Knowledge Integration

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(Editors)

Knowledge Integration

The Practice of Knowledge Management in Small and Medium Enterprises

With 53 Figures and 24 Tables

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Preface

Imagine Measure & Co, a two-person company creating optical measurement instruments for the graphical industry. Mark, the owner and founder of Measure & Co has a thorough background in measurement technology and has worked for years on his own. Lately, he has found a partner, Susan, who is experienced in commercial and marketing activities and takes care of customer relations and sales.

Although Mark and Susan together possess much of the knowledge that is needed to run their company, it is by far not sufficient. They need to stay informed about new measurement technologies, changing customer demands, changes in the printing industry, and so on, and so on. Moreover, they have to make sure that this knowledge is kept within their company and that they can apply it as well; a job that is extremely challenging in their dynamic industry. Thus, for Mark and Susan, it is important to manage their knowledge.

As this example shows, knowledge management (KM) is relevant for even an extremely small company like Measure & Co. Equally, or perhaps even more so, KM is relevant for thousands and thousands of other small and medium sized enterprises (SMEs) all around the globe. In particular, SMEs in high-tech areas, characterized by complex and dynamic environments, are affected. However, if we look around us in the literature on KM, we see that most of it has a strong focus on large or even very large multi-national companies. Much has been written on, for example, knowledge strategies, intra- and interdepartmental knowledge sharing, KM information systems, and on KM in dispersed organizations. To what extent does this apply to Measure & Co?

We see the bias towards large firms also in the development of commercial KM solutions. How should Measure & Co make use of, for example, groupware, intranets, data mining, semantic networks, knowledge maps, and content management systems? Yet, for Mark and Susan there remains knowledge to manage.

This book addresses the challenges of managing knowledge in SMEs and in particularly those SMEs that operate in high-tech sectors. As illustrated in the example of Measure & Co, these challenges are different than those for large companies, not the least because SMEs are much more dependent on their environment than many large companies. Therefore, this book introduces the concept of *knowledge integration* (KI), which consists of the identification, acquisition, and utilization of external knowledge. KI is different from KM in that it places much more emphasis on external knowledge than KM does.

As good KM and KI ensure that high-quality knowledge is applied successfully, this book aims to provide knowledge that is both of high quality and applicable. To this end, it provides many examples and cases from practice, but always with a thorough foundation in the literature.

The book is not exclusively written for academics, nor is it exclusively written for practitioners. It rather aims at integrating both views. It is written by academics and practitioners together who attempted to learn from each other. As editors, we have extensively and successfully cooperated with the authors of the chapters in this book during a 3-year project 'Knowledge Integration and Network eXpertise' (KINX). This project was supported by the European Community under the "Competitive and Sustainable Growth" Programme.

In an attempt to impart our experiences to a wider audience we decided to publish our findings in this book. Drawing on a theoretical basis, it presents concepts and instruments that are designed to help SMEs to cope with their problems in identifying, acquiring and using external knowledge. We hope that it contributes to fill the current gap in useful books for KM in SMEs.

The editors
Antonie Jetter
Jeroen Kraaijenbrink
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1 Knowledge Management: More than a Buzzword

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1.1 Introduction

Knowledge management (KM) has become a major issue in academia and industry in the last 30 years [16]. KM has at least three roots.

1. Suppliers of information technology and academics in this field have developed opportunities of supporting knowledge reuse and knowledge creation by, for instance, artificial intelligence, knowledge-based systems, and Internet applications [12, 20],
2. Organization and human relations professionals and academics have recognized the need for academically challenging jobs and for using the opportunities of an increasingly highly educated work force in modern societies [2, 31, 32, 36] and
3. Strategic management has recognized that, especially for firms in western societies, competition based on motivating people to work harder will not be effective and, instead, the optimal use of intellectual capabilities may be the best source for sustaining competitiveness in our global economy [2, 13, 28].

Consequently innovations in IT, organization, and organizational strategies jointly realize the development of knowledge management. The aimed-at knowledge leverage [38] mostly cannot be done within a task unit, nor within an organization, but requires inter-organizational collaboration. This is particularly so for high-tech small and medium enterprises (SMEs), which need much advanced knowledge that, because of SMEs limited organization size, must to a far extent be identified and acquired from other organizations, and be finally internally used. These processes of external knowledge identification and acquisition, and internal utilization of external knowledge are what we name knowledge integration (KI) in this book.

SMEs often suffer from a lack of resources - tangible resources, such as physical assets, as well as intangible ones, e.g., databases, property rights, and market power. Scarcity of resources also pertains to knowledge available internally at high-tech SMEs. Therefore, SMEs are under strong pressure to identify, acquire and use knowledge generated externally and, therefore, KI is a specific issue of KM by SMEs. This chapter gives theoretical and practical arguments as to why KM (and KI) are important to SMEs (Sect. 1.2), what we mean by KM (Sect. 1.3), and what we mean by knowledge (Sect. 1.4), particularly in the context of SMEs and KI (Sect. 1.5). It closes with an outline of the book's structure (Sect. 1.6).

1.2 The Relevance of Knowledge Management for High-tech Small and Medium Sized Firms

Knowledge management is particularly important to high-tech SMEs, because high-tech SMEs create most of their value-added by knowledge work, like engineering, research, and new product development (NPD). Unfortunately, however, it is difficult to implement KM in SMEs, because SME-specific KM theories, methods and techniques are rare. Most of the current KM concepts have been developed in the context of large firms. This is illustrated by Table 1.1, which presents a few of the major KM concepts and their organization of origin.

Table 1.1. KM concepts and their organizational roots

KM concept	Authors	Organizational case studied
Knowledge strategy	[16]	Boston Consulting Group, McKinsey, Dell computers
Knowledge valuation	[30]	Skandia
Knowledge creation	[24]	Matsushita
Knowledge acquisition	[15]	Philips Electronics and Sony
Knowledge sharing	[10]	CapGemini
Knowledge information systems	[17]	Ericsson

If KM and KI are so important to high-tech SMEs, two major questions come up for them:

1. Can we move up into the knowledge management swing and be successful by working smart, or will we become the non-knowledge-based firm that has to succeed by working hard?
2. If we want to pick up KM, how can we - as an SME - do this, given our limited resources?

Most SMEs in western countries quickly found out that, with respect to question 1, there is no alternative. An increasing level of production overcapacity and (Internet and telecom-based) globalization resulted in fierce competition that was not sustainable in high-wage countries. Consequently, becoming smart has become the imperative for SMEs as well, and resulted in the occurrence of large numbers of high-tech SMEs in western countries. These high-tech SMEs have high capital investments, the profitability of which can only be achieved by highly educated professionals resulting in high salary costs per employee and the need to invest heavily in personal learning and development.

With respect to question 2, becoming smart has been achieved through business process reengineering, resulting in lean production [11, 43], as well as through superb new product development processes (in high-tech firms), possibly for niche markets [8]. In NPD, SMEs always have to identify, acquire, and incorporate external knowledge. Consequently, for understanding KI by high-tech SMEs, a focus on new product development as the KI context is more fertile than a focus on business process reengineering.

1.3 Knowledge Management – What Is It About?

Answering the question of what KM is about is difficult because 1) KM is often confused with competence management, 2) there are many different perspectives on management, each emphasizing different issues, and 3) KM, like other management areas, is a very broad category of activities ranging from strategic to operational levels.

1.3.1 Knowledge Management versus Competence Management

Knowledge is regarded as the key production factor in the post-industrial society [4, 15, 28]. If knowledge is a unique competitive force, it is a core competence and provides an organisation with sustainable competitive advantage. Core competencies, however, in addition to knowledge, may also include tangibles, e.g., land, money, installations, and buildings, and non-knowledge intangibles, like social networks, legal and infrastructural arrangements, power and influence. Fig. 1.1 shows the conceptual relations between core competencies and knowledge.

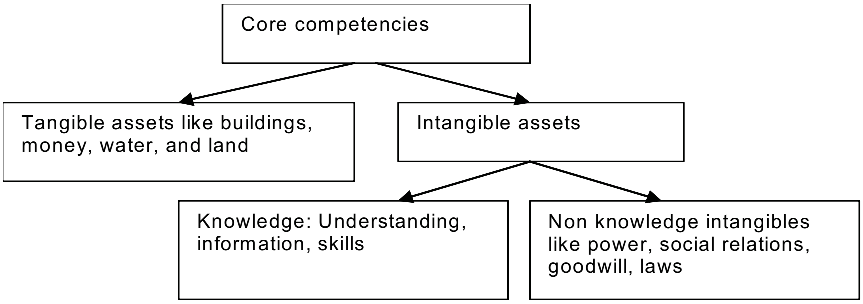
Core competencies
Tangible assets like buildings, money, water, and land
Intangible assets
Knowledge: Understanding, information, skills
Non knowledge intangibles like power, social relations, goodwill, laws

Fig. 1.1. Relations between core competencies and knowledge. Adapted from [41].

1.3.2 Approaches to Knowledge Management

A way to structure perspectives of knowledge management is to relate them to paradigms of knowledge and paradigms of social reality. The two major paradigms of knowledge are subjectivism and objectivism [6, 24]. Subjectivism assumes that knowledge is connected to an individual's mind and has no objective law-like nature. In addition to people's explicit views of the world, it is often even more important to grasp their tacit knowledge while trying to understand their behavior [31]. Alternatively, objectivism is interested in the (scientific) validity of knowledge and the ability of explicating and formalizing it, possibly in manuals and information systems. Thus, the emphasis is on person-independent knowledge, created by making the tacit knowledge explicit and documented.

With respect to the nature of social reality, again, two main paradigms may be distinguished, one based on order and regulation, and a second one based on conflict and radical change. Knowledge management has an obvious role in both of them. In regulation, it can provide or help to define the solution to shared problems and increase organizational integration and efficiency. In radical change, knowledge management may be used as an instrument for outperforming competitors in the market place, as well as a source for internal power.

Table 1.2 describes the four knowledge management perspectives that result from combining the perspectives on knowledge (epistemology) and social reality (ontology). The perspectives differ on the

- basic *definition* of knowledge management (process and purpose),
- basic *requirements* for knowledge management (data, views, etc.),
- definition of *knowledge actors* (a group or an individual, a specific elite, all organization members or the organization), and
- definition of the *knowledge* (that changes under the influence of learning).

Table 1.2. Perspectives for the study of knowledge management. Adapted from [41].

		Ontology	
		Order	Conflict
Epistemology	Objectivism	*Cybernetic perspective.* • Knowledge management is discovering objective reality. • Requires data and models. • Individualistic developing and testing of knowledge. • Knowledge is about the production process (organizational technology).	*Scientific Management.* • Knowledge management is used to change power relations. • Requires detecting sources of conflict, and latent dysfunctions. • Knowledge management is mainly done by the power elite. • Knowledge is the technology of domination.
	Subjectivism	*Soft Systems.* • Knowledge management is about perceptions that motivate behaviour and about organizational change. • Requires feeling with 'reality', by soft modeling. • Individuals interacting in a specific social context (culture). • Knowledge is, e.g., work attitudes, collaboration, leadership, and understanding cause-effect relationships.	*Organization Development.* • Knowledge management is about understanding dysfunctions caused by routine processes and problems of change. • Requires open communications, mutual feelings of trust and willingness to change. • People interacting in a specific social setting (power relations). • Knowledge is about social and political issues influencing organizational processes and thought.

1.3.3 Levels of Knowledge Management

These approaches and issues can be organized by different levels of management. Gulick [14] defined management as the functional elements of the task of the executive. These elements are planning, control, financing, budgeting and reporting, organizing and staffing, coordinating and directing. Additionally, the executive tasks involve responsibility for operational management and information systems [22]. A major question is whether it is feasible to manage knowledge. Because it involves much person-dependent tacit knowledge and information, one may state that KM is the purposeful sum of human resource management and information management. If we group the general management concepts under the headings of strategic, tactical and operational management [3], we find the following workable list of KM activities.

Strategic knowledge management: Knowledge management at this level is the definition of the organization's knowledge architecture [15]. The organization's knowledge architecture is a view on which "functionalities" will be offered to customers over the next decade or so, on what new core competencies will be needed to create those benefits, and on how the customers' interface will have to change to allow customers to access those benefits most effectively [15: 107-108]. More concretely, a knowledge architecture is about the knowledge and information needed in the longer term, how this knowledge and information will be acquired and handled, and how effective use can be made of it. This means that knowledge and information policies and plans must be well in line with the organization's ambitions and environments. Furthermore, within strategic knowledge management, knowledge is evaluated on its strategic relevance, by stating which competencies should be given superior attention and what control policy is needed so that knowledge is defended against fraud and theft. This activity is called knowledge control.

Tactical knowledge management: Tactical management is concerned with the acquisition of resources, determination of plant locations, new product initiation, establishment and monitoring of budgets. At the tactical knowledge management level, general rules should be set for the handling of knowledge in terms of responsibilities, procedures, and means (motivational and financial). This involves organizing, financing and budgeting of knowledge management activities.

Operational knowledge management: Operational management is concerned with the effective and efficient use of existing facilities and resources within given budget constraints. For knowledge management, this implies that concrete ways of developing, storing, disseminating, using (reusing) and adjusting of knowledge and information must be established, in line of course with the strategic and tactical outlines [1, 35].

The activities to be performed at each level are summarized in Fig. 1.2.

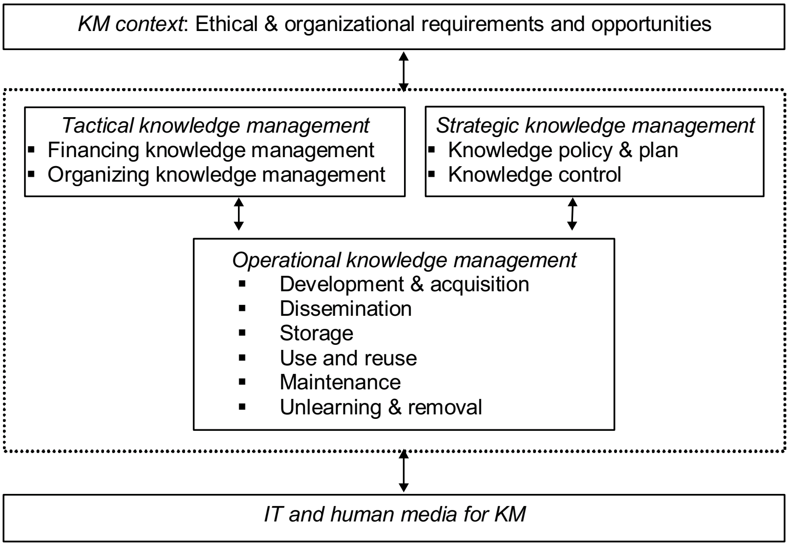
KM context: Ethical & organizational requirements and opportunities
Tactical knowledge management
Financing knowledge management
Organizing knowledge management
Strategic knowledge management
Knowledge policy & plan
Knowledge control
Operational knowledge management
Development & acquisition
Dissemination
Storage
Use and reuse
Maintenance
Unlearning & removal
IT and human media for KM

Fig. 1.2. A model of knowledge and information management. Adapted from [41].

Although Fig. 1.2 can easily be transformed to an interesting managerial structure for KM, much of what is presented therein is independent from the substance of knowledge. In addition, the KM model presented focuses upon internal organization and, thus, needs to be extended to include the context of knowledge transfers between organizations. In our efforts to structure the field of KI, we therefore shall improve the KM model in two directions that are discussed in Sects. 1.3 and 1.4:

1. To further specify what we mean by knowledge,
2. To further develop the inter-organizational aspects of KM.

1.4 What Aspects Are Related to Knowledge?

To realize KI, one may approach the knowledge phenomenon from the angles of their identification and acquisition, as well as from the angle of knowledge utilization. The identification and acquisition stages emphasize how knowledge is represented and possibly made explicit and person-independent because, the more knowledge is tacit and person-dependent, the more difficult it is to identify and to acquire the knowledge. This is what we call the content aspect of knowledge. Furthermore, for the utilization of knowledge, its context is important. Company-foreign knowledge - i.e., knowledge that is created at a company other than where it is used - is harder to apply than knowledge that originates from the same context. In addition, knowledge in many ways is related to activities and process flows in and between organizations. This is so because knowledge is far from being a static entity but is under constant improvement or revision, and because knowledge exerts several roles in knowledge intensive business processes. Finally, KM employs human and information technological media for processes like knowledge sharing, storage, and reuse. We shall explain these four aspects of knowledge (content, context, flows and media) step by step.

1.4.1 Content in Knowledge Identification and Acquisition Processes

Knowledge is frequently defined in relation to information and data. Table 1.3 gives an impression of the diversity of interpretations of these three terms in the current literature. It shows that there is no unanimity on either of them, but the distinction between data, information and knowledge seems to be a very popular way of thinking about what it is what we want to identify and acquire in KI contexts. Because this book is on KI and not on information or computer science, the distinction between data and information is not as interesting as the distinction between different types of knowledge is.

Table 1.3. Definitions of data, information, and knowledge (based on [34])

Data	Information	Knowledge	Source
Not yet interpreted symbols	Data with meaning	The ability to assign meaning	[37]
Simple observations	Data with relevance and purpose	Valuable information from the human mind	[9]
A set of discrete facts	A message meant to change the receiver's perception	Experience, values, insights, and contextual information	[10]
Text that does not answer questions to a particular problem	Text that answers the questions who, what, or where	Text that answers the questions why or how	[27]
Facts and messages	Data vested with meaning	Justified, true beliefs	[7]
Signs/carriers	Representations with linguistic meaning	Norms & values, explicit understanding, skills	[41]
Carriers of information and knowledge	Description carried by data	Correlational and causal associations	[18]
-	Facts organized to describe a situation or condition	Truths, beliefs, perspectives, judgments, know-how and methodologies	[40]
-	A flow of meaningful messages	Commitments and beliefs created from these messages	[24]

The purpose of this book is to provide insights into and examples of KI processes, problems, and solutions for SMEs. A typology of knowledge that is useful for this purpose is the distinction between **tacit**, **explicit**, and **latent knowledge**. This typology is useful because these three types of knowledge require very different processes, involve different problems, and demand different solutions (see also Chap. 4 of this book). The distinction between tacit and explicit knowledge has been well described by the philosopher Polanyi who said that "we can know more than we can tell" [26: 4]. In short, the part that we can tell is the explicit part and the part that we cannot tell is the tacit part of knowledge. Polanyi has stressed that knowledge always has both a tacit and an explicit dimension. For example, the knowledge represented in this book is explicit because it can be explained in detail in text, figures, and tables. However, the extent to which you as a reader are able to understand this book is what Polanyi would have called the tacit part of knowledge. It is tacit since you cannot explain exactly why you understand it (or not). Just like Nonaka and Takeuchi did in the early 90s [23, 24], however, we treat these two dimensions as a distinct typology: there is tacit and explicit knowledge.

While Polanyi, Nonaka, and Takeuchi have made the distinction between knowledge that *can* and knowledge that *cannot* be expressed, their distinction is often confused with the distinction between knowledge that *is* and knowledge that *is not* expressed (for example in documents). In this book, we distinguish three levels of explicitness of understanding or prehension in order to reflect this difference. The first type is *tacit* knowledge, which is not and cannot be expressed. The second type is *explicit* knowledge, which is expressed, or could be expressed without attenuation. The third type is *latent* knowledge, which could be expressed, but is not because of inherent difficulties to express it without attenuation. The difficulties to express this knowledge without attenuation usually stem from the fact that this knowledge resides in the subconsciousness.

Often, the distinction between tacit and explicit knowledge is equaled with the distinction between written up and not documented knowledge, or between representation and no representation. This is basically incorrect, because often documentation/representation of explicit knowledge is forgone, due to a lack of motivation or cost effectiveness. People may not convey what they know to others because that would result in a personal value reduction or the costs of knowledge documentation will not outweigh its value. This results in the combinations of understanding/comprehension and representation (or information [33]), with related knowledge types. These are given in Table 1.4:

Table 1.4. Content: knowledge prehension and representation

		Representation	
		Not represented	Represented
Comprehension	Tacit	Person-dependent skills; personal knowledge;	-
	Latent	Shared informal norms and values (paradigms).	Information about people with their personal knowledge (of course the personal knowledge stays personal, but the representations of the people are feasible so that they can be found)
	Explicit	Person-independent, non-documented shared knowledge embracing explanations, predictions and methodologies	Documented knowledge and information, i.e., representations of knowledge or of objects and events in reality that may be used for knowledge creation (potential knowledge)

1.4.2 Utilization of Knowledge in Contexts

Task and firm/industry setting are important contexts for knowledge and information. Following this division, Nordhaug [25] distinguishes background knowledge, industry-based knowledge, intra-organizational knowledge, standard technical knowledge, technical trade knowledge, and unique knowledge, as shown in Table 1.5.

Table 1.5. Knowledge and contexts. Adapted from [25].

		Firm/industry specificity		
		Low	Medium	High
Task specificity	Low	Background knowledge	Industry knowledge	Intra organizational knowledge
	High	Standard technical knowledge	Technical trade knowledge	Unique knowledge

Background knowledge is general knowledge with often a significant tacit component like individual literacy, knowledge of foreign languages and mathematics. Industry-based knowledge is relevant for role-related organizational activities and comprises, for instance, knowledge of the industry structure, its current state of development, the key individuals, networks and alliances. Intra-organizational knowledge is highly firm- and industry-specific, but not specific to organizational tasks or activities. This is firm-specific background knowledge and comprises, e.g., knowledge about organizational culture, communication channels, informal networks, organizational strategy and goals. Standard technical knowledge is task-specific and involves a wide range of operationally-oriented knowledge that is generally available to all actors, like financial and accounting practices, knowledge of computer programming and software packages, knowledge of craft and engineering principles. Technical trade knowledge is task- and industry-specific, i.e., generally available among firms in an industry, like knowledge of automobile construction methods and knowledge of techniques for computer hardware construction. Unique knowledge is specific across all dimensions. It consists, at the individual level, of self-knowledge and skills, and, at the organizational level, of unique organizational routines, production processes, and IT infrastructures.

1.4.3 Knowledge Flows

Many different knowledge flows can be recognized in organizations. Much of the KM literature, e.g., [10 and 18], focuses on the knowledge process, which consists of the development, maintenance, storage, dissemination and removal of knowledge. From a KI perspective, this is too limited because the actual utilization of the knowledge in NPD processes gives the ultimate reason for KM activities. Consequently, important knowledge flows exist between 1) the knowledge processes and the business use processes, and 2) within the business process between the different business activities, like NPD activities and commercial activities. Also, managerial activities occur that guide how the knowledge flows in the knowledge processes and business processes take place and how knowledge flows between knowledge processes and business processes interact. Finally, an important role of management is to facilitate knowledge flows. We discern knowledge facilitation processes, covering the sub-processes of generating, exploiting and maintaining the supportive means, like funding, organization (including HRM policies and leadership), and information technological and human media.

Fig. 1.3 (based on [29, 41]) gives some knowledge flows for knowledge management, knowledge facilitation, knowledge processes, and business processes. It also describes what knowledge flows occur between these knowledge management areas.

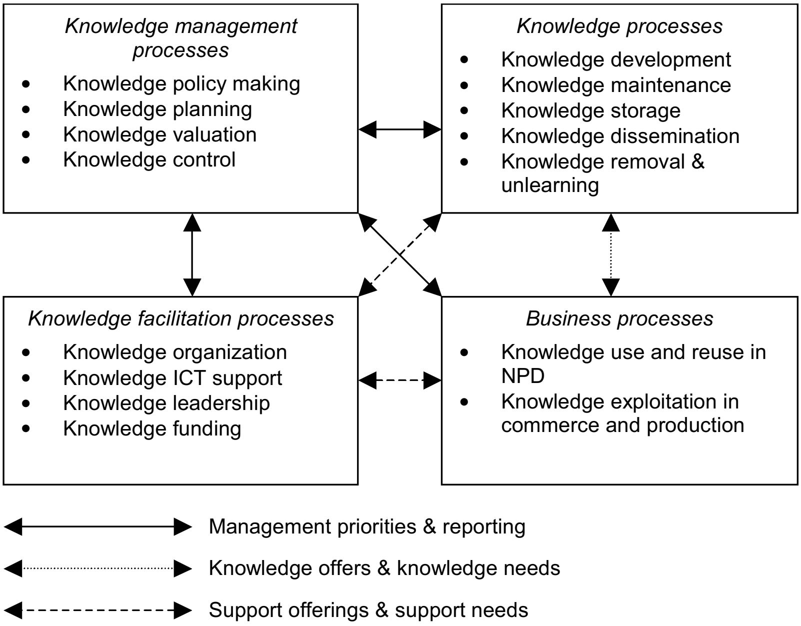
Knowledge management processes
• Knowledge policy making
• Knowledge planning
• Knowledge valuation
• Knowledge control
Knowledge processes
• Knowledge development
• Knowledge maintenance
• Knowledge storage
• Knowledge dissemination
• Knowledge removal & unlearning
Knowledge facilitation processes
• Knowledge organization
• Knowledge ICT support
• Knowledge leadership
• Knowledge funding
Business processes
• Knowledge use and reuse in NPD
• Knowledge exploitation in commerce and production
Management priorities & reporting
Knowledge offers & knowledge needs
Support offerings & support needs

Fig. 1.3. Classes of knowledge flows

1.4.4 Knowledge Media

Basically we distinguish two knowledge media: human and information technological. Human media have been extensively discussed in the past and are summarized in Table 1.6 with typical examples for their content.

Table 1.6. A list of human knowledge media and related content. Adapted from [39].

Human media	Knowledge content
Individual	Professional skills; knowledge about evaluation criteria and results; explanations of procedures and decision rules; personal ethics and beliefs, performance criteria; individual routines
Culture	Schemes; stories; external communications; cultural routines; norms
Business processes	Task experiences; rules, procedures and technology; patents and prescriptions
Structure	Task divisions; hierarchy; social structure; formal structure; communication structure
Internal ecology	Layout of shop floor; building architecture
External ecology	Client and market characteristics; competition profiles; list of knowledgeable people and organizations; technology of competitors

Information technological media have been classified in many ways. One type of classification describes what kind of applications and technologies are supportive of what knowledge processes; another type describes architectures of knowledge information systems. An example for the first is given in [5]. [21] gives an example for the second type. Because [21]'s architecture is more informative, we present it here in Fig. 1.4. The elements of the knowledge management software systems of Fig. 1.4 will not be discussed here in detail, but several of them are discussed further in Chaps. 5-10 of this book.

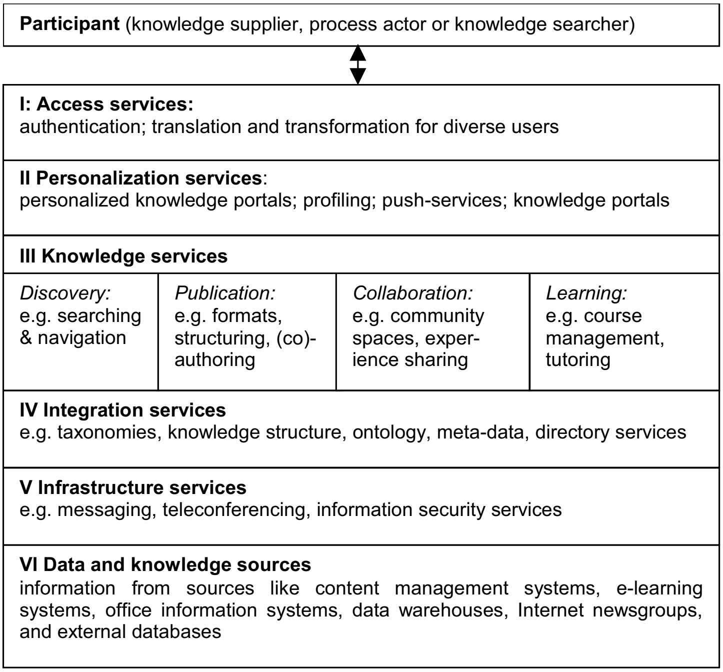
Participant (knowledge supplier, process actor or knowledge searcher)
I: Access services:
authentication; translation and transformation for diverse users
II Personalization services:
personalized knowledge portals; profiling; push-services; knowledge portals
III Knowledge services
Discovery: e.g. searching & navigation
Publication: e.g. formats, structuring, (co)-authoring
Collaboration: e.g. community spaces, experience sharing
Learning: e.g. course management, tutoring
IV Integration services
e.g. taxonomies, knowledge structure, ontology, meta-data, directory services
V Infrastructure services
e.g. messaging, teleconferencing, information security services
VI Data and knowledge sources
information from sources like content management systems, e-learning systems, office information systems, data warehouses, Internet newsgroups, and external databases

Fig. 1.4. Classes of KM software