

**OECD Survey on Knowledge Management**  
**German Pilot Study – Key Results and**  
**Bullet Points for Discussion within the OECD Group**

*Focused Summary – Draft*  
*do not quote*

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## **In a nutshell**

### **Purpose**

This report contains the analysis and conclusions of the German pilot study conducted in the context of the OECD initiative to analyse knowledge management in industry. The purpose of the pilot study is to test a questionnaire that was developed in the OECD expert group conducting the study. This report summarises tendencies in the data on the basis of that questionnaire and gives some comments and recommendations for the possible improvement of the questionnaire.

The *German* pilot study had an *add-on section* focused on the detection, absorption and integration of external "technological" knowledge – as opposed to knowledge on market participants, clients or organisational features etc. While this add-on delivers additional results that can stand alone, it enables also a further differentiation and deeper understanding of some major aspects of the core study as well. In the second section (chapter 4) this report summarises the results of the add-on as well.

### **Methodology**

For the German pilot study, 400 companies from four traditional sectors chemistry, mechanical engineering, electronics/electrical engineering and vehicles were randomly selected and received a questionnaire. While in the main OECD study the service sector should be included as well, this selection was based on the special fit for the German add-on. 53 questionnaires were sufficiently filled in, the response rate is 13.25%. The responding sample was distributed very unevenly across sectors, but as regards size the distribution was rather even, allowing for sound differentiation in the dimension size. Furthermore (coming from the add-on section), 54% of the companies had an R&D department, and 55% were innovators (more than 10% turnover with products introduced within the last 3 years). This also enabled some differentiation as to innovative and R&D active companies.

In addition to the analysis of the questionnaires, six telephone interviews (ex post) were conducted with responding companies, the results of which are included in the comments sections.

The statistical analysis at this stage is mainly descriptive, however, a list of 42 hypotheses has been drawn up (annex 1) that were all tested with various statistical measures. At this stage the results are not satisfactory for the majority of hypotheses. A higher responding number, however, will enable differentiated analysis of the questionnaire.

The German pilot questionnaire is given in annex 2, accompanied by a table of correspondence with the OECD core questionnaire (annex 3). In addition, appendices 1 and 2 give the relating figures for the data interpreted in this report.

### **Tendencies in the Data: OECD Core Study**

*Practices currently in use:* all in all, practices of a more operational mode are more common than strategic activities (strategies, leadership, incentives), while incentives in the context of KM are the exception. While written KM strategies are not very common, companies claim to have appropriate value systems. Acquiring external knowledge seems to be the most common KM activity, followed by communication measures (database, intranet) and training/mentoring. Big companies are more likely to have a whole range of KM activities and to have some kind of explicit or conscious KM strategy. Companies in which top management is responsible and companies which are strong innovators, respectively which are active in R&D (this information stems from the German add-on) use KM practices more intensively and broadly. As a result of the question about activities not asked for, it seems that a more differentiated look at electronic devices (intranet etc.) would be worthwhile.

*Reasons to introduce KM:* overall, the three most important reasons are competitiveness, efficiency in production and protection from loss of knowledge. The least important reasons are enabling collaborative work across distances and the sharing of knowledge with external partners. However, the variance of the reasons to use KM is very low, which might have methodological reasons, as the scale is only ranging from 1 to 4 and all reasons are somewhat important for management activities in general. Therefore, the differentiation according to size or other variables also results in low differences, with big companies indicating slightly higher values along the whole set of reasons. Reasons were intellectually clustered in four different sets (internal knowledge integration, external knowledge interfaces, operative reasons, strategic reasons), however, variance remains low.

*Effectiveness of KM:* the most important effect is the improvement of worker skills, the adaptation of products and avoidance of duplicated R&D. There is no clear tendency as to what *kind* of effects are especially important. By the same token, the differences in size, top management responsibility or innovation activity within firms is negligible. Clustering the numerous variables intellectually into the same four clusters as for reasons above, the effects are highest for "internal knowledge integration". Bigger companies also have high values for the improvement of "external knowledge interfaces".

*Measurement of effects:* only a minority of companies measure effects and there is no single measurement practice that stands out. Interviews conducted confirm difficulties to grasp effectiveness methodologically.

*Relations between use of, reasons for and effects of KM practices:* for the variables in question 1, 3 and 4 three correlation matrices have been tested, both for all variables (question 3 and 4) and – in order to get more aggregated results - for the clusters of variables. While there are some correlations at this stage already that need not be further interpreted here, a higher number of respondents will certainly deliver interesting results at a later stage. What is striking looking at the correlation of the practices (question 1) with the *aggregate of all effects* is the *significant correlation* of practices of *knowledge capture and training/mentoring* on the one hand with the total aggregate of effects on the other hand.

In slightly more than 50% of all companies the *top management* is *responsible* for KM, with negative correlation for size of the companies, since in big companies KM is a sub-field of some other function (e.g. HRM). Therefore, it is not surprising that the management itself is the most important *triggering source*. As for budget for KM; the companies had difficulties to define one, only 29% indicated to have a dedicated *budget*. Resistance to KM is generally very low, management being mentioned most often. As for a possible *increase or introduction* of KM, the need to control and retain the tacit knowledge of the company's workforce would be the prime motivation.

### **Tendencies in the Data: Main Results of the German Add-on**

The *importance of external technological knowledge* is rated to be very important (a bit lower than internal knowledge, though), and in the future the vast majority of companies expects it to become even more important. 70% of the companies occasionally use external technological knowledge, 15 % do this often.

*Reasons to procure external technological knowledge:* the major reason to procure external technological knowledge is speed and lack of in-house capacity. Innovative companies are more aware of the fact that their in-house capacity is too special and too expensive in order to generate knowledge to be absorbed from outside.

*Importance of sources and instruments for capture:* the classical codified sources (journals etc.) are still the most important sources, followed by interactive events (fair etc.) and Internet. Direct contacts with external experts is – across the board – less important for smaller companies (exception: Fraunhofer institutes and the like). As for instruments, beyond finding access to written documentation, vertical co-operation with market partners is the most important activity to absorb external technological knowledge. Small companies seem to be disadvantaged, they do not

hire expertise and are not able to co-operate as intensively as bigger ones do, although they rate the importance of external technological knowledge as highly as bigger ones.

*Definition of demand and supply:* although external knowledge sourcing is important, only a third of the companies actively seek to define demand and supply for it. Interestingly, innovative companies are much more keen to do so than non-innovators. However, the majority of companies indicates plans to install a unit to take care of external technological knowledge in the future.

*Information on external technological knowledge:* the level of information on the knowledge provided by the public sector is significantly higher than on knowledge coming from the private sector. Half of the sample indicate knowing the supply from that source, again, bigger companies know more than smaller ones, and innovators (59%) know more than non-innovators (30%).

*Obstacles for absorption:* by far the most important obstacle is the fear of losing sensitive internal knowledge. For the whole range of obstacles, bigger companies indicate higher values than smaller ones.

## **Comments and Major Recommendations**

Following bullet points are some major conclusions for the German pilot study regarding *content*:

- From the responses and the discussion with a couple of respondents it can be concluded that, all in all, the questionnaire covers the range of KM very well. Since – like in all surveys – many companies have many different and contradicting problems with the questionnaire, the main problem seems to be to make companies fill in the questionnaire even if some (many) things are not extremely relevant for them. Here the accompanying letter is extremely important.
- The *definition* given seems to be understandable for the companies and – equally important – makes respondents think more broadly about their knowledge management than they would do without a definition or without a couple of examples.
- The clusters given in question 1 seem sensible, they could be amended with more detailed variables on IT measures, though.
- Questions 3 and 4 are crucial and, as far as the interviews and written comments are concerned, cover all relevant aspects, no respondent asked to have additional variables (except for negative ones, see below). They give a mixture of variables that can be *clustered* in related families or factors. In order to avoid question order effects it seems functional that these variables are separated. However, one could think of defining intellectual clusters to use for analysis in all countries.

- The questions on the *characterisation of companies* should be expanded to some degree in order to sharpen analysis (e.g. part of a company group).
- Furthermore, beyond the question of resistance to KM, the questionnaire fully ignores the *problem dimension*, a sub-questions on drawbacks could be added.
- Budget is hard to define for companies, it should be clearer what we are asking for (dedicated and labelled KM budget, or expenses for KM measures?).

As for the German add-on:

- The add-on questions are important for those interested in the external interfaces of KM.
- Some company characterisation as well as a set of hypotheses would further improve the possibilities of analysing the core questions (especially for use of practices, reasons and effects).
- However, it remains to be seen how relevant these questions are in the service sector.

As for *methodology*, the following is recommended:

- A separation of answering categories "*do not know/not applicable*" into "*not in use/not planned*" and "*do not know*" would ease answering and analysing alike.
- In contrast, the division "*before 1999*" and "*since 1999*" could be kept in order to identify the dynamics of KM, it would be worthwhile to consider blurring the time line ("in the last two to three years" instead of 1999).
- For statistical reasons and for the sake of uniformity in different languages, the *scale* for the questions asking for "importance" should be changed to a *five- or seven-step scale*, and only the extreme poles should be labelled.
- The question remains open how to try to detect the effects of KM better, beyond the self-estimate.

## 1. Introduction: Context and Scope

The OECD has launched an initiative to conduct comparative studies in member countries in order to learn about the existence, dynamics and effectiveness of knowledge management practices in the private sector, and in order to systemise these practices and their measurement. To do so, a group of country representatives from ministries and research bodies has been formed that aims at the formulation of a core questionnaire to be used in each of the participating countries in the course of 2002.

Since the analysis and measurement of knowledge management is a rather new exercise, there is little knowledge available about how to design and conduct empirical work in this field. In order to reduce this knowledge gap and to design a questionnaire as relevant, reasonable and operational as possible, the group has decided to conduct a few pilot studies, the results of which will be discussed in a group meeting in spring 2002. Researchers from three countries (Canada, Denmark, Germany) have volunteered to conduct these studies.

This report is the summary of the German pilot study conducted in autumn and winter 2001/2002 by the Fraunhofer Institute for Systems and Innovation Research, Karlsruhe. This pilot study – as well as the main study later on – has been made possible by the Donors' Association for the Promoting of Sciences and Humanities in Germany who fully fund it, and by the willingness of the German Federal Ministry to officially support it.

This report has the character of a draft and is meant to be an internal basis for discussion within the OECD group in the meeting at Karlsruhe, on March 25/26. In order to minimise redundancies within the group – and given the fact that the members of the group are well aware of the purpose of the whole endeavour as well as of the concepts, definitions and the core questionnaire used – this report exclusively focuses on the characteristics and results of, as well as the conclusions from, the German pilot study.<sup>2</sup>

The structure of the report derives from this main purpose. In the following chapter the operational details of the German pilot study are shortly introduced. This is followed by a presentation of the results of core questions, mainly based on descriptive statistics. Since the number of respondents is somewhat limited in the German pilot study, so are the possibilities for more elaborate statistical analysis. However, some

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2 Those readers who feel the need to put this pilot into the group context and to re-fresh the concepts and definitions used will find all this in the excellent Danish summary report by Wenche Strømsnes from the Center for Ledelse in Kopenhagen and the very detailed work by the Canadian group led by Louise Earl (StatCan) as well as in the report of the group meeting in Paris in summer 2001.

thoughts on possible analysis for the main study are presented. The key results are accompanied by comments on the possible improvement of the questionnaire, based on the analysis as well as written comments and comments given by a series of ex post telephone interviews. Chapter four presents the additional analysis of a series of questions that were of special interest both for the supporters as well as the analysts of the German pilot study. This is based on the possibility opened up by the OECD study group to add on questions to the common core questionnaire that are of a special interest to the country experts and funders. Therefore, the German pilot study added a series of questions relating to the management of (technological) knowledge external to the organisation. The report concludes with a summary of recommendations and some more general remarks.

In annex 1 at the end of this report there is a list of hypotheses given that indicates what kind of statistical and intellectual analysis could be done on the basis of this questionnaire. In addition, the German questionnaire and a list of amendments to it is given (Annex 2 and 3). The appendix gives the figures both for the Core Study (Appendix A) and the German Add-on (Appendix B).

## **2. Methodology of the German Pilot Study:**

### *Sample:*

The German pilot study covers four sectors of traditional industries:

- Chemicals (Nace 24)
- Mechanical Engineering (Nace 27-29)
- Electronics/Electrical Engineering (Nace 30-32)
- Vehicles and Transport Equipment (Nace 34-35)

It is obvious that this choice does not fully cover all sectors of interest; especially the service sectors are not represented and should be included in the main study. This choice for the pilot study was guided by the special interest in the German add-on section (see below, chapter 4), that is more relevant for traditional industry. In addition, this choice enables a cross comparison with existing studies with related topics.<sup>3</sup>

For each sector 100 companies were randomly selected from the most comprehensive German company database Hoppenstedt.<sup>4</sup> In early January, 400 questionnaires

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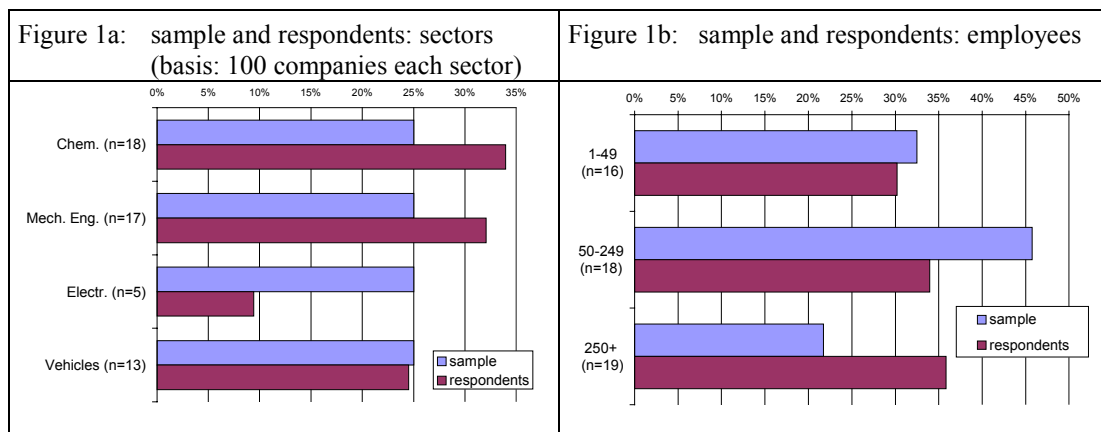
<sup>3</sup> However, this cannot be dealt with in this summary report.

<sup>4</sup> Moreover, the selection of companies had to be compared with the sample of a large scale survey done by the Fraunhofer ISI a year ago in order to minimise overlap in the field.

were sent to the companies. A reminder was sent by normal mail in early February. Altogether, 53 companies replied in a way that enabled analysis. 10 companies indicated that the questionnaire was not relevant for them, mainly because they were too small. A few indicated lack of time to answer. The overall response rate is 13.25%, which is not fully satisfactory, but compared to similar surveys conducted in Germany (e.g. Community Innovation Survey), the response rate is much better.<sup>5</sup>

Figure one shows the distribution of respondents as to sectors and employees. The sectoral distribution is rather uneven, with a response rate over 30% for chemistry and mechanical engineering and less than 10% for electronics/electrical engineering.<sup>6</sup> The distribution of responding companies as to size (employees) is characterised by a high response rate for big companies (21%), an average response rate of 12% for very small companies and a low response rate for medium-sized companies (below 10%). Given the random distribution of the sample, this means in effect, that the absolute numbers of respondents for each of the three size groups is very similar (lower bars in figure 1b), enabling a differentiation of the analysis along dimension *size*, while due to the low numbers a differentiation according to sectors is not done at this stage.

Figure 1: sample of German pilot study: total responding N: 53



### Qualitative Feedback

In addition to the postal survey, there was an attempt to get some *qualitative feedback* by telephone. Once the questionnaires had come in, all companies that had an e-mail address in the database (approximately 35) were asked if they were willing to discuss the questionnaire via telephone. 9 companies agreed, six interviews were

<sup>5</sup> In contrast to the Canadian case study, the German study is not an official state survey and participation is fully voluntary.

<sup>6</sup> Given this uneven distribution and the number of four sectors for only 53 companies, a differentiation according to sectors is not given in this analysis.

finally realised by mid March. These comments are included in the comments sections of the results.

#### *Core Questionnaire – German Add-on*

Regarding the questions of the core questionnaire, the German pilot study has used the final version that was the result of the Paris group meeting and was – after some polishing by Louise Earl from StatCan – used for the Canadian pilot study. Within this core questionnaire, *no changes* were made in the formulation of the questions<sup>7</sup>, the order of sub-questions within a block of questions, or the answering categories. The only changes in fact have been add-on questions. The *numbers* of the *questions* that are given in this report relate to the *German questionnaire*, which is given in Annex 2. Annex 3 gives a *table of correspondence* with the original core questionnaire.

#### *Merit of Descriptive Analysis at this Stage*

This chapter presents some *tendencies in the data* based mainly on a *descriptive analysis* and *some comments* derived from these analyses, as well as from written and oral comments by respondents. This discussion serves three purposes:

- (1) to indicate tendencies in the data,
- (2) to get a "feeling" for the kind of analysis that could be done and the kind of information we will get with the main study later on,
- (3) to improve the questionnaire for the main study.

#### *Differentiation*

In addition to the aggregated data - and only in those cases where significant results can be seen - the questions are *further differentiated* along three dimensions (the figures relating to this discussion are given in the appendix to this report):<sup>8</sup>

- *size*,
- *responsibility* within the company (top management yes/no) respectively
- the *innovative activity* (*innovators vs. non-innovators*) of companies, respectively R&D activists and non-activists. This last distinction stems from a German add-on question.<sup>9</sup>

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<sup>7</sup> That means that the translation tried to capture the English meaning as accurately as possible.

<sup>8</sup> There is obviously some correlation between these three dimensions: size and top management responsibility are both (weakly) positively correlated with innovation activities, while size and top management responsibility are weakly correlated in a negative direction.

<sup>9</sup> Asked for the share of turnover with new products, 55% of the sample indicated to have obtained *more than 10% of their turnover in 2001 with products that were newly introduced or remarkably improved within the last three years*. This group is defined as “*innovators*”.

### *Re-aggregation through Clustering*

In order to derive more aggregated interpretation on the reasons and effects of KM practices (questions 3 and 4), an attempt was made to cluster the numerous variables intellectually and use aggregated mean values for descriptive analysis. This makes it easier to handle correlations and more sophisticated analysis in a second step. With a higher number of respondents, this clustering could/should be done through a factor analysis to detect “types” of reasons and effects.

### *Hypotheses*

In addition to this descriptive analysis, a list of *hypotheses* has been formulated. It is given in Annex 1. Again, these serve the purpose of indicating what kind of information can be drawn from this questionnaire. A statistical test for all of these hypotheses has been conducted, however, in most cases the number of respondents is too low for significant results. Anyway, some results of the tests are included in the text. Most importantly, these hypotheses serve as a basis for the analysis of the main study later on.

## **3 Usage of Knowledge Management Practices**

### **3.1 Practices currently in use**

*General tendencies:* as to the use of KM practices (question 1), it is obvious that practices of a more concrete, operational mode (capture and acquisition, training and mentoring, communications) are far more widely-used than strategic practices; figure A1 in the appendix shows far higher average values for the various practices in the more operational dimensions than in the more strategic dimensions. However, although KM practices are widely used operationally, incentives to promote the use of KM measures are still not very common.

*Highlights of individual practices:* when looking at the various practices within the strategy/policy dimension in detail (figure A2), it appears that KM is not an object of clear strategic and codified (written) planning yet. However, almost 40% claim to have an appropriate value system and culture, and over 50% have retention schemes and use partnerships to acquire knowledge. As for the responsibility for KM (figure A3), it is interesting to note that KM seems to be a vague and horizontal concept still mainly overlooked by the top management, while distinct functionalities for KM are still the exception and are not even planned by many companies. The very low value for "explicit criteria for assessment of workers" goes in line with the generally very low values for incentive systems. While KM practices are widely used, non-monetary incentives are only in practice within a third of the companies, and non-monetary incentives are a clear exception (figure A4). The values for the acquisition of external knowledge are very high for all four practices asked about (figure

A5). Adding both "in use" answers, the values are above 60% for all of them, with industrial sources as the most important source. The most interesting development over time here is that there has been and still is a growing tendency for joint project work with external experts. Regarding training and mentoring practices (figure A6), the answers given show that companies have no formal or informal knowledge management training as such, and do not even plan to implement it. But as soon as they are asked for concrete KM practices, almost all companies do have training and mentoring practices. In this dimension, the dynamic (values for "in use since 1999" or "planned") is very low. Finally, communication practices are also widely used, and especially database management seems to be a standard tool (figure A7).

*Differentiation:* There are three distinct differences in the use of KM practices between companies of a different *size* (figure A8.1). First, the big companies (more than 250 employees) are more likely to have a distinct KM strategy and policy (almost 40% of the big companies have a written KM strategy); second, these companies at the same time have established more often KM functionalities below the level of top management, while small companies tend to have the sole responsibility at the level of top management. Thirdly, small companies have much less organisational capacity to draw on external knowledge sources than medium-sized or big companies.

For all six dimensions of KM usage, the values are higher for those companies in which *top management* has the *responsibility* for KM (figure A8.2), respectively that are *innovators* (figure A8.3) or that are active in R&D (Figure A8.4). Figure A8.4 indicates the highest difference for the mean value shown in the dimension external knowledge capture and acquisition for companies with an R&D department compared to those without an R&D department, i.e. external knowledge acquisition is – among other things – significantly research-driven. Some further statistical testing also indicates that the use of KM practices in the area of strategies/policies and communication have a significant influence on innovative activities.

***Comments on KM Definition and Practices:***

From the written response as well as from the telephone interviews there is no indication that in general the questions are too complicated or cannot be understood. The telephone interviews indicate that the concept of knowledge management as presented in the definition and the first set of questions can be well comprehended. Especially the explicit definition was important. Asked if a more concrete entry into the questionnaire – as proposed by the Danish team – by giving examples of knowledge management or by starting off with the more operational questions the telephone partners denied that this was sensible. In contrast, they feared that there would be the danger of influencing respondents and narrowing down the scope of KM understanding.

One respondent indicated that for him the definition was crucial since he would have answered the questionnaire much more in relation to IT KM tools (internal database, intranet) rather than relating it to the broader concept, which, however, he found equally legitimate. For example, in his personal definition, he would not have included questions relating to "incentives" or "communication". Similarly, another respondent would have limited KM to the management of knowledge that has been obtained through project work, mainly in R&D projects.

Nevertheless, it must be kept in mind that the interview partners were all volunteers with a special interest in KM-related questions or even with a special KM function within their company, and very likely had a clearer understanding of KM than the average respondent.

### **3.2 Knowledge Management Practices not asked for?**

Only eight out of 53 companies indicated the use of additional KM practices/ instruments not asked for in question 1:

- participation in KM project by a regional business federation
- "smart hour", i.e. a regular brainstorming exercise including external experts
- international project teams
- innovation management (?)
- standardisation
- certified quality management system
- internal training relating to specific products
- intranet forum.

#### ***Comments***

Especially the last practice, "intranet", was emphasised in two telephone interviews and might be considered to be more emphasised in question 1 also, possibly in the context of a more elaborate IT question. Moreover, as a result of telephone interviews it seems that KM for many companies is related to one or two central instruments. Although the study seeks to explore the totality of KM in companies, in order to get a feeling for the most important tools actually in use, an additional question – just after question 1 - could be included on "your most important single tool for KM".

### **3.2 Reasons to Introduce KM Practices**

*General tendencies:* the variance in the meaning of reasons (question 3) for using KM is not very high, almost all values are slightly above the medium value of 2.5 (figure A9). Only one reason stands out, i.e. the improvement of future competitiveness, which should, however, be the aim of any management practice. At the low end of meanings, it is interesting to note that the improvement of external

knowledge transfer gets a low value, although it has the highest level of usage within question 1, policies and strategies. By the same token, the improvement of collaboration with external experts has the lowest value of all reasons, but is a widely-used practice (question 1).

*Differentiation*: the difference in the significance of reasons relating to different company *size* is also rather small. Only the big companies play a somewhat special role, they have higher values than medium-sized and smaller companies in almost all reasons, especially for the improvement of collaboration within alliances, respectively among physically separated teams and for the retention of workers (figure A10). The influence of the dimensions *Top management responsibility* and *Innovators* are negligible here.

*Further aggregation*: since the reasons represent rather different dimensions, and in order to further statistically analyse and connect this question to other variables (size, top management responsibility etc.) without becoming too complex, it appears sensible to cluster the variables by factor analysis and/or intellectually. A factor analysis was conducted, since the number of respondents is rather small and the categories used (1 to 4) are not very differentiated, the results of the factor analysis are not discussed here.<sup>10</sup> Still, in the main study a factor analysis approach in questions 3 (and 4) would make sense.

Intellectually, four clusters of reasons were constructed that were used for further calculations.<sup>11</sup> It is of course open for discussion if the following clustering makes sense:

#### *Internal Knowledge Integration*

- B) to help integrate knowledge within your firm or organisation
- F) to protect your firm or organisation from loss of knowledge due to workers' departures
- J) to identify and/or to protect strategic knowledge present in your firm or organisation

#### *External Knowledge Interfaces*

- C) to improve the capture and use of knowledge from sources outside your firm or organisation
- D) to improve sharing or transferring knowledge with partners in strategic alliances, joint ventures or consortia

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<sup>10</sup> For those interested, such a factor analysis resulted in the following factors: factor 1: variables B, F, J (protection of knowledge), factor 2: H, I, L (employee related and market relations (?)), factor 3: C, E (efficient (external) knowl. integration); factor 4: 4, 11 (ease co-operation); factor 5: 1, 7 (strategy, competition).

<sup>11</sup> This somehow resembles the approach in question 1, where from the beginning the questions were clusters under six headings.

L) to promote sharing or transferring knowledge with clients or customers

*Operative Reasons*

E) to increase efficiency by using knowledge to improve production processes

K) to ease collaborative work of projects or teams that are physically separated (i.e. different work sites)

*Strategic Reasons*

A) to improve the competitive advantage of your firm or organisation

G) to train workers to meet strategic objectives of your firm or organisation

H) to increase worker acceptance of innovations

Since due to the small answering scale (1 to 4) the individual reasons show a low variance, so do the aggregated clusters (see comments below for a suggestion to improve this situation). This low variance is also reflected when looking at companies of different *size*. In general, the bigger companies show slightly higher values in all four clusters, especially in the cluster “internal knowledge integration” (figure A11). The differences for responsibility of *top management* as well as *innovative activities* are again negligible.

**Comments**

Since the alternatives given in this question are all more or less objectives of general management, KM also has some relevance in each of them (at least more than the medium value). This has also been confirmed by telephone interviews. In order to better identify differences in significance of the various reasons, the scale should be extended to 1-5 or even 1-7. This would also ease statistical analysis (e.g. factor analysis). Moreover, only the poles should be defined as being “extremely” and “not at all” important, which would also lead respondents to implicitly attribute a metric scale between the poles. This is all the more important as the questionnaire must be translated into many different languages and the various expressions used to indicate less and more importance might – unconsciously – indicate different distances between the categories in each language.

One alternative to the current approach would be to ask the respondents for rankings of the three or five most important reasons. However, in order to do so, one would have to reduce the number of (or aggregate) reasons somewhat.

Moreover, one respondent answered this question although the company only planned to introduce most of the KM practices, indicating that these “reasons” would be the “aims” of a future KM activity. Therefore, one could think of rephrasing the question and add “currently in use *or soon to be introduced* ...”.

Finally, there is some redundancy between questions 3F (“loss of knowledge due to departure of workers”) and questions 3I (“increase worker retention”), 3F could be dispensed with.

### 3.3 Effectiveness of KM

*General tendencies:* the variance between the different variables for effectiveness (question 4) is higher than the one for the reasons to use KM. At the level of single variables, the improvement of worker's skills is most important, followed by the adaptation of products and services and by the avoidance of duplication in R&D. The lowest values (below the medium value of 2.5) are attributed to involvement of workers in workplace activities, the increased ability to acquire knowledge from external sources and the increase in markets. Obviously, both these most and least important effects represent all very different dimensions of KM, which means that there is not one obvious dimension of effects most or least important.

*Differentiation:* size, top management responsibility and innovative activity make no obvious difference for the effectiveness of KM on the basis of the responding number 53. Figure A12 gives the answers as for size.

*Further aggregation:* just as for question 3 (reasons), the effect variables can also be clustered in order to aggregate information. A factor analysis was tried,<sup>12</sup> however, at this stage, the clusters used for analysis were constructed by done through intellectual clustering. Following clusters can be defined (open for discussion):

#### *Internal Integration*

- A) increased our knowledge sharing horizontally (across departments, functions or business units)
- B) increased our knowledge sharing vertically (up the organisational hierarchy)
- D) improved skills and knowledge of workers
- K) improved our corporate or organisational memory

#### *External Knowledge Interfaces*

- L) increased our ability to capture knowledge from public research institutions, incl. universities and government laboratories
- M) increased our ability to capture knowledge from other business enterprises, industrial associations, technical literature, etc.

#### *Operative Effects*

- C) improved worker efficiency or productivity
- I) increased flexibility in production and innovation
- J) prevented duplicate research and development
- N) improved involvement of workers in the workplace activities

#### *Strategic Effects*

- E) increased our number of markets (more geographic locations)

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<sup>12</sup> Results of this factor analysis: factor 1: variables G, H, I, L, M (products and external knowledge integration); factor 2: E, F, K, N (market knowledge and organisational memory); factor 3: C, D (efficiency); factor 4: 1, 2 (knowledge sharing); factor 5: 10 (R&D).

- F) improved client or customer relations
- G) helped us add new products or services
- H) increased our adaptation of products or services to client requirements

As for the clustered effects, “Internal Knowledge Integration” has the highest values for the whole responding sample, followed by operational and strategic effects. While the *top management responsibility* makes no difference, *size* matters somewhat in one cluster of effects (“External Knowledge Interfaces”), where bigger companies tend to have more positive effects than smaller ones (see figure A 13). Moreover, innovative companies see higher strategic effects than non-innovators.

### Comments

The variables for effect lack an operational basis, they rest solely on estimates and on the capability of respondents to isolate the KM effects from the effects of other management practices. In order to facilitate this estimate – and with the same reasoning as in question 3 - it is recommended to change the categories to a five or seven digit scale and to only label the extreme poles. Some interviewers indicated that the effects of knowledge management can also be partly negative (information overload, over-optimisation of tools etc.). Although it is not compelling to add possible detrimental effects or pitfalls of KM to this question, the possibility should be considered of raising possible negative or problematic effects in the questionnaire. One place to do this could be the question on resistance (question 9 of the core questionnaire, 15 in the German pilot), that could be split into “resistance” and “general problems, negative effects”.

## 3.4 Measurement of Effectiveness

Only 14% of the companies indicated that they measure the effectiveness of KM (question 6). The instruments mentioned were:

operative indicator analysis and quality and milestone controls, design review, audit, balanced scorecard, measurement of specific achievements (e.g. time to deliver technical documentation) (twice), Lotus-Notes control of expert database, numbers of intranet entries.

### Comments

This is a complicated question, since KM in many companies still seems to be one function within different operative areas or one horizontal task of top management among many. Therefore, KM mostly complements traditional management activities. To single out KM and to measure its success therefore is almost impossible for many companies. The same is true for the budgeting of KM (see below). In addition, the operationality of effects is tricky and very dependent on the understanding and tools of KM. One respondent indicated that his unit has tried to define criteria

for a long time and not really succeeded. However, these difficulties necessitate to learn more about sensible instruments and at this stage the question should be kept as it is.

### **3.5 The Relation between Use of, Reasons for and Effects of KM Practices**

In order to determine the relationship between the use of KM practices, the reasons for and the effectiveness of KM, various correlation matrixes were calculated. The coefficients are rather low, and the results of this kind of correlation might not be valid with only 50 respondents. Nevertheless, a first analysis on this basis gives an idea and a tendency, and it is planned to use this kind of calculation in the final analysis with a much higher number of respondents.

#### **3.5.1 Use of and Reasons for KM Practices**

Two correlation matrixes on the reasons to use KM practices have been calculated. For the first matrix, the answers in question one were dichotomised<sup>13</sup> and clustered according to the six groups given (average values within the possible range of 0 to 1). Then they were correlated with all variables in question 3. Table A1 in the appendix A shows this matrix.

The practice cluster “training/mentoring” shows three significant correlating relationships. Each of four further clusters of practices have two corresponding “reasons” with which they show a correlation significant at the 5% level, while the cluster “knowledge capture and acquisition” shows no correlating relationship at all. The distribution of reasons showing significant correlation(s) with practices is much more concentrated, 8 out of 12 reasons have no correlation, whereas the “enabling of co-operation of physically separated teams” shows three correlations and “sharing of knowledge with external partners” has even four correlations (all correlations positive).

In order to attain aggregated interpretation, a second, more dense matrix, was calculated with clustering the reasons also, using the four clusters defined above (see chapter 3.2.). Within this 24 field matrix, 5 relationships show a correlation with a significance above 5%, distributed across only two sets of reasons: The reasons relating to “external knowledge interfaces” have three significant correlations, the reasons relating to “operative” motivations (efficiency etc.) have two. From the

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<sup>13</sup> In use before 1999 and since 1999 was recoded to „in use“ with value 1, „planned“ and „not applicable/do not know“ was recoded „not in use“, value 0.

practices, two clusters stand out: strategies and training/mentoring with two correlations each, while three sets of reasons have no correlation at all (see table 1).

Table 1: Correlation between **use** of KM practices and **reasons to use** KM (clustered)

<i>Reasons to us KM (Q 3)</i>	<i>KM practices (Q1) (averages)</i>					
	Policies/ Strategies	Leader- ship	Incen- tives	K. capture acquisit.	Training/ Mentoring	Communi- cation
Internal Integration (B, F, J)	0.81	0.256	0.094	0.006	0.216	0.089
External Knowledge Interfacers (C, D, L)	<b>0.313</b>	0.186	<b>0.300</b>	0.121	<b>0.412</b>	0.251
Operative Reasons (E, K)	<b>0.283</b>	0.213	0.005	0.010	<b>0.295</b>	0.253
Strategic Reasons (A, G, H)	0.192	-0.051	0.148	-0.013	0.117	0.045

(Pearson coefficients, bold: 5% significance)

While appreciating the methodological difficulties at this stage, it is at least fair to say that “training/mentoring” as well as “policies/strategies” seem to play a prominent role. As for the driving motivations, the external knowledge interface, although having lowest absolute value in question 4, seems to have a rather strong relation with the KM practices.

### 3.5.2 Use and Effectiveness of KM Practices

For the variables of questions 4 (effectiveness) the same procedure as above was done. The first, detailed matrix (table A2, appendix) with the sets of reasons shows only four significant correlations (four within a 98 field matrix), with one being negative (?). Using the clusters defined above (table 2, below) only a - very obvious - relationship appears, i.e. the practices to capture “external knowledge” correlate with the effects for “external knowledge interface”. Two sets of practices (knowledge capture; training/mentoring) show at least a positive correlation with the total aggregate of all effects. This result seems plausible, since it somehow confirms the meaning of these two sets of practices as already identified above.

Table 2: Correlation between **use** of KM practices and **effectiveness** of KM (clustered)

<i>Effectiveness (Q4)</i>	<i>KM practice (Q1) (averages)</i>						
	Policies/ Strategies	Leader- ship	Incen- tives	Knowl. capture/ acquisit.	Training/ Mentoring	Communi- cation	total (all practices)
Internal Integration. (A, B, D, K)	0.134	0.189	0.164	0.052	0.244	0.185	0.229
External Knowledge Interfacers (L, M)	0.114	0.056	-0.037	<b>0.440</b>	0.255	0.140	0.275
Operative Effect (C, I, J, N))	0.142	0.061	0.001	0.116	0.144	0.145	0.160
Strategic Reasons (E, F, G, H)	-0.012	-0.126	-0.087	-0.064	-0.100	0.065	-0.077
Total Effect	0.196	0.229	0.067	<b>0.299</b>	<b>0.334</b>	0.218	<b>0.348</b>

(Pearson coefficients, bold: 5% significance)

### 3.5.3 Reasons for and Effects of KM Practices

Finally, one can analyse the relation between the reasons to use KM and the actual effects that are attributed. In doing so, it might be possible to detect if the intentions of KM actually lead to the effects sought. As respondents might tend to attribute those effects which are directly linked to their prime motivations with high values, it is no surprise that the diagonal in table 3 is correlated. However – and although the coefficients are not that high - in addition to this obvious relation, three striking relations can be detected:

- the set of *strategic reasons* shows correlation with three sets of effects,
- the set of *operative effects* shows correlation with all sets of reasons,
- the set of *internal knowledge integration effects* shows correlation with three sets of reasons.

Table 3: Correlation between **reasons to use** and **effectiveness of** KM practices

<i>Reasons to use (question 3)</i>	<i>Effectiveness (question 4)</i>			
	Internal Integration (A, B, D, K)	External Knowl. Interfaces (L, M)	Operative (C, I, J, N)	Strategic (E, F, G, H)
Internal Integration (B, F, J)	<b>0.511</b>	0.211	<b>0.376</b>	0.160
External Knowledge Inter- faces (C, D, L)	<b>0.373</b>	<b>0.354</b>	<b>0.348</b>	0.229
Operative Reasons (E, K)	0.244	0.277	<b>0.311</b>	<b>0.334</b>
Strategic Reasons (A, G, H)	<b>0.361</b>	0.210	<b>0.352</b>	<b>0.543</b>

(Pearson coefficients, bold: 5% significance)

### 3.5.4 Methodological Comment on Relations

It must be stressed that these tables only show correlations and no causalities, and that the number of respondents is low. It remains to be seen what kind of results can be obtained with a higher number of N. However, statistical analysis would be improved if one had 5 or even 7 digit scale for questions 3 and 4. The differentiation between pre-1999 and since 1999 is no problem and can be kept for descriptive analysis, however, the answers here must be aggregated for this kind of statistical analysis.

### 3.6 Responsibility for KM Management

In slightly more than half of the companies top management has the responsibility for KM (figure A14). However, the smaller a company, the more likely it is that top management is responsible, whereas in 26% of the big companies KM is a sub-field of Human Resources Management. It is extremely interesting to note that management unit and library/documentation centre were only mentioned once.

Other responsibilities mentioned included:

management circle, development unit resp. R&D resp. corporate technology, Information Technology, each employee.

#### Comments

One should think of changing “KM unit” into “KM unit or function” or “specific KM project, even if temporary”, since in many cases it seems that only one person is responsible. Moreover, one additional possibility could be R&D/technology unit, which was mentioned three times in the open field. In general, one could open up

the possibility of ranking up to three most responsible groups/persons or to allow multiple responses.

### 3.7 Sources that Triggered Introduction of KM

By far the most important triggering source for the introduction of KM measures is the companies' management (see figure A15). The second most important source are clients, which means that KM in many cases is a reaction to the needs to optimise downward market relationships. Interestingly, only few companies indicated that upward market relationships (suppliers) have been the trigger. One quarter of all companies also mentioned competitors, indicating that KM is interpreted as a tool that is directly important for competitiveness. Consultants or academics do not play a significant role.

#### Comments

In many cases IT units are in charge of KM activities. It would be interesting to find out if IT management is the trigger. Moreover, it would be necessary to know if the company asked is dependent on some (foreign) mother company and if this was the trigger.

### 3.8 Budget for KM

Less than one third (29%) of all companies indicated having a budget for KM (question 8). Out of this group, only one company said budgets would decrease, while 45% indicated increases (the rest did not know). From the 71% who indicated not having a budget, only 17% planned to introduce a budget for KM.

#### Comments

Since in most cases there is no specific KM unit (and KM cost centre) and KM activities complement activities in a range of ordinary management activities, respondents found it hard to specify a budget for KM although they know that their company spends a lot of money on KM measures. In these cases the respondents seem to have indicated "no". On the other hand, respondents who have indicated "yes" here often do this for a very specific KM tool - the most important one - without taking into account the totality of KM measures. In one case, a respondent indicated that he had given the budget for a specific project to introduce KM. It needs to be decided if the study seeks to explore if companies have a budget *specifically dedicated to KM* and also *labelled "KM Budget"* or if it seeks to find out if companies spend money on these measures at all.

### **3.9 Resistance**

Resistance to KM activities is generally very low (question 15 in the German questionnaire). Only 14% of the companies indicated to have experienced resistance at all. In five cases (less than 10% of the whole responding sample), the management itself resisted, in three cases resistance come from the R&D department. Other resisting groups are mentioned twice or less.

**Comments:**

The category "management" is too broad here and should differentiate between "top management" and "mid-level management" or something similar.

### **3.10 Reasons to Increase or Introduce KM**

The motivation to further increase or implement KM is in accordance with what one would theoretically expect. KM is introduced if the tacit knowledge of the workforce runs out of control and cannot sufficiently be used by the company as a whole. Secondly, and in relation to the first motivation, KM is increasingly seen as a reaction against loss of competency through worker retention. A somewhat contradictory conclusion must be drawn in relation to the low value for “difficulties to incorporate external knowledge”, since in the German add-on section of the questionnaire, a high number of companies indicated that external knowledge will become more important for their innovation activities in the future (figure A16).

**Comments:**

The difference between question 3 (reasons for KM) and question 16 (motivations to increase, introduce KM; question 10 in the core questionnaire) are not fully clear and have a considerable overlap. For example, it is possible, though not compelling, that an under-performance in one of the reasons to use KM (question 3) might also lead companies to increase their KM effort. Therefore, the analysis of the question 16 (10 in core questionnaire) might be misleading since the main reasons to increase might be included in 3, but not asked for here.

### **3.11 Concluding Comments on Content and Technical Aspects**

#### **3.11.1. Content**

As always, some companies indicated the questionnaire would be too detailed for small companies, would contain many questions that were only partly relevant to this company, would be too broad for the manager asked or – only once – too academic. From experience, this cannot be avoided and should not irritate the further practice too much. The problem is rather how to make companies fill in the ques-

tionnaire even if some (many) things are not extremely relevant for them. Here the accompanying letter is extremely important, it has to state very clearly that we know that their company is structured in a unique way, has its own definitions and scope of KM etc. Companies need to understand that they are relevant even if they think they are not.

The *definition* given seems to be understandable for the companies and – equally important – makes respondents think more broadly about their knowledge management than they would without a definition or without a couple of examples.

The questions on *reasons and effects* (3 and 4) are crucial and, as far as the interviews and written comments are concerned, cover all relevant aspects, no respondent asked to have additional variables (except for negative ones, see below). They give a mixture of variables that can be *clustered* in related families or factors. In order to avoid question order effects it seems functional that these variables are separated. However, one could think of defining intellectual clusters to use for analysis in all countries ex post.

The questions on the *characterisation of companies* should be expanded to some degree in order to sharpen analysis. For example, it seems obvious that in many cases companies do KM because they are, or have become, part of a larger company group. The questionnaire could identify if KM is strictly for purposes of the organisational unit asked or if it is part of a broader integration process, e.g. as a part of after-merger integration, broader international activities and so on.

Beyond the question on resistance for KM, the questionnaire fully ignores the *problem dimension*. However, KM might cause some negative effects that at least could be asked about in an open question – in full awareness that many of the respondents are the responsible persons and might not be willing to admit – or be aware of – problems.

### **3.11.2 Some Technical Aspects**

Almost all respondents asked in the telephone interviews indicated that they would have preferred a separation of answering categories "*do not know/not applicable*" into "*not in use/not planned*" and "*do not know*". The analysis later on could still aggregate if wanted, but respondents could differentiate better.

The written answers and the telephone interviews did not bring to the fore many difficulties relating to the categories "*before 1999*" and "*since 1999*". The purpose of this separation is sensible, i.e. to see how dynamic KM management is and if it is a recent phenomenon or a traditional one with a new stylish label. The same is true for the category "planned". Furthermore, in sticking to these categories, the effects could be differentiated between those companies having more traditional KM and

those who introduced it more recently. Therefore, this division could be kept. The only problem indicated was that some respondents were irritated by differentiating, giving an exact date in the past. Maybe one could change this in "introduced within the last 2-3 years", which would make it easier and reduce time to answer.

As indicated in the discussion of *question 3 and question 4*, the *scale* for the questions asking for "importance" should be changed to a *five- or seven-step scale*, and only the extreme poles should be labelled. This would avoid irritations in translating the expression for "not important at all", "less important", "important", "crucial" into many different languages. A uniform, quasi-metric scale could be much better attained only by giving number 1 to 5 or 1 to 7. Moreover, this would ease statistical analysis and result in better differentiation of mean values, especially for the question on reasons, where in effect all reasons are somewhat important for general management purposes and therefore for KM also.

## 4. The German Add-on

### 4.1 Analysing the Absorption of External Technological Knowledge: Aims and Rationale

The add-on questions had one clearly defined focus, i.e. the management of external technological knowledge, with technological knowledge simply defined as knowledge to be directly used for the innovation process of the company – as opposed, for example, to market knowledge or knowledge on organisational aspects etc.. This interest is shared by the institute responsible for the study as well as the financial and “symbolic” supporters of it, and its inclusion in the German study was a condition sine qua non. It is based on the assumption that, in order to cope with the growing dynamics and complexity of knowledge development, companies increasingly have to rely on knowledge that cannot – for various reasons – be produced within the company itself. In fact, in some cases the acquisition of external knowledge has been defined as crucial for the persistence of an efficient innovative capacity of companies. If this is so, and the study seeks to test this hypothesis, another hypothesis derives: knowledge management becomes even more complex, since important external knowledge needs to be detected, acquired and inserted into the internal knowledge circulation of companies.<sup>14</sup>

In analysing external knowledge the study concentrates on external *technological* knowledge directly utilised for product or process innovations. Being fully aware that knowledge on customer and supplier markets is of equal importance, this choice was made in order to better understand the needs, practices and problems of *companies* in the *innovation process related to the growing need to find and absorb external knowledge*. The reasoning behind this is that we know a lot about the knowledge transfer into companies from the perspectives of research institutes<sup>15</sup>. But what we know about companies’ activities to absorb knowledge is mainly limited to industrial complaints about the inertia of the research system. In order to improve knowledge diffusion in all directions within the innovation systems, it is necessary to know more about the scope of external knowledge needed, the role it plays for the knowledge stock in companies and the management of its detection, absorption and integration. On that basis, it is of highest interest to see the relation between internal and general KM practices on the one hand and the knowledge ab-

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<sup>14</sup> An early recognition of this has been given by Barabaschi , Sergio (1993): *Managing the Growth of Technological Information*; in: Rosenberg et al. (ed.), *Wealth of Nations*; Stanford: Stanford University Press; pp. 407-434. Barabaschi is a manager of a big Italian company in the electronics sector.

<sup>15</sup> Schmoch, Ulrich et al. (2000) *Wissens- und Technologietransfer in Deutschland (Knowledge and Technology Transfer in Germany. Main Findings)*. Studie für das BMBF; Stuttgart: Fraunhofer IRB-Verlag; Edler, Jakob/ Schmoch Ulrich (2001): *Wissens- und Technologietransfer in öffentlichen Einrichtungen*; in: ifo-Schnelldienst, 4/54; pp. 18-27.

sorption activities and innovative activities on the other hand. Therefore, an analytical link between the German add-on section and the core questionnaire of the OECD group is not only possible, it is crucial.

For the questionnaire, the add-on questions were included in the following way. After question 8 of the OECD core questionnaire, five questions– with some sub-questions – have been inserted that all deal with the KM practices relating to external technological knowledge. In order to relate these questions to the innovative capabilities of the companies, three additional questions characterising the innovative activities and capabilities were added at the end of the core questionnaire, just before the number of employees are asked for (question 11). In Annex 2 of this report one can find the full questionnaire used for the German pilot study (in English). Annex 3 gives a correspondence table for both versions.

## **4.2 Key Results of Additional German Questions**

### **4.2.1 Some Additional Characterisations of the Companies**

In order to better understand the dimension “technological knowledge” and related contacts with external sources, the companies were asked a couple of additional characterising questions, the results of which are presented here briefly:

- *R&D departments*: slightly more than half of all companies (54%) had an R&D department (only 16% of the small companies).
- *Innovators*: 55% of the sample indicated to have obtained more than 10% of their turnover in 2001 with products that were newly introduced or remarkably improved within the last three years. This group is defined as “innovators” (here the difference for size is rather small), and the following analysis will – in addition to size - differentiate for this dimension.
- *Contacts with public research institutes*: 35% of the sample had/have often contact, 61% “seldom”, 4% never (the bigger companies much more often have regular contacts with public research institutes than the small ones).

### **4.2.3 The Importance and Sources of External (Technological) Knowledge**

To test the hypothesis that external knowledge becomes more important, companies were asked how significant external and internal knowledge sources are for the innovation activities and if the importance of external technological knowledge will increase. On the scale between 1 and 4, the mean for the importance of internal knowledge is 3.48, and the mean for external technological knowledge is 3 (see

figure B1). However, external technological knowledge has gained importance in the last years and for two thirds of the companies it will even become more important in the future (figure B2). Again, size matters here, the big companies attribute more importance to external technological knowledge than small and medium-sized companies.

To qualify the demand for external technological knowledge, companies were asked if they use it in the core areas of their technological competence. 70% of the companies do this occasionally, 15% often and only 10% do not do this and do not even plan to do so.

#### **4.2.2 The Management of External Technological Knowledge**

*Reasons to procure external knowledge:* the two most important reasons to procure external technological knowledge are first, the speed with which companies have to react to changes in technological requirements posed by customers or suppliers that cannot be delivered in-house quickly enough and second, the lack of in-house capacity (figure B3). This picture can be further specified by differentiating according to innovative and non-innovative companies (definition see above). The data so far indicate that for innovative companies these two reasons are less important, while they recognise that the necessary knowledge generation in order to be innovative in-house is too expensive and too specialised (figure B4). Interestingly enough, size does not make a significant difference here.

*Importance of sources:* in order to find external technological knowledge for the innovation process (question 10), technical literature, special events (conferences, fairs etc.), database and Internet search are the most important sources (figure B5). As for systematic contact with external actors, public research institutes play a more important role than other, non-associated enterprises or even private R&D providers or business consultants. In contrast to the dimension “innovators”, the dimension size makes a difference here. For smaller companies direct contacts with external actors are much less important – with the notable exception of non-university institutes (like Fraunhofer institutes) – and at the same time the Internet has not yet the same importance for them as for bigger companies.

*Instruments used to capture external technological knowledge:* in order to capture external technological knowledge companies very much rely on written documentation and on vertical R&D co-operation with market participants (figure B6), while R&D co-operation with public research institutes and awarding research contracts rank number 7 and 8 in the lists of instruments. The differences for innovators vs. non-innovators are rather small, innovators tend to have a higher rate of usage of almost all instruments, especially their rate of vertical co-operation with other enterprises is significantly higher. The size of the companies makes a difference here,

the biggest companies are much more prone to higher expertise as they need it, they co-operate much more with other market participants and at the same time they are more active in co-operating with public research institutes. It is obvious that small companies are disadvantaged – or less aware. While they rate the importance of external knowledge as high as the bigger companies, their abilities (or awareness) to exploit the whole range of sources seem limited.

*Activities to define needs and detect supply for external technological knowledge:* in order to exploit external knowledge sources, companies need to determine their needs, both in the long term and for specific projects. However, the percentage of companies systematically determining these needs and keeping themselves informed about the external knowledge supply is only around 30 to 35%, with only 11% investing in procedures to specify long-term external knowledge needs (figure B6). It is no surprise that again the bigger companies are more active and more aware than smaller ones. However, the true dividing line here is innovation activities: innovators have significantly higher values in all of these dimensions, above all, they spend more on keeping themselves informed about external knowledge supply, more than 50% of the innovators invest (35%) or plan to invest (15%) in necessary procedures. What is striking is the determination of 70% of all companies to install a unit or management function to manage external technological knowledge in the future. Statistical testing shows that the usage of procedures and organisational units to scan the supply of external technological knowledge (questions 12 B, 12C) actually leads to the effect that companies utilise it more often (1d) and have better information about the supply of external technological knowledge (13).

*Information on external knowledge:* interestingly enough, despite low investments in activities to get informed, almost half of the companies claim to be informed about the external knowledge supply offered by the public research system (while only a bit less than 30% claim to be adequately informed about private knowledge providers) (figure B7). Not surprisingly, the values for innovators (59%) are almost twice as high as for non-innovators (30%) relating to the adequate information on supply at the national level. The same division can be seen as for size, with big companies being much better informed than small ones. Although almost all companies indicate that external technological knowledge will become even more important in the future, only a very small minority plans to improve their level of information on knowledge supply!

*Obstacles to appropriate and use external technological knowledge:* for the aggregate of all companies, by far the most important obstacle is the fear of giving away sensitive knowledge, pointing to problems of trust and intellectual property regulation in inter-organisational co-operations, while the supply of research institutes, often claimed as a bottleneck, seems not to be overly problematic (figure B8). A more differentiated look at the data here shows not much difference between innovators and non-innovators, except that non-innovators sense a much higher unwill-

ingness on the part of other enterprises. The differences as for size are somewhat counter-intuitive, since the values for the three most important obstacles (reservation to give away sensitive knowledge, lack of procedures to discover external knowledge and unwillingness of other firms to co-operate) are *higher* with *bigger* companies (figure B9). By the same token, they have also much higher reservations about becoming dependent on external knowledge sources and, since big companies have R&D departments more often than small companies, the “not invented here” effect is much bigger with big companies. Finally, top management responsibility for KM in general has a positive effect (figure B10). In companies in which top management themselves care for KM, the three most important obstacles are rated much lower than companies in which KM responsibility is exclusively in the hands of the lower hierarchies.

### 4.3 General Comments on the German Add-on

What is the importance of the dimension management of external technological knowledge? What is the relation between this dimension and KM in general? From the written and oral comments on the questionnaire, very diverse answers were given. Most interviewees found that knowledge management for the innovation process is at the core of knowledge management in general, therefore this dimension has full legitimacy for this questionnaire. One respondent even indicated that for him KMK management is innovation management.

However, one respondent indicated that the focus on external technological knowledge was too strong, since this was only a minor side aspect. Another one stated that external experts are only one less important component in the intranet and internal database efforts to manage KM.

To include this dimension in the German pilot study is based on a complementary interest on the part of the institute and the sponsors alike. However, in addition to the extra knowledge based on the add-on questions themselves, there are a couple of possible and sensible connections between the add-on questions and the core questions. The *hypothesis in italics* listed in annex 1 show these and further connections. In conclusion, a preliminary list of those connections is given below (in brackets, the number of question in the German questionnaire). It is open for discussion which kind of relations might be of interest for the OECD core study:

- deeper knowledge and further differentiation and specification of those questions that relate to external knowledge interfaces (1d) (3C) (3D) (4L) (4M);
- differentiation of core questions for the dimension innovator vs. non – innovator (17.4, 17.5), especially the relation between use of KM activities and innovation behaviour;

- differentiation of core questions as to the (future) importance of internal and external knowledge sources (9) for the KM activities (1);
- the connection between explicit *innovation strategies* (12A) and KM strategies and practices (1);
- the relationship between the meaning of information on external sources (9) for the practices to actually seek and integrate it (1d);
- the relationship between R&D activities (17.1) and KM practices (1) (is KM research-driven?).

Finally, one could think of having more detailed questions on *external knowledge* for the *downstream* and *upstream market* included in an add-on section in some other country that would be interested. This could complement the experiences of the German pilot study and could be used for future improvement of the external knowledge dimension, as focus studies or related to future core questionnaires.

## Annex 1: Preliminary List of Hypotheses

The following table comprises a list of possible hypotheses to analyse the questionnaire. It was tested in the German pilot study. In many cases the tests are unsatisfactory because of too few respondents. This list can however make clear how the questionnaire can be assessed in the second phase.

The numbers of the variables refer to the questionnaire of the German pilot study, which corresponds for the main part (questions 1 to 8) completely to the core questionnaire. See Annex 2 for the German questionnaire and Annex 3 for a correspondence table.

### Explanation

- **The hypotheses written in bold script are those which are based exclusively on variables of the core questionnaire.**
- *The hypotheses written in italic script contain a variable, which stems from the additional German questions.*
- The hypotheses written neither in bold nor italic script are those which are based exclusively on the German additional questions.

The variables are characterized as explanatory and dependent even if at the present time in some cases merely correlations (without direct causality??) could be determined.

	Hypothesis	„Explanatory Variable“	„Dependent Variable“
1	<b>The KM practices, and the reasons for and significance of them, differ according to the size and sector of the organisation</b>	Size (19) or sector	all
2	<i>The KM practices, and the reasons for and significance of them, differ according to whether an organisation is an active innovator or not</i>	<i>(17.4, more than 10%) vs. (17.3 no and 17.4 smaller than 10%) or 17.5 yes / no</i>	<i>all</i>
3	<b>The KM practices, and the reasons for and significance of them, differ according to whether the responsibility for KM lies with top management or not</b>	<b>5, dichotomy: top management yes – no</b>	<b>all</b>
4	<b>There are different types of KM utilization and attributing effectiveness to KM</b>	<b>Factor analysis for question 3 and question 4</b>	
5	<b>The introduction of individual KM practices (1) depends very strongly on the kind of motivation</b>	<b>3 (A to L) or four factor set see H 9)</b>	<b>(1a) – (1f) (with 1a = strategies/policies etc.)</b>
6	<b>The intensity of utilization of different types of KM practices have different effects on KM</b>	<b>(1a) to (1f)</b>	<b>4 total A to 4N 4 (cluster: a) internal integration (A, B, D, K) b) ext. interface. (L, M) c) operative</b>

			<b>(C, I, J, N) d) strategic (E, F, G, H)</b>
7	<i>The use of KM practices leads to higher innovation rates</i>	<i>(1a) to (1f) [a]: strate- gies/policies etc..]</i>	<i>(17.4, more than 10%) vs. (17.3 no and 17.4 smaller than 10%)</i>
8	<b>Organisations with own R&amp;D dept. are more intensively using KM practices</b>	17.1 yes / no	<b>1, total (1a)to (1f)</b>
9	<b>The type of motivation (3) and stated effects(4) correlate</b>	<b>3: cluster (factor analysis or 4 intellectual clusters) a) internal integration(B, F, J) b) external interface (C, D, L) c) operative (E, K) d) strategic (A, G, H, I)</b>	<b>4A to 4N or 4 (cluster) see H6</b>
10	<b>The effects of KM are greater if top management bears the responsibility</b>	<b>5, dichotom: top management yes – no</b>	<b>4 total also 4A, 4B</b>
11	<b>Own budgets for KM increase its effectiveness</b>	8 yes – no	<b>4A to 4N or 4 total</b>
12	<b>Organisations in which there was resistance to KM are less successful</b>	15 yes / no	4
13	<b>The frequency with which the organisation plans the introduction of KM measures correlates with the supposition that the KM budgets will increase in future</b>	<b>1, answer (planned in the next 24 months)</b>	<b>8: If yes: "increase" vs. the rest; if no: "yes"</b>
14	<i>Organisations with high significance of the internal / external knowledge sources for innovation activities have a greater probability of having assigned an own budget for KM</i>	<i>9.1A and 9.1 B (separate)</i>	<i>8 (yes – no)</i>
15	<i>Organisations with high significance for internal knowledge sources for innovation activities utilize KM measures more intensively</i>	<i>9.1A</i>	<i>(1a) to (1f)</i>
16	<i>Organisations with high significance for external knowledge for innovation activities utilize KM measures more intensively</i>	<i>9.1 B</i>	<i>(1a) to (1f)</i>
17	Organisations with high significance for external knowledge for innovation activities are also better informed about the knowledge on offer	9.1 B	13
18	<i>The estimation that the significance of external technological knowledge will increase has a positive influence on the future use of KM measures, especially in the area "capture and appropriation of knowledge"</i>	<i>9.3: "increase" vs. the rest</i>	<i>1, once complete, once separate for (1d)</i>
19	There is a connection between the importance of different reasons for the procurement of technological knowledge and the importance of single sources	9.4	10A to K
20	There is a connection between the importance of different reasons for the procurement of technological knowledge and the use of single instruments	9.4	11A to 11B
21	<i>Organisations which have an explicit innovation strategy utilize KM instruments more strongly than those without a strategy</i>	<i>12A</i>	<i>(1a) to (1f)</i>
22	Organisations which have an explicit innovation strategy are more likely to be innovators	12A	17.4, higher than 10 % 17.5 yes – no

23	Organisations which attribute high significance to external knowledge have procedures in place to identify the external knowledge on offer and their need thereof	9.1B (suggestion as for H8)	12B, 12 D, 12E
24	<i>Organisations with procedures / special organisations to identify external knowledge also utilize external knowledge more than other enterprises</i>	12B to E	(1d), single alternatives
25	Organisations with procedures / special organisations to identify external knowledge are more successful in the appropriation of external knowledge	12B to E	4L, 4M
26	Organisations with procedures / special organisations to identify external knowledge are better informed about the external knowledge on offer	12B to E	13
27	<i>Knowing the sources influences the use of instruments to appropriate external knowledge</i>	13 a dichotomous aggregation variable)	(1d)
28	The better known the sources, the less important the obstacles to using them	13 (a dichotomous aggregation variable)	14
29	Organisations with own R&D dept. are better informed about external knowledge on offer	17.1 yes / no	13
30	Organisations with own R&D depts. have procedures to determine short-term external need	17.1 yes / no	12C
31	Organisations with own R&D depts. have procedures to determine short-term external need	17.1 yes / no	12 D
32	Organisations with own R&D depts. have greater resistance to procurement of external knowledge	17.1 yes / no	15 yes / no
33	Organisations with own R&D depts. have a greater need of internal knowledge	17.1 yes / no	9A
34	Organisations with own R&D depts. have less need for external knowledge	17.1 yes / no	9B
35	For organisations with own R&D depts. public research institutions are more important sources than for other enterprises.	17.1 yes / no	10A, B, C
36	Organisations with own R&D depts. have more knowledge in the core areas and peripheral areas of their technology	17.1 yes / no	181 18.2
37	Organisations with own R&D depts. often have contacts to public research institutions	17.1 yes / no	17.2 often vs. never/ seldom
38	Organisations with own R&D depts. are more innovative	17.1 yes / no	(17.4, more than 10%) vs. (17.3 no and 17.4 smaller than 10%) or 17.5 yes / no
39	Organisations with frequent contacts to research institutions regard obstacles to cooperation with public research institutions as slight	17.2 often vs. never/ seldom	14 A
40	Organisations with a great need for external knowledge tend to have had more contacts with research institutions	9B	17.2 yes / no
41	Organisations with high competences (good/ very good) in the core areas of their technology have less need of external knowledge	18A	9B
42	Organisations with low competences (less good/ bad) in the peripheral areas of their technology have more need of external knowledge	18B	9B