

The future of knowledge management: an international delphi study

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Abstract The field of knowledge management (KM) is highly estimated in research and practice but at the same time relatively diffuse and scattered into diverging concepts, perspectives and disciplines. On that background, it was the aim of this delphi study to give more structure to the field of KM and to get an outlook on worthwhile developments for the next ten years. International experts of KM from natural/technical and social/business sciences as well as practitioners of KM with a similar background were asked some basic questions onto the future of KM in two rounds. According to the experts, the future of knowledge management lies in a better integration into the common business processes, a concentration on the human-organization-interface and a better match of IT-aspects to human factors whereas IT-aspects rank low on this agenda. There are no broadly agreed theoretical approaches though something can be gained from the related organizational learning field; in general much more interdisciplinary and empirical research is needed. There are also almost no broadly agreed practical approaches besides communities of practice.

Keywords Knowledge management, Delphi method, Human resourcing, Business development

Introduction

The immense interest in knowledge management is reflected throughout the world in articles, books, conferences and research papers. Despres and Chauvel (2000, p. 5) speak of “an explosion of interest in the term ‘knowledge management’”, whereas Grant (2000, p. 27) holds that “among the innovations that have swept through the world of management during the past two decades . . . knowledge management has probably aroused the greatest interest and made the biggest impact”.

At the same time, the field of knowledge management (KM) is relatively diffuse and scattered. It is characterized by many differing concepts, perspectives and approaches. Knowledge management spans multiple areas, reaching into many disciplines and is said to be “one of the most ramified topics in the business lexicon” (Despres and Chauvel, 2000, p. 55). The same authors notice that “there exists a patchwork of subdomains in and around knowledge management that deal with one set of issues while ignoring others” (Despres and Chauvel, 2000, p. 57).

The varying foci of interest may be exemplified with three contrasts: the process of knowledge sharing is often seen as the central theme of KM. On the other hand it is agreed that successful knowledge management demands the consideration of the whole life cycle of knowledge

processing, for instance, to generate, to store, to distribute and to apply knowledge (Mertins *et al.*, 2001, p. 3). Other authors have developed similar process models but it seems that the distribution or sharing process is more important to most KM writers than the other processes.

A second contrast exists in the literature between a focus on intelligent IT-solutions and on human resources' solutions like communities of practice or storytelling. Though no one recommends a purely technical or a purely human approach, the disciplinary orientation of the authors often defies an integrative approach such that the authors' disciplinary approach dominates the method and the solutions.

As a third contrast, many underlying – but often undeclared – differences can be observed regarding the nature of knowledge itself. Lueg (2002, p. 4) states that “defining the scope and the aim of ‘knowledge management’ is as difficult as defining the nature of ‘knowledge’ which is the ‘substrate’ to be managed . . . we have some understanding of ‘management’ but our understanding of the stuff to be managed is rather rudimentary. It does not come as a big surprise that it is difficult to manage something we haven’t understood yet”.

Following an European-wide company benchmarking survey carried out four years ago (Heisig and Vorbeck, 2001) we wanted to assess the “future of knowledge management” with a global delphi survey searching for answers to these and other questions deemed important by the delphi experts.

Method

Our study was based on the delphi technique for getting a clearer picture of unintelligible developments. According to Murry and Hammons (1995), delphi is generally characterized by three features including:

- (1) anonymous group interaction and response;
- (2) several rounds of questionnaires or other means of data collection with researcher-controlled statistical group responses and feedback; and
- (3) presentation of statistical group responses.

Proceeding along these lines, first of all, potential delphi panellists were identified. All panelists had to be experts in the field of knowledge management. “Experts” were defined as people being active in KM research or practice who had published on the subject. Due to extensive research in databases, more than 400 potential panelists from all over the world were identified and invited to participate in the study; 254 actually received the questionnaire in winter 2001/2002, the rest were not reachable via e-mail, because of technical errors or due to outdated addresses. Presumably, they formed a representative sample of all experts in knowledge management. A stratified panel of experts was aspired: theory and practice of KM as well as the different disciplinary backgrounds should be equally represented.

It was harder to get the desired answers on a mailed questionnaire than thought; nevertheless 45 experts took part in the study. Yet, the desired stratification of the sample was possible such that at least ten persons filled the provisioned cells, see Table I.

The response rate of 17.7 percent may be mainly due to the fact that most of the KM experts may have had hard deadlines with other work duties. Many of them may have been afraid of just another questionnaire and have clicked it away without opening it. And the open format made it necessary to reflect some time over a suitable answer such that some experts may not have finished the questionnaire. An inspection of possible response biases in demographic background (gender, education etc.) showed no obvious biases except one: the smaller the cultural distance to Berlin, the issuing location of the questionnaire, the (relatively) higher the response rate: Germany 18 (40 percent), Europe 15 (33.3 percent), North America 11 (24.4 percent), others 1 (2.2 percent). We interpret this bias as caused by loyalty reflections due to social identity feelings, but – of course – this may add a more German and European flavor to the results than with a totally representative sample.

The study consisted of two rounds: the first questionnaire contained open-ended questions in order to be maximally open to all perspectives on knowledge management. The second round



Table I Sample distribution of delphi participants in the first round

	Scientists	Practitioners	Total
Natural/technical sciences	10 (22%)	14 (31%)	24 (53%)
Social sciences and business administration	11 (25%)	10 (22%)	21 (47%)
Total	21 (47%)	24 (53%)	45 (100%)

questionnaire condensed these answers from the first round into scalable questions in order to get precise estimates on all topics with at least some importance. A third round would have been nice but seemed not necessary because already the second round showed substantial agreement. This fact is in line with Richey *et al.* (1985), who hold that two rounds are sufficient to achieve both consensus between the panelists and stability in the individual responses. Instead of a third delphi round, we presented the results of the first two rounds at an international conference to invited KM experts and a Berlin group of researchers, both originating from different disciplines. Their commentaries on the results helped us to come to a more thorough interpretation[1].

In the first delphi round, individual judgments and opinions about the future of knowledge management should be elicited from each member of the panel. Therefore, all panelists got a questionnaire in an open-ended format and were asked to give their personal responses. The first-round questionnaire comprised the following six questions:

- (1) What is the most pressing and challenging theoretical research issue for the understanding and advancement of knowledge management?
- (2) Which theoretical approach and/or scientist is most likely to deal effectively with this theoretical research issue?
- (3) What is the most important recent theoretical advancement in knowledge management?
- (4) What is the most pressing and challenging practical problem for the understanding and advancement of knowledge management?
- (5) Which practical approach and/or organization is most likely to deal effectively with this practical problem?
- (6) What is the most important recent practical advancement in knowledge management?

After the questionnaires had been returned, the panelists' responses were reviewed and compiled. Table II shows how a response given by a scientist was categorized:

Similar responses were categorized as close as possible to the original content into common categories. This procedure led to 61 categories which could be assigned to 14 main classes (see Table III).

After frequencies had been counted, all those categories were selected which integrated at least two responses. These categories served as a basis for the second-round questionnaire: under each of the six questions already known from the first round, the corresponding categories were listed in the rank order of their frequency. The selected categories were

Table II Categorization example

Response	Keywords	Categories	Main classes
How to combine human resource management, organizational management and informatics into a coherent framework such that knowledge management is smoothly integrated into the common business processes that are executed anyway	Coherent framework Integrating knowledge management into the common business processes	Knowledge management framework Integration into business processes	Conceptual framework Organisational concepts

Table III List of categories condensed from the answers from the first round

I. Conceptual framework	VII. Implicit knowledge
Knowledge management framework	Externalisation of implicit knowledge
Standards	Implicit knowledge
Terminology	Implicit vs. explicit knowledge
II. Scientific areas	VIII. Knowledge assessment
Computer science/artificial intelligence	Knowledge assessment
Economic sciences	IX. Knowledge creation, knowledge selection and use of knowledge
Human approaches	Knowledge creation, knowledge selection and use of knowledge
Interdisciplinarity	Sense making
Mathematics/statistics	X. Personal knowledge sharing
Philosophy of knowledge	Best practice
Psychology	Communities of practice
Social sciences	Knowledge sharing
Systems theory	Knowledge trading
III. Scientific approaches	Learning
Action theory	Networking
Complexity theory	Transfer techniques
Contextual logic	XI. IT-instruments
Description logic	AI-tools
Kelly-grids	Instruments and practices
Knowledge structures	IT-systems (Internet/intranet; groupware)
Ontologies	Knowledge-orientated data-bases
Situated cognition	Programming languages
Structuration theory	Usability
IV. Social vs. technical aspects	XII. Motivation
Matching social and technical aspects	Barriers
Priority on human factors	Incentives
V. Management concepts	Motivation
Different conception of management	Sensibilization
VI. Organizational concepts	XIII. Research methods
Coordination based approaches	Research designs
HR management	Network analysis
Integration into business processes	XIV. Others
Knowledge enabling	No breakthrough
Knowledge organization	
Knowledge roles	
Knowledge strategy	
Micro politics	
Organizational culture	
Organizational learning	
Time for knowledge management	

presented with the best exemplifying phrases from the first round to all panelists, who were asked to rate these categories on a seven-point Likert scale. For example:

Question 1: Do you agree that the following theoretical research issues are the most pressing and challenging theoretical research issues for the understanding and advancement of knowledge management?

	I strongly disagree						I strongly agree
	-3	-2	-1	0	+1	+2	+3
KM framework: integrating human resource management, organizational management and information management							

The second delphi panel attracted 25 experts, with 22 of them having already participated in the first delphi round. No systematic drop out could be observed; it seemed that the non-respondents from the first round were just too busy with other things to participate again. The scientists and practitioners as well as those with a natural/technical sciences background and

those having a business administration or a social sciences background participated in similar proportions (see Table IV).

Results

The results are presented separately for each of the six questions. The corresponding tables summarize the frequencies (F) of the categories in the first delphi round as well as their means (\bar{x}) and standard deviations (s) in the second delphi round. The focus of the following analyses lies on the results obtained in the second delphi round because these judgments were formed under consideration of all responses given in the first round. The results obtained in the first delphi round will be outlined comparatively and possible explanations for noticeable ranking differences will be offered.

Question 1: What is the most pressing and challenging theoretical research issue for the understanding and advancement of knowledge management? (see Table V)

According to the panelists, the most pressing theoretical research issue lies in the integration of knowledge management into the common business processes ($F = 2$; $\bar{x} = 2.12$), which was only mentioned twice in the first round. This raises the question whether knowledge management has mainly been a concern of some designated specialists so far. The most frequently

Table IV Sample distribution of delphi participants in the second round

	Scientists	Practitioners	Total
Natural/technical sciences	4 (16%)	7 (28%)	11 (44%)
Social sciences and business administration	8 (32%)	6 (24%)	14 (56%)
Total	12 (48%)	13 (52%)	25 (100%)

Table V Results for question 1

Category	F	\bar{x}	s
Knowledge sharing, e.g. identifying the knowledge bearers within an organization, convincing and motivating people to share their knowledge	7	2.04	1.14
Implicit knowledge	5	0.80	1.83
Organizational learning, e.g. forming and developing organizational competence, its connection with business success	5	1.92	1.12
Knowledge management framework: integrating human resource management, organizational management and information management	4	1.56	1.04
Knowledge assessment, e.g. valuing contributions to a knowledge pool, identifying invalid knowledge as well as measuring valuable knowledge and intellectual capital in unambiguous terms	4	1.52	1.76
Terminology, e.g. definitions, taxonomies, classifications and ontologies	3	1.04	1.46
Motivation, e.g. motivating people to participate in knowledge management	3	1.44	1.47
Integration into business processes, e.g. integrating knowledge management into the common business processes	2	2.12	1.17
Knowledge enabling; enabling knowledge management e.g. by using knowledge management infrastructure	2	1.00	1.38
Learning, e.g. the differences between implicit and deliberate learning and between non-formal and formal learning, as well as the social aspects of learning and their connection with business success	2	1.52	1.36
Knowledge-orientated data-bases, e.g. structuring and integrating text documents and data-bases into knowledge bases	2	0.00	1.91
Knowledge creation, knowledge selection and use of knowledge	2	1.32	1.28

mentioned theoretical research issue of the first round, knowledge sharing, received second highest weight in the second round ($F = 7$; $\bar{x} = 2.04$). The second most often mentioned research issue from the first round, organizational learning, came third ($F = 5$; $\bar{x} = 1.92$). This second and third rank reflect earlier interests: knowledge management started with an interest in knowledge sharing, and organizational learning (OL) is probably the most suitable earlier concept to learn from. Relatively agreed upon ($\bar{x} > 1.5$) are also the need for an integrative KM framework, for research on the organizational assessment of relevant knowledge and on the specialities of learning in general.

Apparently, IT-aspects are not at the forefront; the only mentioned category from the IT field is knowledge-oriented databases, which both had a low frequency in the first round and the lowest average score in the second one ($F = 2$; $\bar{x} = 0.00$). But this is also the most controversial category as indicated by the high standard deviation ($s = 1.91$). This might reflect the fact that in organizational practice IT-driven solutions are still dominating. Taken together, the most pressing theoretical research issues center on the organizational integration of KM efforts.

Question 2: Which theoretical approaches are most likely to deal effectively with these theoretical research issues? (see Table VI)

The approaches which could effectively deal with the research issues mentioned before, were in the first round often formulated in a rather global way. Whole disciplines were often mentioned in the first round but received far less weight in the second round.

According to the experts, KM would primarily profit from inter- and transdisciplinary work ($F = 3$; $\bar{x} = 2.4$) and from manifold empirical research designs ($F = 4$; $\bar{x} = 1.88$). This result is an indication that some very basic work has first to be done before more specific KM approaches can be successfully applied.

The importance assigned to social network analysis as the only specific approach that is mentioned among the agreed ones ($F = 2$; $\bar{x} = 1.76$) might be related to the growing interest of communities in KM. Organizational learning ($F = 2$; $\bar{x} = 1.52$) and aspects of knowledge sharing, e.g. transactive memory, common knowledge, connecting people ($F = 2$; $\bar{x} = 1.64$) are again broader categories. Both categories have already been mentioned as important in the first question; thus, they do not only seem to be pressing research issues but have some promising aspects to offer.

Table VI Results for question 2			
Category	F	\bar{x}	s
Psychological approaches	5	1.32	1.57
Complexity theory	5	0.48	2.14
Social science approaches	4	1.48	1.39
Economic approaches	4	1.08	1.47
Empirical research designs, e.g. action research, case studies, survey studies, qualitative studies, statistical studies	4	1.88	1.27
Interdisciplinary and multi-disciplinary approaches, combinations of respective methods and techniques	3	2.40	1.19
Philosophy of knowledge deliberations	3	-0.20	2.04
Aspects of knowledge sharing, e.g. transactive memory, common knowledge, connecting people	2	1.64	1.15
Organisational learning	2	1.52	1.29
Knowledge enabling	2	1.16	1.34
Social network analysis	2	1.76	1.13
Instruments and practices	2	1.40	1.15
A different conception of management	2	1.16	1.82

Question 3: What is the most important recent theoretical advancement in knowledge management? (see Table VII)

Whereas the even distribution of most of the frequencies in the first round (eight categories with $F=2$) give no clear distinctions regarding the relevance of recent theoretical advancements, the ratings of the second round present a clearer picture. Noticeably, the first three ranks: priority on human factors; shift from an IT-perspective to a behavioral science perspective ($F=2$; $\bar{x}=1.92$); social network analysis ($F=2$; $\bar{x}=1.79$); and matching social and technical aspects ($F=2$; $\bar{x}=1.72$) are pointing to the growing importance of behavioral science approaches as compared to IT-approaches – a shift towards that perspective is taking place. IT-systems and capabilities are rated much lower ($F=2$; $\bar{x}=0.5$). This can be interpreted as learning from the failure of the first generation of KM projects, which promoted sophisticated information management techniques as the core of knowledge management (Snowden, 2002). A better match between the social and technical aspects of knowledge management is considered to be a substantial progression.

Also, some advancements have been made by the use of organizational learning approaches ($F=2$; $\bar{x}=1.52$). Organizational learning ranks high in all three questions; it is mentioned as an important problem as well as a promising solution and some advancement already has been made. This appears odd at first sight but can be explained by the different contexts in which it is mentioned and with the different examples it was stated: in the first question, it was exemplified by forming and developing organizational competence, which was seen as a challenging problem. In the second question, the concept of organizational learning was not narrowed at all and thus presented as a global concept. And it was the view of the panelists, that in organizational learning in general, some advancement has been made, especially in emphasizing the collective in contrast to the individual learning aspect.

The advancements in connection with implicit knowledge, most frequently mentioned in the first round ($F=5$; $\bar{x}=0.76$), are not considered to be of high relevance in the second round on average, although there is less consensus on that issue as indicated by the relatively high standard deviation ($s=1.94$). But what is more important, it is disagreed by the majority of the respondents that there is no recent theoretical advancement at all ($F=2$; $\bar{x}=-1.14$), as two participants have stated in the first round.

Question 4: What is the most pressing and challenging practical problem for the understanding and advancement of knowledge management? (see Table VIII)

Answers to the fourth question are slightly more concrete than to its theoretical counterpart, the first question. The results obtained in the first round are more differentiable here, at least among the higher ranking categories. The categories knowledge assessment ($F=14$), knowledge

Table VII Results for question 3

Category	F	\bar{x}	s
Implicit knowledge: the distinction between implicit and explicit knowledge	5	0.76	1.94
Knowledge enabling	3	0.79	1.25
Systems theory, e.g. autopoiesis, systemic thinking	3	1.04	1.52
Organizational learning, collective learning models	2	1.52	0.99
Nonaka and Takeuchi: spiral of knowledge creation, Ba	2	1.04	1.78
Boisot: I-space, knowledge production	2	0.33	1.66
IT-systems such as Web tools and portals, IT capabilities	2	0.50	1.98
Matching social and technical aspects	2	1.72	1.06
Priority on human factors: shift from an IT-perspective to a behavioural science perspective	2	1.92	1.19
Social network analysis	2	1.79	1.25
None (there is no recent theoretical advancement)	2	-1.14	1.73

Table VIII Results for question 4

Category	F	\bar{x}	s
Knowledge assessment: measuring and validating knowledge, inventorying knowledge; distinguishing between data, information and knowledge; quality measures	14	1.96	1.17
Knowledge sharing, e.g. identifying the knowledge bearers within an organization, convincing and motivating people to share their knowledge	10	1.75	1.29
Knowledge creation, knowledge selection and use of knowledge	6	1.32	1.38
Barriers: organizational, technical and emotional barriers; breaking the dominance of Taylorist thinking	4	2.29	0.95
Matching social and technical aspects	4	1.42	1.21
Organizational culture promoting knowledge management	3	2.04	0.98
Time for knowledge management	3	1.36	1.44
Knowledge organization: transforming an organization into a knowledge organisation, reducing the knowledge management overhead	3	1.60	1.29
Sensibilisation, awareness raising for knowledge management	3	1.32	1.35
Knowledge-orientated data-bases, e.g. knowledge formats, extracting knowledge from documents	3	0.16	1.89
Implicit knowledge: externalisation of implicit knowledge, distinction between implicit and explicit knowledge	3	0.80	1.29
A different conception of management, new mindset for management	3	1.40	1.63
Motivation for knowledge management	2	1.30	1.43
IT-systems: intranet, internet and groupware	2	0.00	1.73
Instruments and practices, e.g. activity reports and measures to increase usability	2	1.12	1.01
Standards: standardization of knowledge management vocabulary and knowledge management processes	2	0.60	1.63

sharing ($F = 10$), and knowledge creation, knowledge selection and use of knowledge ($F = 6$) stand out. Thus, the core activities of knowledge management processes are often used to frame the pressing practical problems. The importance assigned to knowledge assessment reflects a clear need to have some indicators to measure the organizational knowledge base and to control its development.

However, the emphasis is shifted quite a bit in the second round. The first and second ranking categories from the first round remain among the largely agreed categories, i.e. knowledge assessment ($\bar{x} = 1.96$) and knowledge sharing ($\bar{x} = 1.75$). But they are topped by barriers to knowledge management ($F = 4$; $\bar{x} = 2.25$) and an organizational culture that promotes knowledge management ($F = 3$; $\bar{x} = 2.04$) as the most pressing practical problems. These answers reflect that the progress to a conscious knowledge management was and is much more difficult than promised and expected in the past. Transforming an organization into a knowledge organization is therefore agreed upon as a pressing practical problem ($F = 3$; $\bar{x} = 1.60$). The addendum: reducing the KM overhead suggests that this category parallels the answer to question 1 – integrating KM into the common business processes and can be seen as a rejection of the implementation of a special organizational KM overlay.

Again, IT-aspects get the lowest ratings both in the first and in the second round and thus are less important practical problems than organizational issues, which again indicates a withdrawal from the IT-focus of the first generation of knowledge management.

Question 5: Which practical approaches are most likely to deal effectively with these practical problems? (see Table IX)

Whereas the use of IT systems to solve the practical problems was mentioned relatively often ($F = 4$) as a promising practical approach in the first round, IT-aspects ranked very low in the

Table IX Results for question 5

Category	F	\bar{x}	s
Communities of practice	6	2.12	1.09
HR management, e.g. capabilities development, management by knowledge objectives, altering assumptions about people and human nature, measuring employees on knowledge management	4	1.12	1.45
IT-systems: intranet, internet, groupware; computer-based information-systems, Web tools, networking, chat rooms	4	0.64	1.91
Focus on organizational culture; cultural change away from command and control, fit between the business culture, knowledge management potentials and information systems	3	1.76	1.01
Knowledge roles, e.g. internal auditors, knowledge workers	3	1.12	1.45
Incentives: providing (im-)material rewards for sharing knowledge	3	0.72	1.81
Knowledge assessment, e.g. evaluation systems, verification of knowledge, follow-up analysis and project success measures	3	1.88	1.17
Knowledge trading, e.g. via knowledge market places or e-commerce	2	0.40	1.85
Learning, e.g. internally by encouraging user interaction or externally by capturing experience from consulting firms	2	0.92	1.64
Integrating knowledge management into business processes	2	2.48	0.65
Artificial intelligence tools, e.g. human language technologies	2	-0.17	1.86
Sensibilisation: raising the awareness for the importance of knowledge management	2	1.42	1.32

second round ($\bar{x}=0,64$). Here too, organizational measures seem to be more promising. Integrating knowledge management into business processes ($F = 2$; $\bar{x} = 2.48$) holds the highest promise in the eyes of the respondents. But there have been few clear exemplifications in the first round answers of how to achieve this, which could be presented in the second round. Categories like sensibilization, incentives, internal and external learning or human resource management could be such integration candidates but they are on average not really agreed upon. Taken together, they may reflect an appropriate focus on organizational culture ($F = 3$; $\bar{x} = 1.76$), with a change away from command and control in order to unleash knowledge potentials. This result validates the findings in the benchmarking survey regarding the management tasks “provide conditions for autonomous actions” (76.7 percent) as one important characteristic of management tasks to support knowledge sharing (Heisig and Vorbeck, 2001, p. 109).

Communities of practice rank second among the practical approaches ($F = 6$; $\bar{x} = 2.12$), a much more concrete and apparently effective means to (self-)organize and to utilize human capabilities. Another important approach is marked by various forms of knowledge assessment, e.g. evaluation systems, verification of knowledge, follow-up analysis and project success measures ($F = 3$; $\bar{x} = 1.88$). Interestingly, knowledge assessment has already been among the three pressing practical issues which indicates that some promising methods of knowledge assessment are out there which could solve those problems if they were developed further.

Question 6. Which practical advancements are the most important recent practical advancements in knowledge management? (see Table X)

Whereas IT-systems were most often nominated as a recent practical advancement in the first round ($F = 7$), it declined sharply in the comparative judgment of the second ($\bar{x} = 0.60$). Instead, the priority on human factors, e.g. the non-technical reflection of knowledge management, emphasizing social aspects is seen in retrospect as the most important advancement ($F = 2$; $\bar{x} = 1.96$). This is underlined by the high valuation for emphasizing human approaches, considering human values, trust etc. ($F = 3$; $\bar{x} = 1,83$). Highly estimated as a recent practical

Table X Results for question 6

Category	F	\bar{x}	s
IT-systems: intranet, internet, groupware; web conferencing, filing systems, instant messaging, collaborative knowledge creation tools, portals and e-mail	7	0.60	1.96
Communities of practice	5	1.84	1.25
Sensibilisation: awareness raising for the importance of knowledge management	4	1.16	1.31
Transfer techniques, e.g. storytelling	3	1.50	0.98
Emphasizing human approaches, considering human values, trust etc	3	1.83	1.09
Artificial intelligence tools, e.g. sophisticated information extraction and document management systems	2	-0.12	1.96
HR management, e.g. supporting grass-root knowledge management-initiatives, group intervention techniques; Knowledge roles, e.g. knowledge management officers (KMOs)	2	0.96	1.43
Priority on human factors, e.g. the non-technological reflection of knowledge management, emphasizing social aspects	2	1.96	0.93
Knowledge assessment, e.g. knowledge value added (KVA) technique, knowledge as long term investment goal	2	1.64	1.60

advancement are also communities of practice ($F=5$; $\bar{x}=1,84$) which had already a top placement in the last question regarding promising practical approaches.

Although knowledge assessment has been among the practical problems (see above), some advances are also reported, partly due to the development of the knowledge value added technique (KVA) (cf. Housel and Bell, 2001) ($F=2$; $\bar{x}=1.64$). Another advance is visible in the field of transfer techniques, such as storytelling ($F=3$; $\bar{x}=1.50$), which is also a mainly human approach.

Finally, the relatively low values for IT-systems in the second round have already been mentioned. IT-techniques like intranet, Internet, groupware, Web conferencing, filing systems, instant messaging, collaborative knowledge creation tools, portals and e-mail, were nominated in the first round, of which at least some of them are commonly used whereas their value for KM seems doubtful. The practical advancements in the field of artificial intelligence tools seem to be even less important for knowledge management ($F=2$; $\bar{x}=-0,12$). Since more respondents answered this question on the negative side, i.e. they disagreed, it is not fully clear whether they see no recent advancements with AI-tools, whether they see them as not practicable or whether they judge them as not important. Probably a mixture of all three aspects causes the low score in the respondents' answers. Finally, the opinion on technological aspects of knowledge management seems to be quite diverse, since IT-systems and AI-tools get low average weights but also very high standard deviations.

The majority of the observed practical advancements originate from the proper use of human capabilities and a supporting environment. The importance of technical aspects seems to fade, basic problems are mastered and further progress for knowledge management apparently has to be sought in the human capabilities – organizational facilitation interface.

Further comparisons

The expectation was that the topics which received high relevance in the second round had been already named more frequently in response to the open questions in the first round. However, the findings do not support this hypothesis. Five of the six correlations are quite low and not significant (see Table XI).

The reason for this generally low correspondence may be that the respondents originate from diverse fields of research and practice and show vast differences among their disciplinary backgrounds. Thus, the topics that lie within their own area of interest should have been most

Questions	1	2	3	4	5	6
Correlations (n)	0.31 (12)	-0.24 (13)	-0.18 (11)	0.68** (16)	0.11 (12)	-0.26 (9)

Significance: ** = $p < 0.01$

accessible to their memory in the first round; but confronted with topics from another area, things are reflected differently in the second round. As the only exception, the most pressing and challenging practical problems (question 4) seem to have crystallized in the discussions on knowledge management such that the first open answers show a similar weighting as the second closed format ratings of a broader array of alternatives.

How similar or how divergent are the ratings of scientists and practitioners? The sample was explicitly proportioned in order to be able to answer this question. Table XII shows the correlations per question between the rank orders of their mean estimates.

The consensus between scientists' and practitioners' judgments is – according to the effect size of the correlations – strong to very strong, and all but one show significances of $p < 0.10$ or smaller. This indicates that there are no fundamental differences in the views of both groups. Somewhat more divergent is the view on practical advancements in the past (question 6) and on the most promising theoretical approaches (question 2).

Another comparison between respondents' groups can answer the question of how similar or how divergent the estimates of natural versus social sciences people are. Table XIII shows the results.

The comparison between respondents originating from the natural and the social sciences shows even fewer differences in the ratings than between practitioners and scientists. All correlations are high or very high and all of them are at least significant on the 5 percent level. Taken together, the ratings between both pairs of groups are relatively similar, more than expected. This suggests a basic consensus in the field.

A final test is made for possible regional differences. In the second round the German participation was even stronger than in the first, i.e. 14 respondents came from Germany, 6 from other European countries, 4 from the US and 1 from South Africa. So we divided the sample into German and non-German respondents and looked for significant differences in the 74 items of the second round questionnaire. In general, Germans gave more extreme scores, especially in questions 1, 4 and 6, where the average difference was above 0.42. There were

Questions	1	2	3	4	5	6
Correlations (n)	0.65* (12)	0.49 ⁺ (13)	0.83** (11)	0.62** (16)	0.95** (12)	0.50 ^{ns} (9)

Significance: ⁺ = $p < 0.10$; * = $p < 0.05$; ** = $p < 0.01$; ^{ns} = not significant

Questions	1	2	3	4	5	6
Correlations (n)	0.57* (12)	0.60* (13)	0.83** (11)	0.60* (16)	0.76** (12)	0.80** (9)

Significance: * = $p < 0.05$; ** = $p < 0.01$

6 differences significant on the 5 percent level, but the rank differences were usually not so large. The rank correlations between the average German and non-German ratings were all significantly and substantially correlated (see Table XIV).

In question one, the integration into business processes obtained a German average of 2.57 (rank 1), whereas the others gave only 1.55 (rank 3.5). Based on a strong development tradition in applied science of methods and tools for business process design, the proponents now try to widen their approaches towards the combination with KM (Bach *et al.*, 1999; Heisig, 2001; Abecker *et al.*, 2002; Remus, 2002; Reimer *et al.*, 2003; Gronau, 2003). In question two we found the most important difference: complexity theory was strongly valued by non-Germans (1.82; rank 2.5), but almost least valued by Germans (-0.57; rank 12). It seems that complexity theory is not well known and therefore not well accepted in Germany. In question 3, Germans strongly denied that there is no recent theoretical advancement (-1.79; rank 11), whereas non-Germans just did not agree with that statement (0.00; rank 10). In question 4 there are substantial significant differences in the importance of knowledge sharing, with an average German rating of 2.36 (rank 1.5) and a non-German average of 0.90 (rank 10.5), as well as differences in the importance of motivation for knowledge management with Germans giving 1.86 (rank 5.5) and non-Germans 0.44 (rank 14). In question 6 there was a significant difference in the estimation of communities of practice which were valued higher by Germans (2.29; rank 1) than by non-Germans (1.27; rank 5). There were no IT-related estimates significantly different. Taken together, it seems that Germans are a bit more enthusiastic about knowledge management and its main themes (except complexity theory).

Discussion

The delphi study on the future of knowledge management gives a differentiated picture. There is progress in the field, theoretical as well as practical advancements have been noted in the first round and weighted in the second round. In the answers to the questions 3 (q3) and 6 (q6) the most important advancement was a priority on human factors, which means a shift from an IT-perspective to a behavioral science perspective (q3: 1.92), and a non-technological reflection of knowledge management, emphasizing social aspects in practice (q6: 1.96). Consequently, IT-aspects always rank very low in importance or are even not mentioned at all as a promising theoretical approach (q2). The low importance of IT-aspects can be understood as mirroring the not fulfilled promises of the so called first generation of knowledge management (Prusak, 2002; Snowden, 2002). The relatively naive expectation that the new IT-possibilities for information management can be easily translated into large progress in knowledge management is – implicit in these answers – almost unanimously rejected. That does not mean that IT-support is useless; the basic IT-techniques like relational data bases, e-mail and e-conferences, Internet and intranet etc. just seem to be sufficient as information infrastructure for many KM applications. In organizational practice, such IT-solutions are the most frequent approaches to start with knowledge management (Davenport and Völpe, 2001). Matching social and technical aspects (q3: 1.72) therefore seems to be a real advancement. But how to succeed in this (and other) KM matters?

The main steps from a “natural” processing of knowledge in organizations to a reflected knowledge management are not straightforward and have to master primarily the human-organization interface. This is reflected in many specific results of the delphi study. For instance, the popular ideas of Nonaka and Takeuchi (1995) regarding the distinction between implicit and explicit knowledge have been often mentioned as a theoretical advancement (q3) as well as a theoretical and practical problem (q1, q4) in the first round. Yet, they achieved low weights in

Table XIV Rank order correlations (spearman-rho) of averages of the second round between German and non-German respondents

Questions	1	2	3	4	5	6
Correlations (n)	0.70** (12)	0.57* (13)	0.68** (11)	0.58* (16)	0.82** (12)	0.58* (9)
Significance: * = $p < 0.05$; ** = $p < 0.01$						

the second round ($\bar{x} = 0.76$; $\bar{x} = 0.80$; $\bar{x} = 0.80$) and they have not been mentioned at all among the promising theoretical and practical approaches as a means how to deal with this problem (q2, q5). Why are these seemingly convincing ideas not high on the KM agenda? Snowden (2002) suggests, that knowledge has been dealt with as a thing which could be transformed from implicit to explicit and back again, and that this was the fundamental flaw in the concept.

Another example of the human-organization interface problematic are the top values given to the idea of integrating knowledge management into the common business processes as the most promising practical approach (q5: 2.48) as well as the prime theoretical problem (q1: 2.12). These high valuations probably result from the insight, also gained from early KM initiatives, that an extra organizational department or organizational layer for knowledge management misses the main problem: knowledge has to be attained, shared and used within the daily work itself at every point in the organization because the most important parts of knowledge can not be handled as a thing for others. The high valuation has some specific German flavor, because there is a strong tradition in applied science in developing methods and tools for business process design; these proponents now try to widen their approaches towards the combination with KM (Bach *et al.*, 1999; Heisig, 2001; Abecker *et al.*, 2002; Remus, 2002; Reimer *et al.*, 2003; Gronau, 2003). But it is also underlined by the much lower importance ratings for special knowledge roles (q5: 1.12; q6: 0.96) and by the agreement that transforming an organization into a knowledge organization also means reducing the knowledge management overhead (q4: 1.60). Although the integration of KM into daily business processes is the most promising practical approach (q5), as agreed and taken up by many researchers (Wiig, 1995; Weggeman, 1998; Heisig, 2000; Prusak, 2002; El Sawy and Josefek, 2003), research is still required to engineer and test practical methods and tools and to integrate them with the existing organizational environment in order to overcome organizational, technical and emotional barriers (q4: 2.29). A possible step in this direction are the assessment methods proposed by some KM approaches, which aim to identify the current state of knowledge processing, the framework conditions as well as the enabling factors and barriers in order to set up a KM initiative successfully (e.g. Weggeman, 1998; Langen and Ehms, 2000; Mertins *et al.*, 2001b).

A focus on organizational culture with a cultural change away from command and control and a fit between the business culture, knowledge management potentials and information systems (q5: 1.76) give some direction where to move. This validates the results from the benchmarking company survey, where culture ranked first as critical success factor for KM (Mertins *et al.*, 2001a). But at the same time a culture promoting knowledge management is a big practical problem (q4: 2.04). In the scientific debate on organizational culture there is wide agreement that it is difficult to form a culture at will. Of course, the literature on organizational culture offers some insights in general (e.g. Denison, 1990; Gebert *et al.*, 2001), but the link to KM has still to be better specified.

The really complex and difficult nature of knowledge management comes up from question 2: the most promising theoretical approaches are interdisciplinary and multi-disciplinary approaches, combinations of respective methods and techniques (2.40) and empirical research designs, e.g. action research, case studies, survey studies, qualitative studies, statistical studies (1.88). That means, that scientific work from a purely disciplinary perspective falls short of the real problem and much more interdisciplinary and empirical work is needed on KM than until now. KM approaches have to integrate different perspectives in order to provide useful help for the organizational practice. Many of the existing KM frameworks are addressing the main aspects of KM already, but more research is required to fill the gap between the identified critical aspects and appropriate methods to analyze, design and implement appropriate KM solutions.

For theoretical concerns some help can be gained by going back to the organizational learning debate which is rated as an important recent theoretical advancement (q3: 1.52), is seen as a promising theoretical approach (q2: 1.52), but is still more seen as a pressing and challenging issue (q1: 1.92). Of course it is useful to look to the organizational learning debate since it could



be a theoretical basis for the corresponding management problems and solutions. But regrettably, this literature is also somewhat diffuse and contradictory, dominated by interesting ideas which are not sufficiently tested empirically. So, it resembles KM not only in content but also in scientific status.

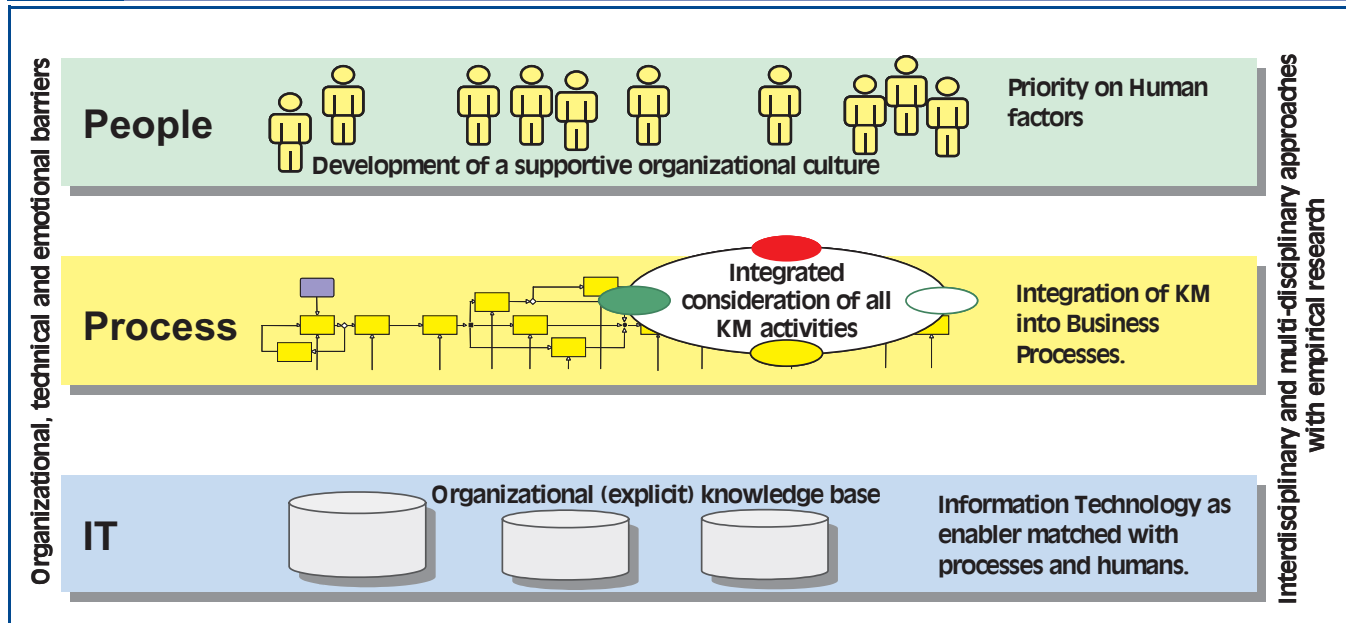
Agreed upon recommendations for concrete theoretical and practical solutions are rare: communities of practice (q5: 2.12; q6: 1.84) stand out, and social network analysis (q2: 1.76; q3: 1.79), which is helpful for identifying connected or to be connected people, e.g. as potential members of communities of practice. Some concrete advancements are also agreed upon in the field of knowledge assessment, e.g. the KVA technique, knowledge as a long term investment goal (q6: 1.64) and other practical solutions are offered, e.g. evaluation systems, verification of knowledge, follow-up analysis and project success measures (q5: 1.88). But some caveats remain, since assessment procedures may be trapped again into handling knowledge as a thing (Snowden, 2002) which can be measured like other things. So, it remains on the agenda as a theoretical and a practical problem (q1: 1.52; q4: 1.88).

Last but not least, knowledge sharing came up as an important theoretical and practical problem, especially in Germany (q1: 2.04; q4: 1.75), e.g. identifying the knowledge bearers within an organization, convincing and motivating people to share their knowledge (Dierkes and Houben, 2002). There are also some promising approaches to that problem: theoretical approaches mentioned as exemplars of sharing include transactive memory, i.e. ways to know about who knows what (Moreland, 1999; Brauner, 2002), which has already been used for a process-oriented KM approach (Remus, 2002), common knowledge, i.e. how to create a common ground for mutual understanding, and connecting people (q2: 1.64); the last may be supported by social network analysis (q2: 1.76). Practical approaches to knowledge sharing concentrate on incentives, providing (im)material rewards for sharing knowledge, which are less well estimated by the panelists (q5: 0.72), and of course include the highly estimated communities of practice (q5: 2.12). Especially in Germany, there is currently a high interest about communities of practice in academic research (Spath *et al.*, 2003) and in industry (Schön and Gunther, 2002).

With regard to the three contrasts from the introduction, the survey revealed that the whole array of knowledge processing tasks like creating, procuring, storing, sharing and applying knowledge is still not equally attended. Often knowledge sharing (see q1: 2.04) is the core intent of a KM initiative, combined with heavy investment in IT-solutions. The other relevant processes like creating, selecting and using knowledge are less well regarded in theory and practice (q1: 1.32; q4: 1.32). This is surprising because one of the most prominent KM approaches, proposed by Nonaka and Takeuchi (1995), focuses on knowledge creation and there is a huge interest in combining the ideas on knowledge creation with innovation management. And what is the use of knowledge creation and sharing if it is not applied by the receiving, deciding and acting persons (see Wilensky, 1967)? In a newer study on information pathologies, the missing or incorrect application of received information was the most frequent failure in the knowledge processing cycle (Scholl, 1999). This gives an answer to the first contrasting question of the introduction: the main knowledge processes are still unequally attended by the experts and practitioners in the KM movement, which started with knowledge sharing and still dwells on it.

The second contrasting question was clearly answered: human resource solutions are seen as much more challenging as well as more promising as IT-solutions. The task of future KM efforts is to concretize that line of thinking and acting. The third question about the better understanding of the nature of knowledge itself was not explicitly brought up in the first delphi round and can therefore not be compared to other problems from the second round. The implicit-explicit-distinction is an important aspect of the nature of knowledge, but it seemed not to be very relevant to the respondents as shown above. Terminology was also mentioned but seemed also not a very pressing issue (q1: 1.04). Least respected are philosophy of knowledge deliberations (q2: -0.20) which may be seen as underestimated when the question about the nature of knowledge is really set on the agenda. Some more differentiated conceptions of the nature of knowledge are given in the literature (Collins, 1993; Blackler, 1995; Krogh and Venzin,

Figure 1 Main research recommendations from the delphi study on “future of knowledge management”



1995; Schreyögg, 2001; Brauner, 2002), but more research is needed on the usefulness of these distinctions.

Taken together, the future of knowledge management depends on the following insights and steps to be taken: a shift to the priority of human factors is already taking place and is strongly recommended for the future. The integration of KM activities into business processes should be fostered and methods to support this are already underway. IT-systems and programs should have no more but also no less than a supportive role if they are properly matched to the human and organizational factors. The sciences have to establish a sound interdisciplinary framework for KM which can be successively developed, filled and improved by manifold empirical investigations (see Figure 1).

First efforts to establish a European KM framework are currently underway within the CEN/ISSS workshop on knowledge management. The aim of this workshop[2] is “to investigate those soft areas related to KM which can be the subject of common approaches, good practice identification or standardization initiatives, and to situate and describe these in the wider organizational context. The overall intention is to provide meaningful and useful guidelines to companies, and notably SMEs, as to how they might align their organizations culturally and socially to take advantage of the opportunities of knowledge sharing within and beyond their organizational boundaries” (CEN/ISSS, 2002).

In the meantime, organizations will make more experiences with existing concepts like communities of practice, storytelling, transactive memory promotion and the like and will develop other new KM forms, i.e. they will learn – after reviewing the experiences of others – by own trial and error. If they do this with a firm commitment to human factors and a keen eye on a supportive culture they will have a better balance of success and become more effective in general.

Note

1. The conference entitled “First international conference on the future of knowledge management” took place on 8-10 March 2002 near Berlin and was financed by the Stifterverband der Deutschen Wissenschaft (Donors’ foundation of German Sciences). We thank all participants for their helpful comments.
2. For more information see www.cenorm.be/iss/Workshop/km/Default.htm

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