain that provides the main concept to ensure that activities in the organization are targeted towards creating customer value.

The concepts provided by activity theory are well suited to analyze the creative, unstructured and learning-oriented practices of knowledge work. However, although activity theory comprises motives and objects, they lack integration with the value chain, i.e., transformation processes in business settings. It is not ensured that activities are oriented towards creating customer value. Also, activity theory does not study the contributions of actions to the creation of customer value. Therefore, concepts of process orientation and of activity theory have to be combined in order to get a more comprehensive picture of knowledge work in a business context.

Nonaka's concept of the hypertext organization[416] can be used to describe this picture. It consists of the three layers (1) business system layer, (2) project system layer and (3) knowledge base layer and describes how employees can switch between different (hyper-)linked settings of an organization depending on their actual work practices. The business system layer might be described by concepts of process orientation and the knowledge base layer might be described by concepts of the activity theory. The project system layer connects these two layers. Projects can either target structured or unstructured problems and thus be studied by process models or activity models. It remains unclear how the relationship between these two layers can be modeled. In a first step, Figure B-37 maps business processes and activities on three levels and contrasts refinement in business process modeling and routinization in activity modeling.

---

415. Source: Kuutti 1997.
416. See section "Hypertext organization." on page 159; see also Nonaka 1994, 32ff.

Business processes aim at improving work processes that can be characterized as routine, well structured or at least semi-structured processes that solve structured problems. Strategically, business processes primarily are the operational counterpart to exploitation as strategic focus for a certain competence and thus aim at the application of knowledge. Hierarchization in process modeling can be characterized as a refinement relationship consisting of the following three levels:

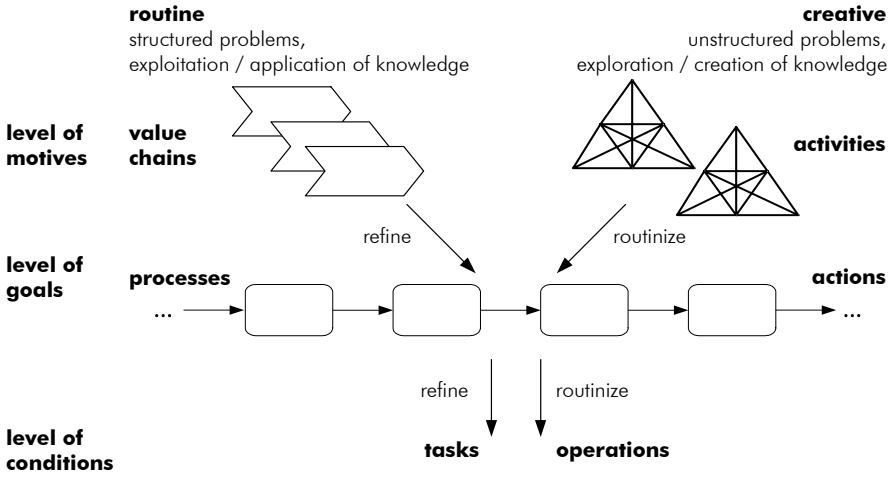

FIGURE B-37. Process modeling and activity modeling compared

- *value chains*: value chains are modeled by core and service processes relevant for an organization that can be visualized in a process landscape,
- *processes*: each of the processes in a process landscape can be detailed or disaggregated as a business process that consists of a sequence of events and functions, i.e. event-driven process chains[417],
- *tasks*: each function can be modeled in detail as a number of tasks that have to be fulfilled in order to accomplish a function's goals.

Activities model the organizational context of creative, often less foreseeable and ill-structured "processes" that focus unstructured problems. Strategically, activities in the sense of the activity theory primarily operationalize exploration as strategic focus. They aim at the joint creation of knowledge that is then applied in business processes. Hierarchization in activity modeling does not mean aggregation and disaggregation as in the case of business processes, but routinization of activities, and consists of the following three levels:

- *activities*: the term denotes the set of activities in an organization that is defined with respect to the strategic core competencies that have been identified in a process of strategy development[418],

417. See section 6.6.1 - "Process modeling" on page 240.

- *actions*: what has been learned by a person or a group of persons can then be used as a (routinized) skill or competence in a (series of) actions within a business process,
- *operations*: further routinization of actions yields operations, i.e. a detailed description of how to fulfill a task that is subject to automation or at least heavy support of ICT.

The three levels contrasted here can be characterized as level of *motives*, level of *goals* and level of *conditions*. Motives specified in a business strategy lead to the definition of a process landscape and of activities. Processes and actions both are performed in order to achieve certain goals that are determined considering the motives during process design and analysis of activities. On the finest level finally, conditions trigger tasks and operations. Value chain orientation and activity orientation could be integrated on the level of goals. On this level, actions could be connected to event-driven process chains. Concepts of process modeling and of activity theory provide two different perspectives on work practices in business organizations. The process-oriented perspective focuses implementation, exploitation, and accumulation of knowledge in the context of business processes. Some knowledge-related tasks may be described by knowledge processes and knowledge flows, i.e. by extended process modeling techniques. The activity-oriented perspective focuses creative, dynamic, and communication-intensive tasks, unstructured problems, membership in communities, self-organizing teams and demand for learning. A concept is needed that connects these two perspectives which is termed knowledge stance (see Box B-7, Hädrich/Maier 2004).

A knowledge stance is a class of recurring situations in knowledge-intensive business processes defined by occasion and context, in which a person can, should or must switch from a business-oriented function to a knowledge-oriented action.

BOX B-7. **Definition of knowledge stance**

Both perspectives and the concept of knowledge stance are shown in Figure B-38. In a process-oriented perspective, an employee accomplishes functions on the level of goals that belong to business processes by fulfilling a sequence of tasks on the level of conditions. Simultaneously, she can be involved in one or more activities framing knowledge-oriented actions necessary to complete the functions.

An activity can be focused on the business process or a more general activity pursuing a motive not related to the business process, e.g., an effort to build competencies related to other topics or business processes. In contrast to the clearly

418. See also the framework for the definition of a process-oriented KM strategy presented in section 5.1.3 - “Process-oriented KM strategy” on page 108. Core competencies and strategic knowledge assets guide the design of activities which are routinized in actions as part of knowledge processes and knowledge-intensive business processes.

defined sequence of events and functions, there is no predetermined flow of actions. Activities, corresponding actions and operations can (a) be focused on the business process or (b) pursue a motive not related to the business process, e.g., an effort to build competencies, and thus may make a direct or a more indirect contribution to the process goal.

A business process offers several occasions to learn, to create or integrate knowledge related to core competencies of the organization. Occasions trigger knowledge stances and are associated with the functions of which the business process is composed. Occasions offer the opportunity or create the need for knowledge-related actions. A knowledge stance is not limited to creation of knowledge, but may also include translation and application of knowledge created outside the knowledge stance which in turn offers the possibility to create knowledge. Examples for occasions are treatment of exceptions, reflection in order to build knowledge with respect to core competencies of the organization.

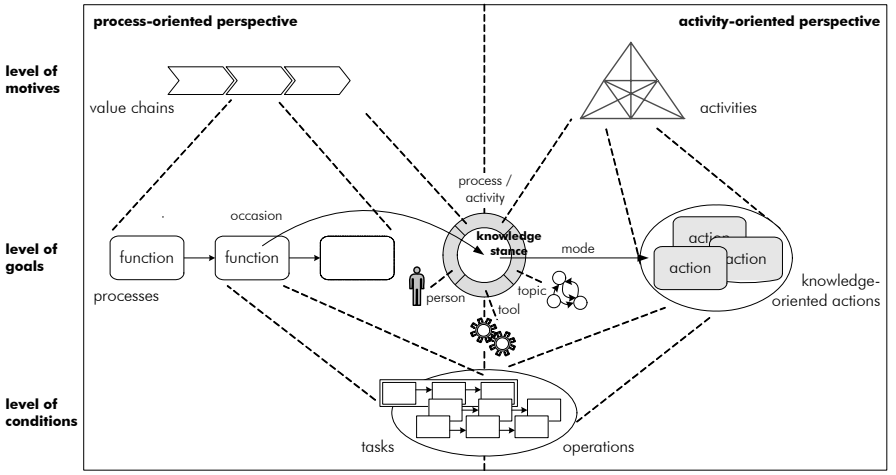

FIGURE B-38. Concept of knowledge stance

Context. This concept comprises all relevant dimensions suitable to describe the actual situation of the worker. Context is classified in process- and activity-oriented perspective on two levels of granularity, i.e. individual function/action or entire process/activity, as well as in type and instance level (based on Goesmann 2002). Instance level means in this case that context is restricted to the work order or action actually processed. Context on the type level refers to all work orders or actions of the same type.

Examples for relevant dimensions are elements of the related activity and the process, e.g., artifacts like software tools, diagrams, knowledge maps, other subjects involved, desired outcomes, relevant roles, rules, e.g., user rights, members of the community important for the user, e.g., with whom she communicates regularly, as well as other process steps connected by knowledge flows. The two

dimensions location and time should also be included as they are important parts of the context.

In order to support knowledge stances with ICT, context should be derived automatically as far as possible by the KMS or the workspace in use on the basis of usage history or information about the participant. The currently best way to represent context and relations between context elements seems to be with the help of an ontology[419].

Mode. Mode classifies actions, or knowledge routines, that can be performed and refers to four informing practices (see Schultze 2000, 2003): (a) ex-pressing is the practice of self-reflexive conversion of individual knowledge and subjective insights into informational objects that are independent of the person, (b) monitoring describes continuous non-focused scanning of the environment and gathering of useful just in case-information, (c) translating involves creation of information by ferrying it across different contexts until a coherent meaning emerges, and (d) networking is the practice of building and maintaining relationships with people inside and outside the organization.

Actions. Context, mode and occasion are means to specify the set of available, allowed, recommended or required partly routinized activities which can be supported by arrangements of knowledge management services[420]. A straightforward approach to support knowledge actions is to automate corresponding operations that accomplish the action. They are highly dependent on the stance and thus must obtain information from context variables as well as mode and occasion of the knowledge stance. This could be accomplished e.g., by offering workflows to automate actions or to guide the user by wizards known from office applications. Examples are actions to integrate, validate, distribute or annotate knowledge elements.

From the perspective of designing KMS, those knowledge stances are of primary interest that can be supported by ICT. Depending on occasion, context and mode, it can be decided which parts of the KMS, i.e. contents and services, are suited to support the selected knowledge-oriented action. With respect to the characteristics of KMS[421], knowledge stances represent situations in which an arrangement or a bundle of knowledge management services can be suggested to complete knowledge-oriented actions. In some cases, flexible knowledge processes can be offered. Due to activities framing the social system in which knowledge is handled, the specifics of knowledge are considered when designing a comprehensive platform for supporting occasions to explore or exploit knowledge in business processes. Knowledge stances also provide a concept to connect KM instruments to business processes. For example, in a certain knowledge stance, a KMS could sug-

419. See sections 6.6.3 - “Knowledge modeling” on page 257 and 7.7 - “Semantic integration” on page 374.
420. See also section 7.3.1 - “Knowledge management service” on page 302.
421. See section 4.3.2 - “Definition” on page 86.

gest to document a personal experience or to start a lessons learned process depending on the activity context and the activities other members of the community are currently engaged in.

Context should be derived with as little user effort as possible. Currently opened documents on the desktop, emails in the mailbox or the history of the Web browser could be used to determine parts of context information. This could be enriched by data about the current function in the business process the user performs and data about actions that other users took in similar situations. Furthermore, awareness services could monitor current activities of other employees relevant in the knowledge stance and thus be helpful in analyzing which cooperation partners are currently available or even engaged in similar business-oriented functions or knowledge-oriented actions respectively. Context elements and their relation can be represented by a standardized or shared ontology. Thus, inference techniques can be applied and context can be communicated to and translated for other applications.

6.6.3 Knowledge modeling

Knowledge modeling aims at a formal description of (documented) organizational knowledge that can be processed by computers and at a visualization of the topics that are of interest in a KM initiative and/or that are supported by the contents of a KMS and their relationships. There are relationships (1) between topics and persons, knowledge maps (see section 6.6.4), (2) between topics and ICT systems, especially which documents and other resources contain information on a certain topic and how they are related to each other as well as (3) relationships between topics themselves. The extensions of process modeling methods to capture knowledge structures have already shown the importance of explicitly modeling topics and structures in an organization's knowledge base.

Knowledge modeling techniques and methods differ with respect to the degree of formality that they focus. On the one hand, methods and techniques from the field of artificial intelligence and knowledge-based systems are highly formal and represent knowledge in the form of rules, frames, semantic nets, with the help of a variety of logic languages (e.g., Prolog)[422]. In the field of KM, particularly knowledge representation with the help of ontologies or domain models that can be processed by computers has gained widespread attention and use in practical example cases. On the other hand, knowledge mapping techniques often primarily serve as a tool for human beings to better understand the (highly aggregated) structure of important areas of knowledge or competence and their relationships to, e.g., the persons, groups or other organizational units that create, hold, seek, distribute or apply the knowledge[423].

Explicit modeling of computer-understandable knowledge that is similar to knowledge-based systems has been an important stream within knowledge man-

422. See textbooks on knowledge-based systems or logic, with an emphasis on knowledge management e.g., Karagiannis/Telesko 2001, 53ff).
423. See e.g., Eppler 2003a.

agement. Several groups of authors have recently extended methods, techniques and tools that were originally developed to model knowledge used in knowledge-based systems to cover aspects of KM. Examples are the CommonKADS method (Schreiber et al. 1999) or the many applications of ontologies in KM that have been shown by the Institute AIFB of the University of Karlsruhe and the company Ontoprise that develops the ontology modeling and brokering tools OntoStudio and OntoBroker[424].

The two terms *ontology* and *taxonomy* are used widely for the results of modeling efforts. Depending on the semantic richness of the constructs that can be used to formalize topics, knowledge objects and their relationships, some authors distinguish between (simpler) taxonomies and (more powerful) ontologies. In the following, these two terms and their usage in KM(S) are briefly reviewed.

Taxonomy. The term taxonomy denotes the classification of information entities in the form of a hierarchy, according to the presumed relationships of the real-world entities that they represent (Daconta et al. 2003, 146). A taxonomy can contain definitions and explanations, synonyms, homonyms and antonyms, as in a thesaurus. A taxonomy is often modeled as a hierarchy of terms and can be used as the semantic basis for searching and visualizing a domain, e.g., a collection of documents. Figure B-39 gives an example of a well-known taxonomy developed in the discipline of biology. There is only one type of hierarchical relationship between concepts in a taxonomy, in this case the *belongs_to* or *subset_of*-relationship.

Kingdom: Animalia
Phylum: Chordata
Subphylum: Vertebrata
Class: Mammalia
Subclass: Theria
Infraclass: Eutheria
Order: Primates
Suborder: Anthropoidae
Superfamily: Hominoidae
Family: Hominidae
Genus: Homo
Species: Homo Sapiens

FIGURE B-39. Example taxonomy[425]

Ontology. "An ontology is a (1) formal, (2) explicit specification of a (3) shared (4) conceptualization" (Gruber 1993, 199). More specifically, an ontology "defines the basic terms and relations comprising the vocabulary of a topic area as well as the rules for combining terms and relations to define extensions to the vocabulary"[426]. (1) An ontology has to be formal which requires that the ontology is

424. See URL: http://www.ontoprise.de/, Staab et al. 2001, Staab 2002.
425. Daconta et al. 2003, 148.

machine-readable. However, there are different degrees of formality of ontologies, from a thesaurus like WordNet to ontologies capturing formal theories for common-sense knowledge like Cyc. (2) Explicit specification means that the concepts and relationships as well as constraints on the use of concepts are defined openly and not left to the interpretation of the ontology's users. (3) Shared refers to the requirement that the conceptualizations made in an ontology have to be agreed upon by a group of people that intend to use the ontology for knowledge exchange. (4) Finally, conceptualization is an abstract model, a representation of a domain or phenomenon which investigates the concepts of that domain or phenomenon that are relevant to the ontology's users.

Ontologies generally can be used for (1) communication between computational systems, between humans and between humans and computational systems, (2) computational inference, for internally representing and manipulating plans and planning information and for analyzing the internal structures, algorithms, inputs and outputs of implemented systems in theoretical and conceptual terms, (3) reuse (and organization) of knowledge, for structuring or organizing libraries or repositories of plans and planning and domain information (Gruninger/Lee 2002, 40).

Typical uses of ontologies in KM fall into the first category. Ontologies here are formal models providing a shared and/or common understanding of an application domain communicable between people and application systems that help to define, retain, exchange and share knowledge with the help of ICT systems and thus facilitate representation, storage, communication and search of knowledge (O'Leary 1998, 58, Davies et al. 2003a, 4f). Ontologies are therefore developed to provide machine-processable semantics of data and knowledge sources that are accepted by a group of users and facilitate semantic integration, knowledge sharing and reuse[427]. Ontologies are not static, but evolve over time. An ontology not only defines basic terms and relations comprising the vocabulary of a topic area, but also comprises rules for combining terms and relations to define extensions to the vocabulary. Ontologies model (1) objects in domains, (2) relationships among those objects, (3) properties, functions and processes involving the objects and (4) constraints on and rules about objects (Daconta et al. 2003, 190). Thus, ontologies support clear-cut, concise, semantically rich and unambiguous communication between persons aided by KMS and/or between different KMS.

Compared to the term taxonomy, the term ontology is usually used not only to describe definitions of terms, basic properties and relationships between terms, e.g., *is_a*-relationship, but also to support an extended set and a variety of types of relationships, e.g., symmetric, transitive or inverse relationships, and rules that allow for reasoning about concepts and instances defined in the ontologies. Figure B-40 illustrates a portion of an ontology with definitions of concepts, relations and instances as part of an ontology assigned to the URI "http://onto.org". In the example, employees are defined as persons including the transitive relationship

426. Neches et al. 1991, 40, cited from Zelewski 2002, 6.
427. See section 7.7 - "Semantic integration" on page 374.

of the reporting hierarchy. Themes are defined as related to each other in a symmetric relationship and treated on events and in publications, defined in the inverse relationship `deals_with` and `is_about`. The concepts are illustrated with the help of several instances. `Book` as sub-concept of `Publication` "inherits" the relation `is_dealt_with` and thus can also be assigned to `Theme`.

The concept of rule is used e.g., to check not only syntactic, but also semantic validity of a statement or that is used to derive new properties of terms and relationships between terms from existing ones. Semantic rules, e.g., in the form of inference rules, describe how knowledge can be gained from existing statements (Zelewski 2002, 7).

```
  << Concepts >>
#Person@"http://onto.org".
#Employee::#Person.
#Theme@"http://onto.org".
#Event@"http://onto.org".
#Publication@"http://onto.org".
#Book::#Publication.
  << Relations >>
#Employee[#reports_to=>>#Employee@"http://onto.org".
#Theme[#has_expert=>>#Person@"http://onto.org".
#Theme[#has_related_theme=>>#Theme@"http://onto.org".
#Theme[#is_dealt_with=>>#Event@"http://onto.org".
#Theme[#is_dealt_with=>>#Publication@"http://onto.org".
#Event[#is_about=>>#Theme@"http://onto.org".
#Publication[#is_about=>>#Theme@"http://onto.org".
relation_property_(#Theme, #has_related_theme, symmetric)@
     "http://onto.org".
relation_property_(#Employee, #reports_to, transitive)@
     "http://onto.org".
inverse_relations_(#Theme, #is_dealt_with,#Event,
     #is_about)@"http://onto.org".
  << Instances >>
#"Alice Aberdeen":Employee@"http://onto.org".
#"Knowledge Management":Theme@"http://onto.org".
#"Knowledge Management Systems":Book@"http://onto.org".
#"IKNOW":Event@"http://onto.org".
#"Knowledge Management"[#is_dealt_with->>#"IKNOW"]@
     "http://onto.org".
#"Knowledge_Management"[#is_dealt_with->>#"Knowledge
     Management Systems"]@"http://onto.org".
```

FIGURE B-40. Example definitions of concepts, instances and relations

An example is: if two companies operate in the same industry and the same geographic region, then they are competitors (Figure B-41). The definition of the term

ontology is broad enough to cover different types of ontologies that play a number of roles in developing KMS (Fensel 2004, 5f):

- *domain* ontologies capture knowledge of a particular type of domain and are thus restricted to the context of this domain,
- *meta-data* ontologies provide a vocabulary used to describe contents in an EKI, e.g., the Dublin Core meta-data standard,
- *common-sense* ontologies capture basic notions and concepts for e.g., time, space, state, event and relationship that are valid across several domains,
- *representational* ontologies comprise definitions of ways to represent knowledge and are not restricted to particular domains, e.g., frame ontology defining concepts such as frame, slot, slot constraint that can be used to explicate knowledge in frames,
- *method and task* ontologies provide concepts specific to particular problem-solving methods, e.g., the concept correct state in a propose-and-revise method ontology, or concepts specific for particular tasks, e.g., the concept hypothesis in a diagnosis task ontology.

```
FORALL company1, region1, sector1, company2
  company1[#is_competitor->>company2]@"http://onto.org" <-
  company1[#operates_in->>region1]@"http://onto.org" AND
  company1[#operates_in->>sector1]@"http://onto.org" AND
  company2[#operates_in->>region1]@"http://onto.org" AND
  company2[#operates_in->>sector1]@"http://onto.org".
```

FIGURE B-41. Example rule

Ontologies can be formalized with the help of a number of languages, e.g., F-Logic as depicted in Figure B-41, that are in turn supported by tools, e.g., Ontobroker[428]. However, the term ontology is sometimes used to describe conceptualizations on a spectrum that extends from weak to strong semantics starting from *taxonomy*, via *thesaurus* and *conceptual model* to *logical theories* that describe semantically rich, complex, consistent and meaningful knowledge (Daconta et al. 2003, 156ff).

Most organizations that are about to implement or have implemented a KMS have also created at least a minimal taxonomy or ontology (O'Leary 1998, 58). However, development and continuous maintenance of an ontology requires a substantial amount of effort. Also, ontologies developed individually in organizations are likely to be incompatible and thus cannot be used to share knowledge across organizational boundaries. Consequently, there is a need for standardization, both in the language used to develop an ontology and also with respect to the content of ontologies.

428. URL: http://www.ontoprise.de/.

An example for a standardization effort aimed at the description of documents with the help of meta-data is the Dublin Core structure[429]. Other examples for semantically richer standardization efforts are discussed in the field of the Semantic Web such as RDF, RDF Schema, DAML+OIL and OWL[430]. There has been put a lot of effort into semantic integration, namely meta-data standards and the standardization of languages that can be used to describe semi-structured data, such as documents, and their handling with the XML standards family which will be described in section 7.7 - "Semantic integration" on page 374.

6.6.4 Person modeling

Person modeling captures that portion of the context of KM initiatives that refers to people. The explicit or implicit modeling of user profiles has had a long tradition in human-computer interaction. User models are required for ICT systems to better adapt to the needs of human beings (e.g., Mertens/Griese 2002, 27ff). In KM, the adaptation of ICT systems to the needs of knowledge workers plays an important role that has been termed personalization. Figure B-42 shows the process of profiling and the subsequent application of the collected and analyzed profiles to personalize KMS. The grey arrows visualize the data flow between knowledge workers, the steps and the data base holding the user profiles. The black arrows visualize the process of the steps.

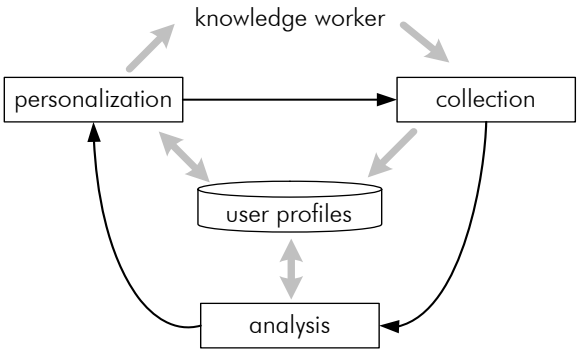

FIGURE B-42. The process of profiling and personalization[431]

The *collection* of information can be:

- explicit with the help of a number of questions that the user answers,

429. URL: http://www.dublincore.org/; see also section 7.7.2 - "Meta-data management" on page 379.
430. RDF stands for Resource Description Framework, DAML stands for DARPA (Defense Advanced Research Program) Agent Markup Language, OIL stands for Ontology Inference Layer; OWL stands for the Web Ontology Language; see section 7.7.1 - "Semantic Web" on page 375.
431. The figure is based on Frielitz et al. 2002, 545.

- implicit by observing user behavior, e.g., user tracking or click stream analysis,
- based on a combination of data collected from other systems, e.g., enterprise resource planning systems or human resource management systems.

Analysis of the collected information requires:

- data mining, e.g., the selection, cleansing, transformation and analysis of relational data, e.g., skill or interest profiles, in analogy to data warehouses and customer relationship management systems,
- text mining, e.g., the analysis of submitted documents or of contributions in newsgroups,
- Web content, structure and usage mining, e.g., the analysis of log files of an Intranet platform or a knowledge management system.

Finally, *personalization* can be:

- user-initiated by explicit user statements,
- KM-initiated, e.g., by predefined "if-then" rules, e.g., data, role, event or time-driven triggers,
- automated content-based filtering, e.g., by comparing user profiles with the contents of the knowledge base,
- automated collaborative filtering, e.g., "communities of preference", active recommendations by other users, automated or hidden recommendations.

Moreover, person modeling in KM covers the following three aspects:

- *formal organization*: person modeling considers the formal organizational structure with e.g., roles, positions, work groups and organizational units.
- *informal organization*: on the other hand, knowledge management is particularly interested in the informal relationships between members of the organization, their communication, social networks as well as communities of practice or communities of interest.
- *skill management*: a third part of person modeling assigns actual employees, not roles or positions, to the skills they hold.

Formal organization and communication modeling in connection with process modeling have already been described in the course of process modeling[432]. In the following, methods and techniques of knowledge mapping and of social network analysis are discussed with respect to their contribution to skill management and the analysis of the informal organization.

Knowledge maps. Eppler (1997, 2003a) distinguishes several types of knowledge maps depending on what kind of elements are mapped to the knowledge domain or topic. He explicitly mentions three groups of elements:

- experts, project teams, or communities,
- white papers or articles, patents, lessons learned, or meeting protocols,

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432. See the organization view and the communication diagram of the ARIS meta-model in section 6.6.1 - "Process modeling" on page 240.

- data bases or similar applications, such as expert systems or simulations.

This leads to the following types of knowledge maps (Eppler 2003a, 192f):

- *knowledge source maps* help to visualize the location of knowledge, either people (sometimes also called knowledge carrier maps) or information systems and their relation to knowledge domains or topics. They can be further classified into knowledge topographies to identify gaps, competence maps to find experts and pointer systems that directly link from challenges within a process to a contact that can assist. Knowledge source maps are used if not only people with knowledge in the desired domain are listed, but also all forms of codified knowledge (see above) that are relevant,
- *knowledge asset maps* is a further enhancement of the knowledge source map as it visualizes not only that there is knowledge in a document or person, but also the amount and complexity,
- *knowledge structure maps* show the relationship between different knowledge domains or topics and should not only visualize that there is a relationship, but also explain the type of relationship (belongs to, how it is related, etc.),
- *knowledge application maps* are a combination of process models and knowledge carrier maps as they describe who should be contacted for help at what step in the process,
- *knowledge development maps* visualize the learning paths that are required to acquire a certain skill as an individual or a certain competence as a team or other organizational unit.

The procedure to create knowledge maps is a five step process that can briefly be described as follows (Eppler 2003a, 202):

- identify knowledge-intensive processes or issues,
- deduce relevant knowledge sources, assets or elements,
- codify these elements, build categories of expertise,
- integrate codified reference information on expertise or documents in a navigation and/or search system that is connected to the work environment of the target group,
- provide means of updating the knowledge map, especially enabling decentralized update mechanisms so that every employee can (re-)position himself continuously within a knowledge map.

There is no standard that describes how knowledge maps should be visualized. Thus, the development of knowledge maps provides a great deal of freedom for both the determination of what elements and relationships should be part of the models and how they should be visualized.

Figure B-43, Figure B-44 and Figure B-45 give examples of knowledge maps and show the variety of approaches to their design (further examples can be found e.g., in Eppler 2003a).

Figure B-43 maps central areas of competence in an IT consulting organization and employees according to their expertise. The bars indicate whether an employee

holds basic knowledge, expert knowledge or is a leader in the corresponding area of competence. The map shows the importance of Mr. Tinner and Mr. Ehrler for the organization because they seem to be competent in (almost) all relevant areas of competence.

Consultants	IT	Strategy	M&A	Accounting	Marketing
Tinner, Jeff					
Borer, André					
Brenner, Carl					
Deller, Max					
Ehrler, Andi					
Gross, Peter					
…					

expert knowledge basic knowledge leadership

FIGURE B-43. Example for a knowledge asset map[433]

Figure B-44 shows a portion of the knowledge source map of a multimedia company that develops Web sites, CD ROMs and stand-alone multimedia terminals.

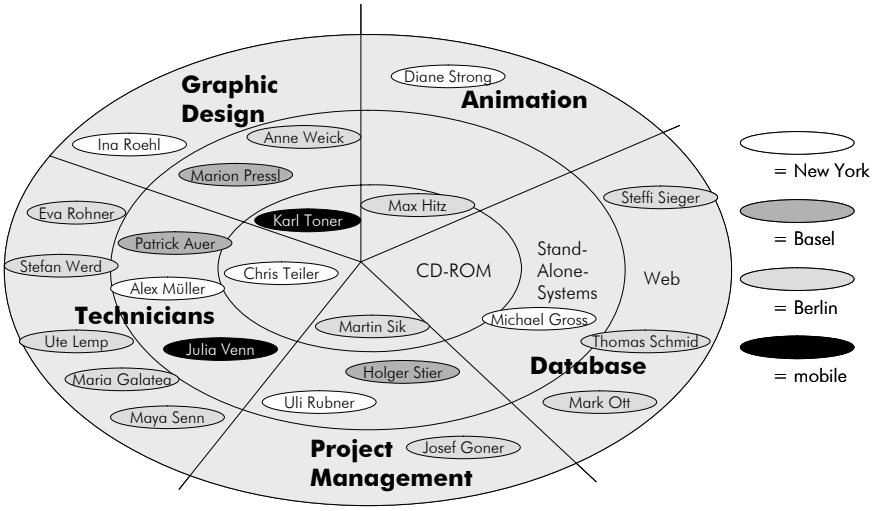

FIGURE B-44. Example for a knowledge source map[434]

433. Source: Eppler 2003a, 196

The map supports staffing of multimedia projects. The map visualizes what experts are available for the company's five areas of competence animation, data base, graphic design, project management and technology know-how and the three product lines Web systems, stand-alone systems, CD-ROMs, at the company's three main locations Basel, Berlin and New York. Additionally, two employees are not located in a single office, but float between the three locations.

Figure B-45 shows a portion of the main knowledge structure used by the author's work group as the central access structure to a knowledge workspace implemented in the knowledge management system Open Text Livelink[435].

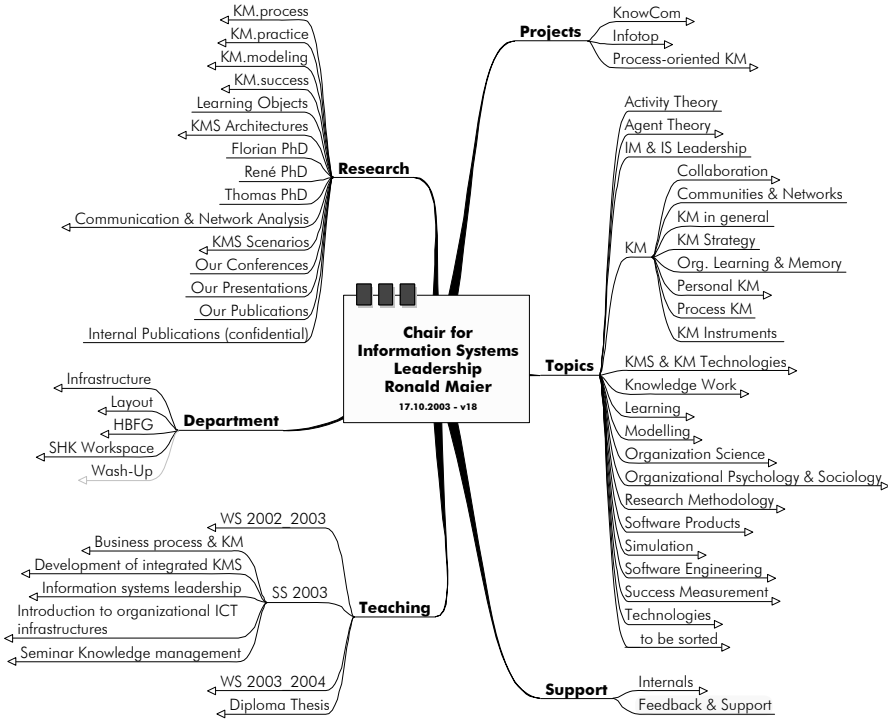

FIGURE B-45. Knowledge map of the structure of a knowledge workspace

The first level of the knowledge structure consists of the terms department, projects, research, support, teaching and topics. Thus, it reflects the two core processes of a university department, research and teaching. In the research branch, there are a number of workspaces to support specific research streams that the work group is engaged in. This includes the Ph.D. workspaces of the research assistants. Teaching contains workspaces for each individual course or seminar.

434. Source: Eppler 2003a, 195
435. See also section 7.4.9 - "Example: Open Text Livelink" on page 336.

Students have access to a portion of the material in the workspaces of the courses that they are enrolled in. Moreover, they can contribute to the workspaces and share knowledge with their colleagues. Projects represent units of funded thematic research. and of cooperations with other institutions. Topics are the primary structure to organize e.g., electronic research articles, news, contributions to newsgroups or empirical data that has been collected by the members of the work group. Department reflects internal projects and collaboration workspaces for the work group's teaching assistants. Support is a category in which the work with the KMS is supported and reflected. Arrowheads at the end of the branches represent collapsed hierarchies that are not visualized in the map.

The map can be automatically generated by a script that exports Livelink's structure, imports it into MindManager[436] and serves as an alternate way to access the knowledge elements stored in Livelink. Each branch in the map contains a hyperlink that directly links to the corresponding object in Livelink.

Knowledge structure maps differ widely between organizations. The maps usually represent the primary instrument to structure the organization's knowledge objects and thus are an important navigation aids.

Analysis of social networks. As stated before, knowledge management is concerned with both types of knowledge: knowledge as an object or product and knowledge as a process. The latter on the one hand concentrates on the flows of knowledge between individuals and on the other hand on processes of jointly creating and retrieving knowledge in a collective of individuals which is conceptualized for example by the transactive memory system approach (Wegner 1986).

How can these processes be described? What kinds of relationships between individuals are needed in order to encourage these knowledge processes or make them possible? How can hidden social structures in organizations be detected which could be supported by organizational measures and instruments (e.g., the selection of members for projects and work groups, the adaptation of roles, the building of communities, the organization of meetings to name a few)? In the following, the main forms and application areas of network analysis are reviewed in order to judge the possible contributions of this instrument to answer these questions (for a detailed analysis see Pappi 1987a).

Network analysis as applied in social sciences is based on two research traditions: sociometrics (e.g., Moreno 1967, cf. Pappi 1987a, 11) and social anthropology (e.g., Mitchell 1969, cf. Pappi 1987a, 11). It can be used in general to study both, micro and macro structures of social networks and to analyze relationships e.g., between individuals, positions, groups, communities or organizations. A social network is defined as a set of social entities (such as individuals, groups, organizations) which are connected by a set of relationships of a certain type.

Sociologists distinguish between *partial networks* – in which only relationships of a certain type are considered, and *total networks* – all kinds of relationships are

436. http://www.mindjet.de

considered. They also differentiate *wholesome networks* in which a multitude of social entities and their relationships are considered and so-called *ego-centric networks* in which one social entity with its relationships to other entities is focused.

The combination of wholesome and partial network analysis seems to be the most promising area to be applied in the field of KM. This is due to the idea that (a) only those relationships have to be considered which support knowledge processes (therefore partial network) and (b) the unit of analysis (= the social entities) could either be (a group of) individuals, groups, communities or other organizational units, such as departments. In either case, it is the "general picture" of the relationships between these entities that is of interest to KM, not only those of one single entity (therefore wholesome network). Network analysis can be used to study the following three perspectives of phenomena of grouping (Pappi 1987a, 15):

Structured order. This perspective is used to interpret the individual behavior as an action appropriate for the position the individual holds. In KM, this perspective stands for the formal structural organization (e.g., hierarchy, positions, ranks).

Categorical order. This perspective is used to interpret the intended behavior as a social stereotype of class, race, ethnic group etc. Also, this perspective could be used to study the effects of different "business-specific stereotypes", such as roles (e.g., technical experts and salespeople, novices and experts) in KM.

Personal order. This perspective is used to interpret the individual behavior as depending on personal relationships to other individuals and, moreover, on the "transitive" relationships which these "other individuals" have in turn. This can directly be applied to knowledge management.

Formally, social networks are represented by graphs. The knots represent the social entities and the edges represent the relationships. Formal characteristics of relationships are:

- *reflexivity:* determines whether or not a social entity chose itself ("self choice"),
- *symmetry:* determines whether a relationship is reciprocal (ego chooses alter and alter chooses ego),
- *transitivity:* determines whether a relationship from a to b and one from b to c imply a relationship from a to c,
- *valued graphs:* are graphs the relationships of which carry values such as intensity, number and duration of relationships.

With respect to the content, the following types of relationships have been investigated so far (Knoke/Kuklinski 1982, cf. Pappi 1987a, 16): transactions in which goods or services are exchanged; communication; boundary penetrating relations, e.g., between organizations; instrumental relationships: development of contacts to achieve goals; emotional relationships (e.g., the so-called socio-metric choice); authority or power relationships; family relationships.

Pappi suggests the following classification of relationships (Pappi 1987a, 17f):

1. **Potential for interactions:**
   - *objective*: opportunities for interaction, e.g., membership in groups, communities, supervisory boards; dependencies: if one social entity is interested in something another social entity controls; measurable in number of opportunities, intensity of dependencies,
   - *subjective*: socio-metric choices, normative expectations; measurable in intensity of choice,
2. **Actual interactions:** (measurable in number)
   - communication; measurable in number,
   - transaction: exchange of goods and services,
   - influential interactions,
   - other interactions: private contacts, etc.
3. **Permanent social relationships:** (measurable in durability)
   - friendship relationships,
   - role structures.

Figure B-46 shows a number of instruments and methods for network analysis classified according to the type of relationships and the unit of analysis.

relation		unit of analysis: one social entity	unit of analysis: partial net	unit of analysis: all social entities
one net	direct relation	popularity	neighbourhood	dense census of triads
one net	connected relation	prestige	clique	connection
many nets	pattern of direct relation	social distance	position	picture structure
many nets	linked relation	multiplexity of local roles	aggregated local roles	role structure

FIGURE B-46. Typology of methods of network analysis interesting for KM[437]

Social network analysis has been repeatedly proposed as an instrument for KM (e.g., Zack 2000) and is definitely a promising direction on an agenda for future KM research and practice. Network analysis can for example be used to identify informal networks which then can be aligned in order to better support business or, in this case, KM goals (e.g., Krackhardt/Hanson 1993). Making informal networks visible can help to found communities which are open to be joined by new members and thus avoid a number of problems that informal, unidentified networks often have, e.g., holes in the network, fragile structures, so-called "bow ties" where the network is dependent on a single employee (Krackhardt/Hanson 1993, 110f).

437. This figure is based on Pappi 1987a, 26. Areas interesting for knowledge management are highlighted.

The following examples show in which KM-related scenarios network analysis has already been successfully applied (Krackhardt/Hanson 1993, 106):

Advice networks. An advice network reveals the experts in an organization as it asks whom employees contact when they need help or advice. These maps seem to be useful when a company considers routine changes.

Trust networks. This type of networks shows the strong tie relationships in an organization as it asks whom employees would reveal their concerns about work issues to. These maps seem to help when implementing a major change or experiencing a crisis.

Communication networks. A communication network simply analyzes whom employees frequently talk to and can reveal gaps and inefficiencies in the information flow. These maps should be considered when productivity is low.

These examples show the variety of application scenarios thinkable for network analysis to help identify networks that can be fostered and better aligned with the organization's knowledge strategy.

6.7 Résumé

This chapter discussed the multi-faceted organizational design of a KM initiative. Generally, the organizational design of a KM initiative and the organizational instruments used to implement it rely on the solid, mature and extensive foundation of the literature on organization science. A complete review seemed impossible because of the enormous number of approaches. Thus, the focus was on selected aspects that seemed to matter most for a KM initiative.

The chapter started with a comprehensive *model of the tasks and flows of knowledge management* which gave an overview of the target system for organizational instruments and measures and connects this chapter with other interventions[438] and the development of a KM strategy[439].

Then, the *structural organization* of a KM initiative was reviewed. The institutionalization of a separate organizational unit responsible for KM was discussed. New roles and collectives of employees were reviewed that have mushroomed with the advent of KM in the organizations. As the interviews preceding the empirical study have shown, so far most of the organizations have not implemented all or even a substantial part of these KM roles. In order to get comparable results across the organizations and not to confuse the respondents with the minor differences between several of these roles, the following three roles will be used in the empirical study:

- *knowledge manager* (CKO) or knowledge integrator,

438. e.g., ICT instruments, see chapter 7 - "Systems" on page 273.
439. See chapter 5 - "Strategy" on page 93.

- *subject matter specialist*,
- *participant/author*.

After definition, classification and detailed description of the most widely discussed *instruments* applied in KM initiatives, the next section was focused on the *process organization* of knowledge management and reviewed selected KM tasks that deal with, involve or are supported by KMS. This restriction was again due to the abundance of knowledge-related tasks that are described in the literature. The KM tasks that will be used in the empirical study had to be reworded and selected due to the results of several pretests with knowledge managers:

- knowledge identification,
- acquisition of external knowledge,
- release of knowledge elements (formal approval of institutionalization),
- storing of knowledge elements,
- integration of knowledge into existing structure (knowledge classification),
- updating/extending of existing knowledge structure (ontology),
- knowledge distribution,
- knowledge quality management,
- refinement, repackaging of knowledge,
- knowledge deletion, archiving,
- knowledge selling.

Also, process-oriented knowledge management was discussed and the differences between knowledge-intensive business processes, knowledge processes and knowledge management processes were shown. Process orientation will be included into the empirical study with the help of one question about the scope of the organization's KM initiative. Respondents will be asked to report the number of business processes their KM initiative targets. Apart from this basic question, the pretests and also the interviews have shown that most of the organizations so far do not integrate KM related tasks, roles and instruments with business process management in their KM initiative. The relationships between these two concepts will be analyzed in detail as part of a subsequent study on the basis of interviews with selected respondents and will not be reported in this book.

Also, the notion of organizational culture was analyzed. On the one hand, the organizational culture has to be considered in the design of a KM initiative, on the other hand to change the organizational culture might be a goal of a KM initiative in its own right. The focus was set on the dimension *willingness to share knowledge* which will be investigated with the help of a set of statements describing:

- mutual understanding of work groups,
- mutual trust of work groups,
- mutual influence of work groups,
- mutual support of work groups,
- communication between work groups,

- help within work groups,
- willingness to learn,
- communication within work groups,
- existence of incentive systems for knowledge sharing,
- approval/acknowledgement of cooperative behavior,
- informal exchange of ideas (e.g., in breaks, at company events, private).

The selection of aspects of the organizational design of a KM initiative left out a number of other possible interventions into an organization's way of handling knowledge. Some of these other interventions were briefly sketched out, e.g., the architecture of office space, recruitment of experts or therapeutic interventions.

Finally, the specifics of *modeling* as part of KM initiatives were discussed. The four perspectives process, person, topic and ICT resources were distinguished. A large number of modeling techniques and methods already exists for each of these perspectives. Selected process modeling, activity modeling, knowledge modeling and person modeling techniques and methods were discussed with respect to their potentials for KM. Their combination is still a challenge for KM initiatives. Whereas KM initiatives with a focus on codification concentrate on the ICT resources and the topic perspectives, personalization efforts rather model person and topic. However, in order to ripe the potentials of KM, processes, persons, ICT resources and topics have to be jointly considered before KMS are implemented. The investigation now turns to KMS, their roots, contents, functions and architectures.