MATURE

http://mature-ip.eu

D1.3
Results of in-depth case studies, recommendations and final knowledge maturing model

Date	19.04.2011
Dissemination Level	Public
Responsible Partner	UIBK
Editors	Andreas Kaschig, Ronald Maier, Alexander Sandow
Authors	Sally-Anne Barnes, Jenny Bimrose, Alan Brown, Andreas Kaschig, Christine Kunzmann, Tobias Ley, Ronald Maier, Johannes Magenheim, Athanasios Mazarakis, Alexander Sandow, Andreas Schmidt, Paul Seitlinger

European Commission
Information Society and Media

DOCUMENT HISTORY			
Version	Date	Contributor	Comments
0.0	25.02.2010	UIBK	initial document
0.1	17.12.2010	UIBK with inputs from FZI, TUG, UWAR	first shared version
0.2	21.02.2011	UIBK with inputs from FZI, TUG, UWAR	second shared version
0.3	09.03.2011	UIBK with inputs from FZI, TUG, UWAR	integrated version
0.4	11.03.2011	UIBK with inputs from FZI, TUG, UPB	internal review version
0.5	24.03.2011	UIBK with inputs from FZI, TUG, UPB, UWAR, LTRI and SAP	extended section 5, integrated feedback from internal review
0.6	25.03.2011	UIBK with inputs from FZI	third shared version
0.7-0.11	14.04.2011	UIBK and FZI	further improvements, particularly to section 5
1.0	19.04.2011	UIBK and FZI	take-up, recommendations, conclusion and finalization

Contents

List of Figures

List of Tables

List of Abbreviations

AAN	Artefact-Actor-Network
KM	Knowledge maturing
KMA	knowledge maturing activity
KMI	knowledge maturing indicator
KMM	knowledge maturing model

1 Executive Summary

This document provides an overview of the results produced by WP1 during year 3. WP1's objective is to explore theories and models that help understand and build a common knowledge base about knowledge maturing, to explore current knowledge maturing practices empirically and to develop a reference model for knowledge maturing.

Year three's activities can be divided into three main strands of action: (1) the planning, performing, analysis and reflection of the in-depth study, involving six organisations and one network of professionals sharing knowledge about careers guidance, (2) to foster the take-up of results of WP1 and thereby to contribute to the software design and development activities and to impact on the evaluation activities in MATURE and (3) the revision and finalisation of the knowledge maturing model landscape.

The deliverable reports on the results of the final of a series of three empirical studies conducted in MATURE. Building upon the two previous empirical studies, i.e. the ethnographic study (reported in D1.1) and the representative study (reported in D1.2), the in-depth study is designed to deepen our knowledge and gain additional insights on the results we had achieved in the earlier studies. The in-depth study was particularly designed to complement and extend the insights we received from single interviewees in the representative study by multiple perspectives gained by several individuals within one organisation or network that together provided richer insights into the organisations. We relied on qualitative, interpretive methods, mainly based on observation and face-to-face interviews at work places of the interviewees. The in-depth study was conceptualized as a case study with multiple instances the investigation of which relied on a single, coordinated framework of study topics and design agreed in the consortium. Concretely, the in-depth study focused on reasons why organisations perceive themselves as performing better with respect to knowledge maturing than others they compare themselves to, what measures have been employed and are planned to be employed to foster knowledge maturing, what barriers have been overcome and how software is used. Also, each case study instance included an additional topic reflecting specific research questions, related to activities in work packages or demonstrator developments of the partners involved in the respective study instance. Thus, the in-depth study was always aligned to research interests in other MATURE activities. Results of case study instances were analysed individually and collectively in a cross-case analysis.

We collected nine reasons why organisations perceived themselves as performing knowledge maturing better, many of them related to the individual employees and their relationships. Another big role played the design of information systems for supporting these informal relationships and supporting the access to knowledge. We also collected 19 measures, organisations employed to support knowledge maturing and 11 measures which were planned to be implemented. These planned measures seemed to be of evolutionary nature and to aimed at improving existing approaches and tools rather than to revolutionize processes. We also collected data on 13 barriers to knowledge maturing that were existent in organisations and ways how they were (partly) overcome. These ways partly overlap with general measures for improving knowledge maturing that were named. Although generally in line with results from the representative study from year 2, it became evident that the organisational culture spans and subsumes other barriers. We also focused on software used for knowledge maturing in organisations. It became apparent, that there was a wide variety of heterogeneous software applications in place that typically not had been designed with knowledge maturing in mind. Employees in organisations seemed to struggle with these software applications to appropriate them to fit the purpose of developing knowledge and keeping track of their contributions in the collaborative learning zone. Especially the transition between individual phases was unsupported. Based on these results, we developed a view integrating measures, reasons and ways to overcome barriers for knowledge maturing into a causal model building on levers and two levels of effects.

This deliverable also presents the results of WP1 activities to collect and analyse the parallel conceptual activities in the MATURE project as well as the take-up of conceptual artefacts in other WPs, in this year with a special focus on knowledge maturing indicators and guidance activities. These and the results of the series of empirical studies are taken on board of the knowledge maturing landscape which is presented in this deliverable in its final form. The model is considered final as an instrument to influence activities

in year 4 of the MATURE project, but we are certainly more than happy to continue to submit our findings to the discourse in the scientific community and intend to develop it further. The deliverable is concluded by a list of recommendations for organisations intending to engage in an initiative to improve knowledge maturing.

2 Introduction

In the third year of MATURE, we were already able to build on concepts and theories developed in two previous studies. We primarily built on the ethnographically-informed study performed in year 1 and results of the representative study conducted in year 2. From a conceptual point of view, a main result of D1.2, the knowledge maturing model landscape with its elements, most prominently, the knowledge maturing phase model (v3) fed into the in-depth study we conducted in the third year of the project. Furthermore, feedback from demonstrator development as well as from ongoing developments in the evaluation WP was taken up for the study design of the in-depth study.

The roles of WP1 in year 3 were to explore deeper into the phenomenon of knowledge maturing in real-world organizations, to coordinate the finalisation of the knowledge maturing model landscape within the project as well as to support other WPs in the take-up of concepts and artefacts that had been created in WP1 in years 1 and 2 in order to more closely link the activities in the development and evaluation WPs with the conceptual core of the MATURE project as developed and presented in WP1. This included further refining its elements, providing conceptual input for take-up in demonstrator development and the design of the summative evaluation. A major input for this was the in-depth study. We designed the in-depth study as a case study that would allow us to further deepen our knowledge on knowledge maturing and provide additional input for the conceptual model development.

These objectives were defined in the following tasks that WP1 addressed in year 3:
- *T1.3 In-depth case studies*. After having finished the first two large empirical studies of the MATURE project, WP1 concentrated on gaining further findings through personal interviews with a number of individuals in selected organizations. The study comprised a number of topics that were agreed in the consortium taking into consideration the results of the two earlier studies as well as findings and experiences gained in demonstrator developments, evaluation activities as well as in general feedback from application and associate partners. Also, case examples for systematic support of knowledge maturing with organisational instruments and information and communication technologies were studied in detail.
- T1.4 *Development of the conceptual knowledge maturing model*. The results of T1.3 were fed into the development of the final knowledge maturing model landscape. Also, input from parallel activities in other WPs and feedback of application and associate partners, as well as feedback gained in various dissemination activities (e.g., at the conference on professional knowledge management 2011 organised by UIBK) was taken up.

We took considerable efforts on the one hand to continuously feed our empirical results into the participatory design process employed in MATURE and on the other hand to absorb feedback about the prototypes gained from the application partners particularly in WP 2-3, but also from development of maturing services which, e.g., relied on knowledge maturing indicators in WP 4, the activities in the evaluation WP 6 as well as the activities on designing a business model for application service partners in WP 9. The overview given in Figure 1 shows the main topics covered in WP1 in year three and their primary use within this WP, concerning other WPs and the corresponding deliverables represented by arrows.
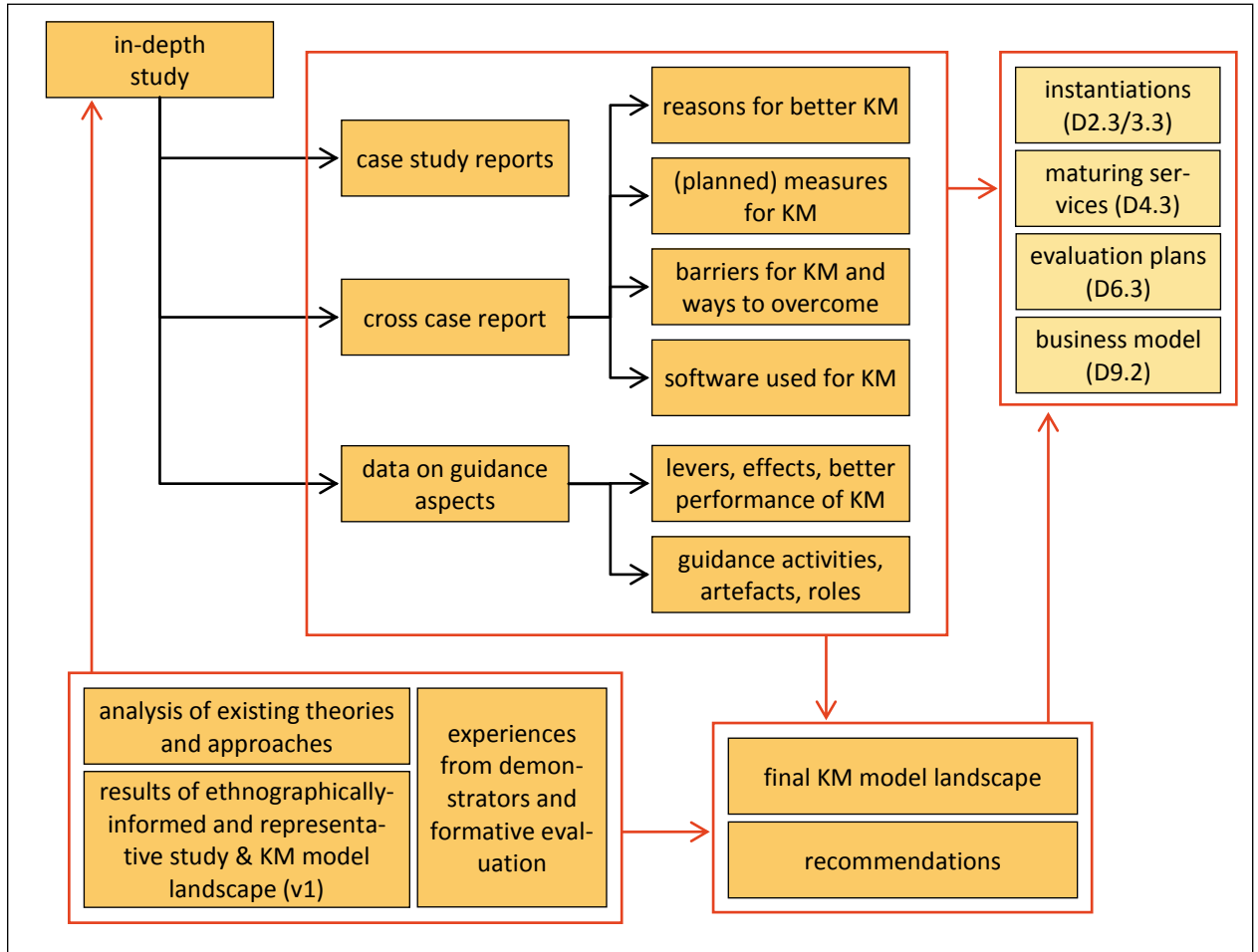
Figure 1: Overview of topics covered in WP1

Each major topic is represented by an orange box. Outgoing black arrows indicate outcomes of activities related to one topic feeding into activities related to another topic. Red rectangles group topics and red arrows show outcomes of activities related to a group of topics feeding into another topic. Starting in the lower-left corner, the figure shows the primary foundation upon which the in-depth study was designed, i.e. existing theories and approaches, outcome of ethnographically-informed and representative study and experiences from demonstrator development and results from the formative evaluation wrapped by a red rectangle. These theories, approaches, results and experiences also directly fed into the activities in other WPs that were closely related to what was done in WP1 shown in the upper right corner. The figure also gives a detailed overview of the most important results from the in-depth study, also surrounded by a red rectangle. Both red rectangles impacted on the finalisation of the knowledge maturing model landscape and the provision of recommendations based on the all three empirical studies which also were an input for instantiations, maturing services and evaluation plans. The results of the in-depth study already informed the development in the instantiations, maturing services, the plans for the summative evaluation as well as the development of a business model for application service providers.

The deliverable is structured as follows. Section 3 explains the general design of the in-depth study. Therefore, we discuss the conceptual and empirical base for the study in section 3.1. The scope of the study is then detailed in section 3.2 by elaborating on the general topics the consortium agreed on and by defining the unit of analysis. Section 3.3 documents the procedure. This includes a description of the case study methodology used, the methods applied for collecting data, the criteria for selecting organisations and interviewees and a description of the general interview guideline, as well as the topics each case study focused individually in addition to the general ones.

Section 4 presents the results of the in-depth study. Firstly, facts about the seven case studies are summarized that together made up the in-depth study (section 4.1). Secondly, the five topics of the cross-case

analysis are presented. For each topic, we present interesting findings observed in one or more cases together with a summary of the topic mirroring the observation with respect to the context of the case (section 4.2). Thirdly, we build upon these results of the cross-case analysis and present a view integrating the different topics and building causal relationships. We then shortly discuss aspects of guidance we additionally collected (section 4.3). Finally, we reflect on limitations of the study (section 4.4) and provide a short conclusion (section 4.5).

Section 5 presents the outcome of year 3 activities to enhance the knowledge maturing model landscape. After presenting the final version of the overall landscape, we discuss knowledge maturing indicators in detail which was a primary focus in this year as we have been encouraged to pursue this topic further by consortium members, application and associate partners as well as many discussion partners alike (section 5.1). The initiatives, we undertook in the third year in order to ensure the take-up of conceptual results, i.e. mapping knowledge maturing indicators to instantiations and describing instantiations with respect to levers they are deemed to provide and effects they are expected to cause are described in section 5.3. Section 5.3 concentrates on guidance of knowledge maturing and discusses the results of our activities investigating how to influence behaviour of participants in goal-oriented learning processes on a collective level, i.e. knowledge maturing. Section 5.4 discusses take-up of the results of MATURE empirical and conceptual activities in other WPs. Section 5.5 concludes the conceptual part. Section 5.6 presents recommendations based on the concepts we developed in WP1 throughout the first three years of the project and finally, section 6 summarises the findings of the in-depth study and the contributions of WP1 to the MATURE project.

3   Study Design

This section provides an overview of the design of the in-depth study. Section 3.1 provides the conceptual and empirical base, taking up results from previous empirical work on the knowledge maturing model landscape (see D1.2) and also considering developments and issues to be investigated in more detail from demonstrator development. Section 3.2 builds upon this overview and describes the scope of the study with respect to organisations targeted and prospective employees. Section 3.3 presents the procedure we employed to conduct the study and provides an overview of the case study approach in general and then describes the methods we applied before describing the interview guideline and the topics that have been investigated in more detail. Finally, section 3.4 summarizes the study design.

3.1   Conceptual and Empirical Base

Based on the results of the representative study presented in D1.2 and a joint reflection of the results achieved in demonstrator development and evaluation as were presented in D2.2/3.2, the in-depth study aims at deepening the understanding of selected concepts of the knowledge maturing (KM) model landscape and, based on that, providing recommendations that could be taken into account for fostering knowledge maturing. In total, seven organisations were investigated in order to obtain a detailed picture of KM processes and perceived impacts of systematic support of knowledge maturing through organisational as well as IT-based measures.

The KM model landscape (see figure 2; please refer to D1.2 for a detailed description) takes into account results gained through previous studies in the first two years of the MATURE project, i.e. the ethnographically-informed study and the representative study, and informs topics of the in-depth study being conducted in year three of the MATURE project.

We aim at providing descriptions of arrangements of organisational and IT-based measures perceived as successfully fostering knowledge maturing as well as recommendations for organisations willing to support knowledge maturing appropriately. Consequently, guidance within the scope of knowledge maturing is one of the main areas of investigation in year three of the project. Therefore, we focus on guidance that could be provided by people, i.e. individuals or groups of individuals, and guidance that could be provided by IT, especially by demonstrators developed in MATURE. Another strand also going in the direction of providing recommendations are motivational aspects and possible ways to overcome barriers in the area of knowledge maturing.

Furthermore, KM indicators and KM activities which had been developed based on findings of the ethnographically-informed study and justified in the representative study build the basis for a refinement in year three of the project. In case of the KM indicators, we specifically aim at restructuring and amending them based not only on the results of the in-depth study but also based on feedback of application partners and mapping to demonstrator developments. Also, the KM activities are subject to investigation. Especially, ways to support them by IT and organisational measures is stressed in the in-depth study.

Demonstrator teams specifically concentrated on describing functionalities and relating them to knowledge maturing activities which can be supported. For a detailed description of results of this investigation see Appendix in D2.3/3.3. Consequently, FZI and UIBK jointly moderated an ongoing process in which the team of researchers performing the in-depth study continuously kept in close connection with the demonstrator teams in order to ease the transition of knowledge created in these parallel activities as well as jointly move the project forward. This process helped to better align the activities in the demonstrator teams with the progression made in the knowledge maturing model landscape.

PHASE MODEL
- identifies distinct phases
- suggests an ordering

DIMENSION MODEL
- identifies different knowledge dimensions

have characteristics depending on

operationalise maturity and maturing in

refer to

KNOWLEDGE MATURING ACTIVITIES
= activities of individuals or groups contributing to knowledge maturing
- general activities that keep the collective learning process running
- specific activities for transitions/overcoming barriers

Knowledge Maturing Activities

are context-specific instantiations of

MATURE Activity Systems

Knowledge Maturing Criteria

structure and explain

Knowledge Maturing Indicators

KNOWLEDGE MATURING INDICATORS
= observable events or states that allow to measure that knowledge maturing takes place

support

are analysed using

instantiate and use

DEMONSTRATORS

implement

Guidance Model

incorporate into design

related to

MOTIVATIONAL ASPECTS
- analysis framework for motivational aspects
- phase-specific intervention possibilities

Figure 2: KM model landscape

On the one hand, we plan to use the KM model landscape (Figure 2) as a means of relating results. The dimension model (upper right part in Figure 2) is used in order to classify types of knowledge identified in the in-depth study according to sociofacts, cognifacts and artefacts. On the other hand, we aim at refining the landscape, supported, e.g., by collecting examples for types of maturing knowledge during the in-depth study. This leads us to a better understanding of the mutual dependencies of these three instances of KM on each other and allows us to develop instruments for KM not only on artefact level. On the basis of this theoretical concept we also support KM on sociofact level (increasing awareness and readiness for knowledge sharing, fostering shared understanding of topics) and cognifacts level (identifying topic related training needs, training course recommendation).

From a conceptual point of view, the KM phase model v3 (see figure 3; please refer to D1.2 for a detailed description) represents the core concept feeding into the design of the in-depth study. Its phases provide

the main anchor for further researching possible ways of providing support and guidance, both with or-ganisational and IT-related measures.

Figure 3: KM phase model (v3)

Furthermore, we aim at reflecting upon the phases of the model, e.g., by reflecting on example instances experienced by participants of the study and, thereby, contextualizing the model with respect to the partic-ipant's work environment.

3.2   Scope of the Study

Based on the foundation of the in-depth study developed in the first two project years (see section 3.1), this section will define the scope of the in-depth study. Starting from the topics and the general (section 3.2.1) aim of the study, we define the unit of analysis (section 3.2.2).

3.2.1   Topics of the study

In order to further develop the KM model landscape that was informed by the representative study (see section 3.1) we collected topics that are of further interest for MATURE. This process already started at the end of year two of the project during the analysis of data of the representative study. Together with all partners who took part in the previous empirical work and with the demonstrator teams we selected a set of topics to be covered in each case study. This set was then discussed at the consortium with all MA-TURE partners, refined and extended with input from the demonstrator teams with the resulting set of topics agreed by all MATURE partners:

- *Performance*: Reasons for better performing knowledge maturing than others. Why do people think that they perform KM better than others they compare themselves to?

- *Organisation*: Organizational measures that are deemed to support knowledge maturing. How is KM supported?
- *Barriers*: Possible ways of overcoming barriers. What barriers have been overcome?
- *Information Technology*: IT-oriented measures that are deemed to support knowledge maturing. How is software used to support knowledge maturing?
- *Plans*: Plans for introducing organizational and IT-oriented measures in order to (further) enhance knowledge maturing. What plans are there or what could generally be done to further enhance KM?

By anchoring these topics in each case study, we aimed at ensuring that the results of the individually conducted studies are targeted at the research questions selected as most relevant to the consortium and also that the results are comparable across studies whilst allowing each team investigating each case study could extend the list and explore further avenues that were deemed important in the interviews. All topics were intensively discussed and reflected in video conferences and at consortium meetings and directly fed into the creation of a common interview guideline. The interview guideline is presented in section 3.3.4 and its topics and open questions are described in more detail.

In addition to the common topics, we also agreed on enriching case studies by one specific topic each. These additional topics were coordinated along all studies and reflect specific research questions, e.g., related to specific activities in work packages or related to demonstrator developments of the partners involved in the respective study. As the amount of time that we could expect to be allocated to the studies by participating organisations was limited, we could not include all topics in all studies, but had to concentrate on one topic in each study. This approach proved very valuable in ensuring that the in-depth study was always aligned to research interests in other activities of the MATURE project and never got disconnected from them. A detailed description of how the specific topics were approached is provided in section 3.3.5.

3.2.2 Unit of analysis

The unit of analysis in our multiple case study approach (see section 3.3.1) is individuals that work and learn in a collective towards a common goal. The plural is important as we do not focus on a single person, but according to the definition of knowledge maturing on goal-oriented learning on a collective level. Individual case studies could concentrate on collectives of individuals working across departments, subsidiaries or even across organisations. This allows us to perform a purposeful sampling strategy. More explicitly, we relied on snowball sampling (Patton, 2002), i.e., to contact (a single) person(s) in an organisation and then select further individuals that are suggested or to address a community without limiting ourselves to organisational boundaries.

With respect to organisations, each partner in the consortium identified organisations that were both willing to participate and provide an interesting showcase for those aspects of knowledge maturing that were investigated in the connected other research activities of the partner in MATURE. We also agreed on considering a network of individuals across organisations that were deemed to offer interesting aspects both with regard to knowledge maturing and to the application domain of some of our application partners, i.e. careers guidance.

Based on characteristics of each case study's additional topic (see section 3.2.1) and researcher's contacts to organisations which strongly influenced possible access to interviewees, the units of analysis were carefully selected for each case study. Following that, the characteristics of units of analysis vary slightly in different case studies. Each study reports on its unit of analysis in section 4.1.

3.3 Procedure

This section describes the procedure we took. First, the applied multiple case study approach is outlined in section 3.3.1. The used methods within the case studies are then presented in section 3.3.2. The approach for selecting candidate organisations and interviewees is detailed in section 3.3.3. Finally, the general interview guideline of the study (section 3.3.4) and the individual topics per case (section 3.3.5) are explained.

3.3.1 Case Study

We chose a case study approach for the in-depth study in year three of the MATURE project which goes along with the DoW. Although not limited to qualitative research methods, case studies are a common way to perform qualitative research (see, e.g., Sake, 2005, Yin, 2009). Creswell (2007) describes case study research as a qualitative approach in which a bounded system (a case) is or multiple bounded systems (cases) are explored by investigator(s) over time in order to report a case description and case-based themes. For detailed in-depth data collection, multiple sources of information are used, e.g., interviews, observations, audio-visual material as well as documents and reports (Creswell, 2007). Case studies in information systems research are applied for studying human actions and interpretations related to developing and using information systems (see, e.g., Walsham, 1995).

Multiple designs for case studies are available (see, e.g., Sake, 2005, Yin, 2009). Yin (2009) distinguishes in his typology with respect to different designs by the number of units of analysis and the number of cases (Figure 4). In MATURE, we followed a multiple-case study which is deemed to be more robust than a single-case study design and, furthermore, provided evidence is often seen to be more compelling (Yin, 2009, Herriott and Firestone, 1983). For our unit of analysis, we chose specific organisation(s) (section 3.2.2). We followed an approach representing a holistic multiple case design: within each of our organisations to be researched, we did not distinguish specific parts and therefore employed a holistic design.
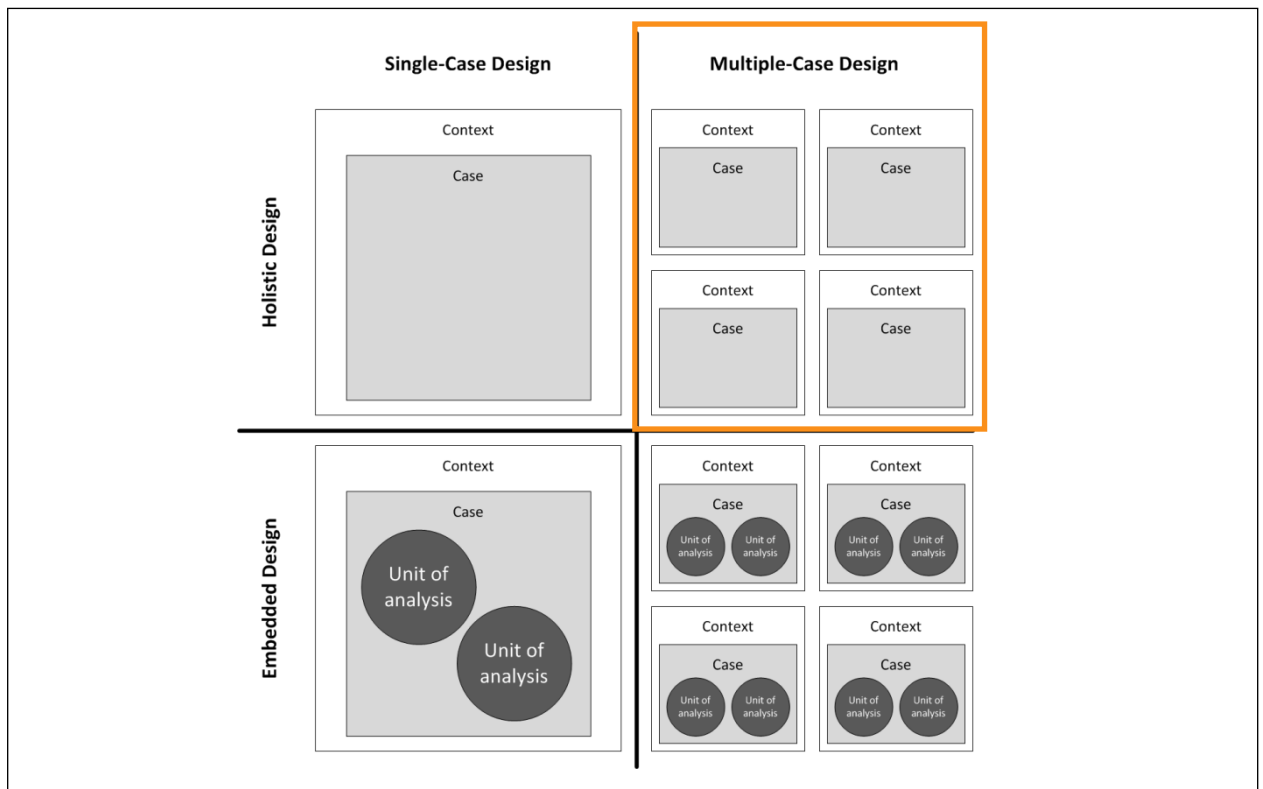
Figure 4: Types of designs for case studies (after Yin, 2009)

Based on this decision, we consequently followed Yin's approach for the conduction of a multiple-case study and adapted it for the MATURE project (see figure 5).
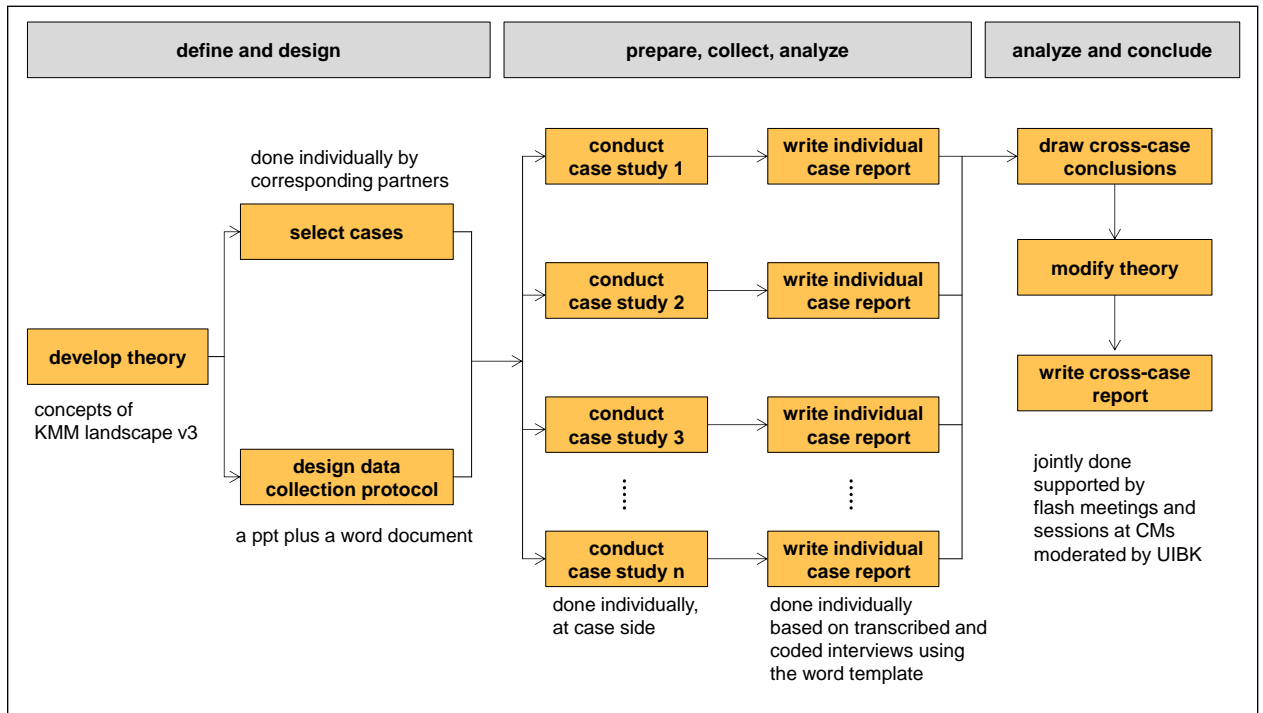
Figure 5: Design of a multiple-case study (after Yin, 2009)

Figure 6 reflects on this approach by proposed by Yin (2009) and adds information on the timeline we followed for conducting the in-depth study in year 3.
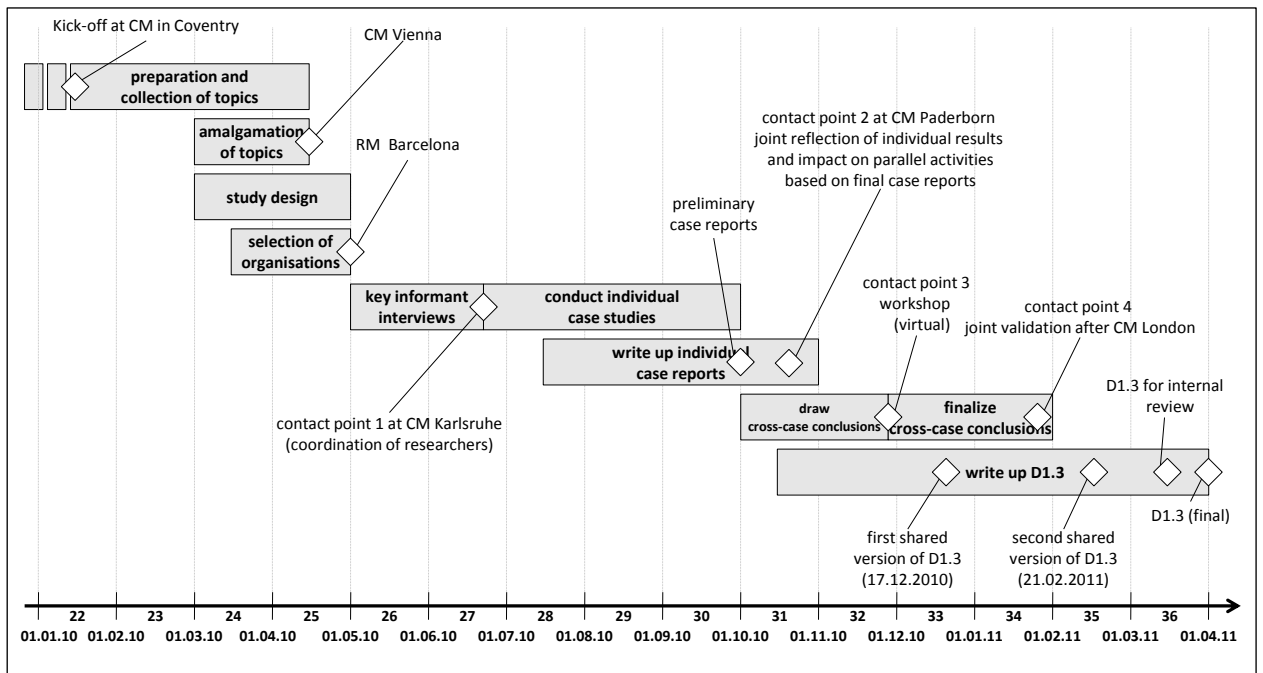
Figure 6: Timeline year 3

Based on the scope of the study (see section 3.2), cases were carefully selected by partners of the MATURE project individually, considering both the five common topics and one additional case-specific topic (see section 4.1). Each case study was managed by the responsible partner individually.

UIBK coordinated the individual activities and provided support as well as opportunities for case study teams to exchange lessons learned on case selection, data collection, analysis and interpretation. For collecting data on the common topics, an interview guideline was developed and adopted by case studies.

Besides interviewing, in some cases further methods for data collection, such as focus groups, were employed. Methods used for data collection are described in more detail in the next section in general and also referred to in the description of each case study. After conducting the research separately at sites of the cases, i.e., subsidiaries, organisations or networks of organisations, each partner analysed the collected data and created an individual case report structured according to a common template. Once the main findings were summed up and partners were aware of the results from all the case studies, we jointly developed cross-case conclusions during a series of video conferences and discussions at consortium meeting. The results of the in-depth study were then jointly interpreted in the consortium and consolidated on several occasions of video conferences and discussions at consortium meetings. In this way, the impacts of the study, for example on other work packages, instantiation developments and on the KMM landscape were discussed and taken up in the project. Finally, results were documented in form of a cross-case report that was also fed back to the participants of the study.

3.3.2 Applied Methods

Researchers participating in the case study jointly developed the topics of the in-depth study and therefore had a common understanding of its goals. We also defined the stance of the researchers in the interviews would take as well as the methods that should be applied which are shortly described in the following.

Interpretative Phenomenological Analysis (IPA) is an approach to qualitative research with an idiographic focus which aims to offer insights into how a given person, in a given context, makes sense of a given phenomenon. In our case, we focus on knowledge maturation which is seen as having some personal significance for participants, e.g., for future development of guidance of the careers innovation group in the UWAR case. Scoping was aided by a semi-structured interview guideline which is described below in section 3.3.4.The theoretical origins of IPA, developed by Smith and colleagues, can be traced to phenomenology and hermeneutics, with key ideas from Husserl and Heidegger (Smith et al., 2009).

IPA studies involve a close examination of the experiences and meaning-making activities of a small number of people. Participants are sampled purposively (because they can offer a meaningful perspective on the topic at hand - knowledge maturation), and usually there is an attempt to construct a reasonably homogenous sample.

In IPA, researchers gather qualitative data from research participants using techniques such as interviews or focus groups. Typically, these are approached from a position of flexible and open-ended inquiry, and the interviewer adopts a stance which is curious and facilitative (rather than, say, challenging and interrogative).

Data collection was done face-to-face directly within the workplaces of participants where as possible. This allowed for direct observation of phenomena in the context of particpants' workplaces by the researcher (Kuhlmann, 2002). This was intended (1) to support participants in remembering important facets surrounding support of knowledge maturing by IT or other observable artefacts in the participants' work environments, (2) to support the researchers' understanding of descriptions of work environments by participants as well as (3) the stance of the researcher as being interested in the specifics of the work environment and facilitative in joint meaning-making of organisational and IT-based measures fostering knowledge maturing. The semi-structured interviews[1] with participants were recorded, if allowed, and then transcribed and analysed with qualitative content analysis (Mayring, 2007).

IPA's hermeneutic stance is one of inquiry and meaning-making, and so the focus is upon making sense of the participant's attempts to make sense of their own experiences. IPA is used because the research questions aim to understand what the chosen experience (knowledge maturation) was like (drawing on phenomenology) and how someone made sense of it (drawing on interpretation).

IPA encourages an open-ended dialogue between the researcher and participants and may, therefore, lead to unforeseen answers, including a new perspective on the research questions. Themes are likely to identi-

---

[1] they are considered to be expert interviews as described by (Liebold and Trinczek, 2009)

fy both something that matters to the participants (i.e. an object of concern, topic of some importance) and also convey something of the meaning attached to the knowledge maturation process for the participants (including their feelings etc.).

In IPA, analysis should seek to balance phenomenological description with insightful interpretation, and anchor the interpretations in the participants' accounts. This is the approach we adopted, also seeking to maintain an idiographic focus (so that particular variations are not lost), and to keep a close focus on meaning. Cross-validation and triangulation were used through drawing on a variety of other sources in order to increase confidence in the analysis (Smith et al., 2009).

3.3.3 Interviewees and organisations

For selecting organizations, we relied on a sampling-method that can be described as convenient and purposeful (Patton, 1990). We aimed for organizations that would provide insights into interesting aspects of knowledge maturing. For the selected organization, we performed a key informant interview as a starting point. This key informant, then provided an overview of the organization and highlighted interesting topics and contact persons (Patton, 1990). We then used a snowballing approach for finding further relevant interview partners for the researched case (Patton, 1990). The interviews were conducted in person, at the interviewees workplace were possible. If personal interviews were not possible, we fell back to teleconferences.

Besides the general approach for conducting the case studies, we defined criteria that prospective interviewees needed to fulfil. These criteria are based on the criteria we chose for the representative study and should help us to gain valuable data from persons that have a broad and informed view about their organisation.

- high share of knowledge work
- gained experience through work being based on offering and applying expertise in different organisational settings (e.g., interviewee changed department or is involved in project work). This criteria should have been fulfilled for at least three interviewees per case
- have access to a variety of technical systems and are able to describe them in detail
- consigned with conceptual and management tasks
- strong communication, coordination and cooperation needs
- should mediate between organisational units applying IT and those designing, implementing, administering and maintaining respective systems
- university degree and at least three years of work experience (one year in organisation) in order to satisfy the high level of education, training and experience typical for knowledge work

3.3.4 Interview Guideline

As depicted in figure 7, the interview guideline consists of two pages (for a detailed view of both pages, please refer to section 7.1). The first page is intended to shorten time required for scoping interviews and provides general information with respect to the MATURE project. In particular, scope and goals of the project are described and, definitions of knowledge and of knowledge maturing are provided with examples. Furthermore, the KM phase model v3 and an explanation of each phase are presented.

used during interview

Knowledge Maturing:
- explains the basics of knowledge and knowledge maturing (KM phase model v3)
- interviewee could be provided with

Topics:
- contains all common topics to be addressed in each case
- interviewee could be provided with
- should be aligned by interviewer, e.g. with respect to unit of analysis
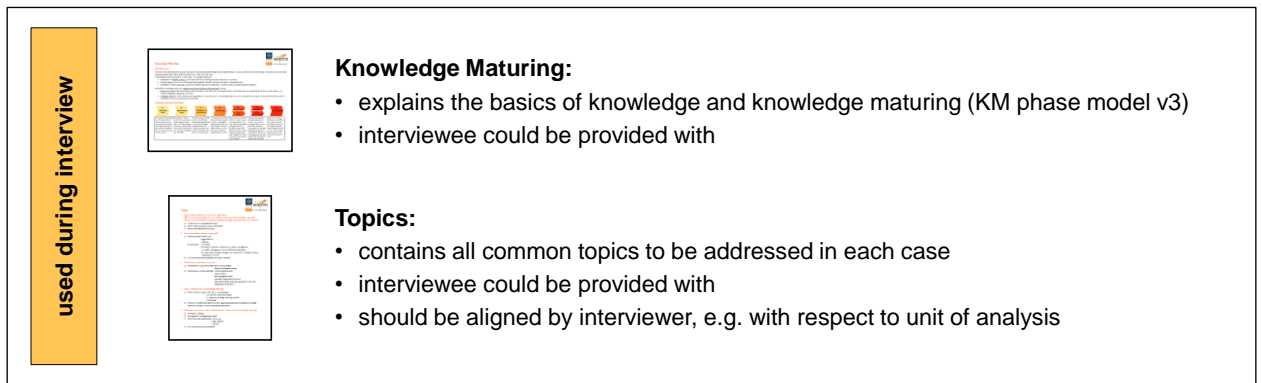
Figure 7: Documents used during interviews

Each interview started with a description of the main concepts of the MATURE project presented on the first page of the interview guideline. In conjunction with the interviewee, examples for knowledge bound to digital resources, people and processes were identified and reflected on a perspective of knowledge maturing. During the description of the KM phase model, interviewees were asked to reflect on the different phases, provide feedback and also try to find an example of knowledge maturing which they have experienced in the context of their work. The example was then discussed and used as an instrument to describe knowledge maturing and to reflect on the phases of the KM phase model in more detail. Furthermore, the instance of knowledge maturing provided by the interviewee was valuable for exemplifying descriptions during the subsequent part of the interview.

The second page of the interview guideline was developed based on the agreed five primary topics (section 3.2). These topics represent the main part of the interview. Depending on the specifics of each case study specific questions (i.e. the phrasing or the relation to the organisation) were appropriated. Each topic and its sub-questions are described in more detail.

Topic 1: Performance: Reasons for performing KM better than others

1 If you compare different units in your organisation:

Which one performs(ed) best in your opinion with respect to knowledge maturing?

Why do you think that this unit performs(ed) knowledge maturing better than others?

a) To whom do you compare the unit to?

b) Which criteria would you use to confirm this?

c) What is the relation to key performance indicators (KPIs), if any?

By asking interviewees to perform a comparison, the aim of this question was to trigger a discussion about aspects of knowledge maturing that are deemed to be performed well in the organisational unit[2] the interviewee works in or is responsible for or alternatively used to work in or be responsible for. In a first sub-question, interviewees were asked to reflect on whom they compare the unit to. This was not only related to other units within the same organisation, but also to units outside the organisation or even to communities or other entire organisations. We deliberately concentrated on things that are deemed to be performed better in a first place in order to focus on the reasoning behind the comparison in a second place. This reasoning then was used to foster a collection of criteria the interviewee used in order to back his or her statements (sub-question b). This should aid sharpening of indicators or even performance measures used in order to judge the quality of knowledge maturing, explicitly touched on in sub-question

---

[2] Please note: The term 'organisational unit' was adopted according to the case study, i.e. with respect to the unit of analysis and the interviewee's work environment. Where in some case studies (different) units of a single organisation were focussed, others concentrated on a community consisting of members of different organisations.

c. Here, the interviewee was asked for key performance indicators that are related to the collected criteria. The main interest in this case was to discover whether criteria that are deemed to represent aspects of performance of knowledge maturing are already used in the organisations represented by the interviewees.

Topic 2: Measures: Organisational and IT-based measures supporting knowledge maturing

a)   What measures ◦ community,

◦ organisational,

◦ software

are employed   ◦ informally,

◦ formally in projects or initiatives (e.g., quality management, innovation management, human resource development),

◦ formally with knowledge management in general or knowledge maturing in particular in mind?

b)   How are these measures aligned with other initiatives?

This topic aimed at getting an overview of how knowledge maturing is supported in general and of what organisations currently do in order to foster knowledge maturing in particular with respect to community, organisation and software (part a). This included typically more bottom-up, informal, interest-driven measures applied in communities of practice or interest as well as more top-down, formal, goal-driven measures applied in formal organisational units such as work groups or departments that were termed organisational.

Similar to the study we conducted in year 2 (see D1.2), we again distinguished between the formal and informal dimension: "formal" refers to official projects or initiatives of the organisation (i.e. quality management or innovation management). "Informal" measures are employed by the initiative of individual(s). In these cases, members of the organisation do not get official support from the organisation. These measures are not prohibited in the organisation, but are also not encouraged.

Besides getting insights on each measure, it was also interesting to compare these measures with respect to their linking to other organisational measures or initiatives (part b).

Topic 3: Barriers: Ways to overcome barriers hindering knowledge maturing

a)   What barriers do you think affect

◦ all or several phases

◦ transitions between phases

b)   Can barriers be further specified

◦ (inter-) personal level

◦ work context

◦ technological barriers

◦ caused by organisational culture

◦ personal interdependencies (personality, traits, etc.)

◦ organisational structure

The main focus of this topic contained two aspects: Firstly, we wanted to know which and how barriers have already been overcome for knowledge maturing. Secondly, we also asked more generally about other barriers that could affect the organisation represented by the interviewee. With this topic, we wanted

to extend the findings of the representative study, in particular about the classification of barriers, in order to give help for management decisions about successful knowledge maturation. This goes in line with the key findings of Riege (2005), that knowledge sharing barriers can provide help and a starting point for the effectiveness of knowledge management activities. Barriers can help us to identify the potential for knowledge sharing and therefore can assist companies to develop a knowledge-based business view (Riege, 2005). Besides research about the quantitative occurrence of different classifications of barriers, the classification can also help to discover greater relations. For example, can the barriers "lack of usability" and "discontinuity in software applications" occur together in one organisation and so this can indicate to further technical barriers.

Topic 4: Information technology: Appropriation of software for knowledge maturing?

a)   Which software is used ◦ within all or several phases

                        ◦ for transitions between phases

                        ◦ to support knowledge maturing activities

                        ◦ (in)formally

b)   What are the differences between units in appropriating software for specific knowledge maturing purposes, i.e. how is software actually used?

In conjunction with topic 2 and following up question 7[3] of the year 2 study (see D1.2), this question focuses on software supporting knowledge maturing in organisations (part a). Besides targeting specific phases, we especially wanted to gain information on how transitions between phases would be supported. Besides focusing on the phases, we aimed at getting a rich picture on how software is actually used for knowledge maturing. This was deemed particularly important because in most cases in the year 2 study, standard software (e.g., office software, wikis) was mentioned as being used for knowledge maturing and we wanted to extend this information about what software was used by how this software was used. To do so, we asked specifically for how the software had been appropriated, including usage besides the "official" use (see DeSanctis and Poole, 1994). This would allow us to create a more in-depth analysis of the actual use of software supporting knowledge maturing, especially considering that, according to the results of the year 2 study, there seemed to be no distinct support for knowledge maturing along its phases (i.e. phase transitions) (part b).

Topic 5: Plans: Goals and measures to enhance KM planned for the foreseeable future

a)   Timeframe 1-5 years.

b)   What goals and strategy are pursued?

c)   What measures are employed   ◦ community

                        ◦ organizational

                        ◦ software

d)   How are these measures assessed?

The fifth topic is seen to be in conjunction with topic 2. Topic 5 aims at data on planned measures to enhance knowledge maturing whereas topic 2 asks for measures employed currently or in the past. Consequently, we also distinguish between a community, an organizational and a software dimension as in topic 2. We aimed at a timeframe of 1-5 years, i.e. the future foreseeable by the interviewee. Again referring to

---

[3] Which locally installed or web-based software is used for each phase?
a) "officially" endorsed by your organisation
b) "informally", i.e. software which is not supported by your organization

another topic (topic 1), the last part of this question (part d) asks for how planned measures are supposed to be assessed.

3.3.5 Individual Topics

In addition to the general topics (see section above), each case study focused on an individual topic. These topics are described in the following.

FZI1 and FZI2 - specific barriers and problem situations in KM

For the case studies FZI1 and FZI2, we focused on the collection and analysis of barriers in detail and ways to overcome them. The results of the representative study showed the importance of identifying barriers for KM. The identification of barriers can be crucial for knowledge management in organisations (see also Riege, 2005). In our individual analysis we aimed at finding possible matches between barriers and the specific context of a situation. Also we wanted to gather additional barriers deemed important by representatives of the organisation, thus extending the general results of the representative study.

TUG - observing/analyzing maturing processes in company/customer knowledge base

For the case study TUG, we put emphasis on the interactions between employees in the area of customer support and how these interactions are socially organized in the company as well as supported and mediated by different software products. Particularly, we analyzed changes of the interactions during the collaborative development (co-authoring) of an artefact (learning object for customers) and how these changes are reflected in the organization's knowledge base. By using the language of the company's representatives we gained a shared understanding of maturing activities and mapped changes of software-enhanced interactions to the phases of the MATURE model.

UIBK1 - knowledge maturing indicators

In addition to the common topics, in case study UIBK1 we put special attention on knowledge maturing indicators (see section 5.2). Knowledge maturing indicators can be seen as one way of assessing (changes in) maturity of knowledge. The outcomes of the representative study (see D1.2, section 4.6) suggest that the knowledge maturing indicators identified in the MATURE project are deemed to suit well to the context of participating organisation. With respect to the case study UIBK1, we aim at researching whether knowledge maturing indicators are currently or prospectively used in the targeted organisation in order to assess (changes in) maturity of knowledge. In order to collect open-minded reflections from the perspective of the researched organisation, we decided to not go through the list of knowledge maturing indicators item by item, but instead link and align the general topics of the interview guideline to the topic of knowledge maturing indicators, when deemed applicable.

UIBK2 - adaptation of software for KM in general and for specific phases

For UIBK2, we focused on software with two distinct lenses: A specific solution including software that aimed at improving knowledge handling and knowledge work in the studied organization was focused. How the members of the organization, specifically a community of practice, make use of this KM initiative will be the first part of UIBK2's individual topic. The second lens will be used for explore how actual software tools provided by the organisation are employed for coping with knowledge intensive work. Especially how members of the organisation cope with changing tools across the different KM phases (i.e. the transitions between the phases) will be of interest.

UPB – sociofacts as a factor of on knowledge maturing

The UPB case study was conducted at an outsourcing company which focuses itself on the relationship between knowledge achievement and process improvement. Therefore, in our analysis we want to enable a special view on the mutual dependencies between artefacts and sociofacts. This means not only to analyse the use of software tools for knowledge maturing in the company but also to gather a more systemic view on the relation between artefacts and sociofacts. Thus, the analysis of the UPB case study was guided by the lead question: How can Sociofacts contribute to and improve knowledge maturing? In this context we understand sociofacts as capacities to perform specific actions which are related to a topic and a target group. In addition to the social dimension of their intended action sociofacts mostly are goal-

oriented. Besides their internal individual aspects, sociofacts have an external representation, observable as social interaction and as activities of individuals within groups. The topic related actions in groups include a different degree of shared topics and a common understanding of those topics between the interacting group members. This social interaction, often supported by digital media, also effects the creation of associated artefacts. Therefore, as a result of that kind of social activity (e.g., delivering emails in a working group, using a Wiki cooperatively), we also generate artefacts. This topic-related communication and the resulting social interaction establish a specific workflow in a company. Thus, so-called Artefact-Actor-Networks (AANs) (Reinhardt et al., 2009) may indicate the existence of related sociofacts and can be used to describe and analyse them. The concept of sociofacts supports the analysis of existing social networks and associated topics the network is dealing with. Regarding sociofacts and AANs shifts the focus of analysis from the use of a specific software tool to a more broadened view of media-supported topic-related communication in a social network within a group, a company or an organization.

UWAR - inter-organisational learning and interactions/relationships between individuals across organizations

The UWAR case study focused upon a Careers Innovation Group (CIG). This group was formed of individuals (in senior positions involved with career guidance management, training or research) interested in knowledge development, sharing and maturation in careers guidance. The focus of the case study was upon learning, development and knowledge maturation in a distributed community. The participants were members of this group because of a shared interest in knowledge maturation in career guidance. This topic mattered a great deal to the participants (as an object of pressing concern) but it also had deeper significance and meaning for the participants as it was bound up with their emotions, feelings, sense of identity and imagined futures. It was concerned with the future rather than being grounded in daily work activities, and so complemented those case studies based in a single organisation.

3.4 Summary

This section gave an overview of the design of the in-depth study. Based on the existing KM landscape, representing a major part of WP1's outcome of the first two years of the MATURE project and inputs from WP2, WP3 and WP4 which particularly put special attention on software and services, we defined the scope of the in-depth study. The consortium agreed on focussing the following topics:

- *(Performance)* Reasons for better performing knowledge maturing than others.
- *(Organisation)* Organizational measures that are deemed to support knowledge maturing.
- *(Barriers)* Possible ways of overcoming barriers.
- *(Information Technology)* IT-oriented measures that are deemed to support knowledge maturing.
- *(Plans)* Plans for introducing organizational and IT-oriented measures in order to (further) enhance knowledge maturing in the future.

In order to investigate these collected topics at different organization sites, we decided on a multiple case study with a common design which incorporated individual case reports and a jointly conducted cross-case analysis. Within these cases, we employed several methods of data collection and analysis, i.e. interpretative phenomenological analysis, semi-structured interviews, participant and workplace observation.

We relied on a purposeful and convenient sampling for selecting organisations to study: we aimed for organisations which we had prior relations with and which were deemed to provide in-depth insights into interesting aspects with respect to knowledge maturing. Within the studied organizations, we started with one interviewee in a key informant interview who provided an overview of the organization, highlighted aspects currently performed with respect to knowledge maturing, and helped establishing contact to further interview partners which we collected using a snowball approach. Additionally, we also collected data from an inter-organisational organisation, concretely a professional network that not only deals with the topics of knowledge development, sharing and maturation, but connects professionals in the domain of careers guidance which is what two instantiations of the MATURE project focus as application partners. Criteria for selecting interviewees, similarly to the representative study before, were amongst others proper work experience with knowledge-intensive work, a broad view of the organization and knowledge of IT. Additionally, we made sure that we interviewed members of different departments or, in case of the

network even of different organisations, in order to cover diversity and multiple viewpoints on the topic of knowledge maturing.

The in-depth study was planned to comprise two parts: a common part, consisting of the five topics above and a study-dependent part focusing on an individual topic. We developed an interview guideline (see section 3.3.4 and appendix 7.1) for the common part that was intended to support the discussions and joint reflections during the interviews and covers open questions on the five common topics.

4 Results

This section presents the results of the in-depth study. For our seven cases, section 4.1 presents an overview as well as a brief summary on the context of the study and key findings. Based on the data of the individual cases, section 4.2 focuses on the cross-case evaluation consisting of five topics. The evaluation will be aligned to an integrating model, which we present in section 4.3. Finally, section 4.3 presents the impact of the results and impact for the project and section 4.4 elaborates on limitations for the in-depth study. Finally, section 4.5 summarizes the results of the in-depths study and concludes this section.

4.1 Facts about Individual Case Reports (Summaries)

Following the common approach described in section 3, seven cases were studied by individual partners, with continuous interaction with each other in order to ensure an early exchange of interesting results so that joint interpretation, cross-case analysis and thoughts about the potential impact on the project, particularly the parallel activities of demonstrator and evaluation teams, could be started as early on as possible. The comprehensive case reports created by the partner responsible for the individual case can be found in the appendix (see section 7.2). Based on the recommendation of Walsham (1995), this section will provide the following data on the case studies. The first part, including

- What other data sources were used (method of data collection)
- Research site and unit of analysis chosen (organisation)
- Number of people that were interviewed (no. of participants)

is described in table 1, together with the short name of the case in column one and the method of data analysis (see section 3.3.2) and the individual topic.

case	organization	no. of participi-tici-pants	individual topic	method of data collection	method of data analysis
FZI1	large, internationally operating company in industry sector - headquarters and many affiliated companies in Germany	15	analysis of barriers in detail and ways to overcome them	interviews; field notes of observations	reflection of work environments; field notes and transcripts of interviews as basis for qualitative content analysis
FZI2	large, internationally operating company in automotive sector in Germany	5	analysis of barriers in detail and ways to overcome them	interviews; field notes of observations	joint reflection of work environments; field notes and transcripts of interviews as basis for qualitative content analysis
TUG	medium-sized software company	2	observing/ analyzing maturing processes in company/ customer knowledge base	interviews, field notes of observations	reflection of work environment, field notes, transcripts of interviews as basis for qualitative content analysis
UIBK1	large company in industry sector (Germany)	7	knowledge maturing indicators and indicators with respect to performance of	interviews; field notes of observations	(joint) reflection of work environments; field notes and transcripts of interviews as basis for qualitative content analysis

			knowledge maturing		
UIBK2	large company in service sector (Germany)	5	adaptation of software for KM in general and for specific phases	interviews; field notes of observations	(joint) reflection of work environments; field notes and transcripts of interviews as basis for qualitative content analysis
UPB	large, globally operating company in the area of knowledge management (Poland)	7	barriers of knowledge sharing; lean processes and outsourcing of KM; inter-organizational learning and knowledge maturing	interviews; field notes of observations	(joint) reflection of work environments; field notes and transcripts of interviews as basis for qualitative content analysis
UWAR	Careers Innovation Group	14	inter-organisational learning	interviews and participant observation	Interpretative Phenomenological Analysis: idiographic focus - insights into how interviewees, in the given context, make sense of the phenomenon of knowledge maturation

Table 1: Overview of case studies

The second part of the recommended data by Walsham (1995), comprising the following points:

- What hierarchical or professional role the participants occupy
- How field interviews and other data were recorded
- Over what period the research was conducted
- How data was analysed and how the iterative process between field data and theory took place and evolved over time

will be enclosed in the summaries of the seven cases which are presented, together with a short summary of the main findings, in the following subsections (4.1.1 to 4.1.7). The comprehensive case reports of each case study can be found in the appendix (section 7.2).

4.1.1 FZI1

For FZI1, we visited a construction and multi service company in Germany. This company operates worldwide. The criteria for selecting this company are that it is a large company (criteria used from (OECD and EUROSTAT, 2005)), that employees and management are interested in knowledge management and FZI had already contact with this company in an on-going project about the usefulness of Web 2.0 tools for some departments. Furthermore the company was part of the representative study and willing to participate in the in-depth study as they were open-minded to the concept of knowledge maturing.

The unit of analysis of this case study is a set of fifteen knowledge workers (ten department leaders and five team members) who work together or had previously worked together on different projects and departments. The professions of the individuals are mixed, including construction engineers, members from the knowledge management team and the knowledge manager, i.e. the head of the knowledge management department. During interviews, field notes were taken. Recording was not allowed at all. For two interviews also taking field notes was prohibited.

In the case study FZI1, all common research topics are addressed (see section 3). Additionally, special attention is put on the analysis of barriers in detail and how some of these barriers have been overcome. Another focus of the interviews was to identify existing barriers and to examine the possibilities for the

introduction of Web 2.0 tools in the organisation. Because the company struggled to introduce Web 2.0 tools successfully by itself, the analysis of existing barriers was the main motivation for the company for participating in the interviews.

In general, the interviewees state that knowledge maturation is performed quite well in the organisation, in particular the phases III (Formalizing) to Vb (Standardising) are supported very well. This is justified by comparison with competitors.

Some work processes of the company are not well defined for the first phases of the knowledge maturing model, thus the current organisational culture does not really fit for the introduction of Web 2.0 tools for knowledge maturing. A better support of the first phases of the KM phase model is planned.

Also, the barriers *lack of information* and *communication* are important, because they lead to the barrier *lack of trust*. . For the senior management, the barrier *personal interdependencies* (e.g. personality traits or different individual skills) is perceived as the most important barrier for knowledge maturing, because different personalities act in given situations differently. *Lack of time* is a barrier that has been partly resolved and only exists at a low level, although it is still perceived as important.

Finally, personal contacts are preferred by the interviewees. This limits the beneficial effects of knowledge exchange and knowledge maturation is handicapped because only a small number of persons share their information. This leads to the barrier *fear of losing power*.

Further steps focus on transforming the organizational culture to more open discussions and transparency. This process has been acknowledged by some interviewees and they consider this a process, taking some years, which has already began with focus groups for the introduction of a Wiki.

4.1.2 FZI2

For the FZI2 case study, we conducted research on a large car manufacturing company which operates and serves markets worldwide and is based in Germany. The criteria for selecting this company are that it is a large company (criteria used from (OECD and EUROSTAT, 2005)) and prior contact had been established with this company. The company perceives itself as performing very well in the context of knowledge maturation and it is therefore useful for the MATURE projects to see, how former barriers have been overcome. The research of these barriers has also been requested by the company itself. Furthermore, the knowledge management department recently launched some innovative tools and perceived the interviews as a possibility to reflect on knowledge maturation.

The unit of analysis of this case study consists of five employees (two team leaders, two software engineers and one construction worker) who work together or had previously worked together in different projects and departments. The professions of the individuals are mixed, for example construction engineers or software engineers. The interviewees compared themselves with other departments and competitors. During interviews, field notes were taken. Recording was not allowed. Field notes of thee interviews were used for joint analysis.

In the case study FZI2, all common research topics are addressed (see section 3) and additionally again special attention is put on the analysis of barriers in detail and how some of these barriers have been overcome.

In general, the interviewees replied that knowledge maturation is performed very well in the organisation. All interviewees think that phase Vb (standardisation) is supported best, although other phases do not get significantly less support. In particular, the phases Ia (expressing ideas), Ib (appropriating ideas), II (distributing in communities), III (formalisation) and Vb (standardisation) are perceived to be performed most effectively, with an emphasis on Vb (standardisation) because of many iterations in this phase.

The company has a constructive discussion culture. If the employees have the possibility to participate in different discussions, then this is seen as a positive indicator for knowledge maturation. Multiple different multidisciplinary work settings support and need this constructive discussion culture in this company.

Also, knowledge maturation is perceived to be more effective in the construction departments, because the departments are better connected with each other and therefore share and exchange information about

projects and other work related aspects more efficiently. This is achieved through different tools, like wikis and forums and also via regular meetings. Also, aspects like in-house exhibitions and the use of latest technology, e.g., looking at computer constructions via 3D technology, support the knowledge maturation process by the distribution and presentation of ideas and products within the company.

A research and development forum, and also a business innovation forum are part of the broad variety of different technologies and software which the company uses. These forums are frequently used by a high number of participants, but lack some experts. Also, social media software is being used for accessing and maintaining personal profiles of the employees, consisting of job related information like, e.g., profession.

For the barriers, *organisational culture*, *lack of time* and *lack of resources* are barriers that have been partly resolved but also still exist and are perceived as still important. The employees miss support for the Phase Ia (expressing ideas). Although the employees know that there is immediate action necessary, the interviewees cannot determine the exact start of the support of this phase and they consider this a long-term process.

Open communication is performed very well and is also a key factor for the success of phase II (distribution in communities) of the knowledge maturing model. New ideas are discussed and therefore also supported in forums. These forums have also replaced traditional suggestion systems, which were based on paper-and-pencil, in the company. Finally, with this action more responsibility has been given to the individuals and teams. Transparency and more discussions are the results of this organisational culture and less hierarchical structures. Also, a total quality management system has been established, to lower the risk of new barriers.

4.1.3 TUG

The unit of analysis of this case is a small company in the sector of computer programming and consultancy (NACE-Code 62) with around 20 employees. There are two main interacting areas: the *development of software-products* for different branches, such as horticultural production and trade, reservation systems and event management, and the *customer support*. The company consists of a home office situated in Graz (Austria) and two branch offices for customer-support abroad, one in Germany and one in the Netherlands.

The company has been chosen as unit of analysis due to its prior relationships to TUG as well as its reflectiveness about organizational and technological measures fostering collaborative learning processes. The case report is based on two extensive interviews with the company's manager and a longstanding employee responsible for project management, as well as on information gathered in the context of a series of meetings held in advance of the case study. The two interviews were audio-recorded, transcribed and afterwards analysed by means of a qualitative content analysis.

An encouraging outcome has been that company's managers regard the MATURE-model as a helpful concept to picture learning sequences in their company and to address barriers in distributing and documenting knowledge. Collaborative learning processes with respect to customer support are triggered by a new and specific customer request that cannot be answered by retrieving information from either the individual or organisational memory but may instead require contacting experienced colleagues or exploring and searching internal databases or the web. Insights gained during this early phase of maturation are stored and externalized by means of emails or telephone notes. In case of being repeatedly confronted with the same customer request, the responsible customer advisor may create an FAQ in order to ensure the distribution of the approach to the solution, so to crystallize procedural/implicit knowledge and to shorten the future process of searching for functioning operators in the problem space of the distributed cognitive system of the company. If the idea to deal with the customer request gets legitimation and is enriched by contributions of other team members in the course of meetings (e.g., SCRUM meetings) the knowledge becomes further formalized by turning the FAQ into a new chapter of the software documentation, realized in form of a wiki-based manual. This formalization step consists of the consolidation of several drafts: Wiki articles of different employees are firstly collected in a file only accessible by employees of the company and secondly stitched into a coherent whole. After this document has met some quality criteria, for instance readability, its content is released as a new learning module also accessible

by customers. If they approve of this extension of the Wiki it will become a standardized part of the software documentation and procedure in customer support.

With respect to measures to support knowledge maturing, the emphasis is on the lack of hierarchical structures to facilitate less bureaucratic mechanisms and a social basement of network-like arrangements. The focus is on a physical layout supporting face-to-face communication which is regarded as the most effective way to convey ideas and all their associated layers of context necessary to understand them.

Conducting SCRUM meetings is seen as an important measure at the community level by providing a formal structure for communities of practice to *discuss* urgent tasks and to *evaluate* the progress of the software development. They contribute to an open-minded organizational climate that supports cognitive flexibility when searching for new ideas. They increase the transparency of relations among team members and their approach to solutions and thus are regarded as an important factor for newcomers to become familiar with socio-cultural practices.

Moreover, the company takes much effort to introduce software-based solutions for the improvement of formalization processes. For instance, the implementation and continuous advancement of an internal Wiki should foster documentation of problem solving. The company has also implemented a widget-based software combining several services such as a collection widget to collect and structure resources (e.g. Web-resources or articles of the internal wiki), a discussion-widget to engage in dialogue about collected resources or a tagging-widget to enable a more flexible organization and effortless retrievability of resources. As media disruptions in the course of one task are seen as detrimental to individual as well as collaborative learning processes, the implementation of *one* software product supporting different aspects of a single task is a highly prioritized and software-based goal to be achieved within the next three to five years.

4.1.4 UIBK1

For UIBK1, a large company in the industry sector in Germany was selected for investigation. The major reasons for considering this company as a promising candidate for researching knowledge maturing are: (1) It is a large company (criteria used from (OECD and EUROSTAT, 2005)) and provides its employees performing knowledge work with access to an elaborate technical infrastructure and several different systems. (2) It follows the approach of management by objectives (Drucker, 1993) implemented with the help of different measurements which could possibly be related to the area of knowledge maturing. (3) Its employees showed high interest in the area of knowledge management. (4) Researchers of UIBK have already had contact with some employees of the company. The unit of analysis of this case study is a set of knowledge workers who work together or had previously worked together towards a common goal. During their time at the company, all of them switched between different subsidiaries and between different departments within one subsidiary.

In the case study UIBK1, all common research topics are addressed (see section 3). Additionally, special attention is put on indicators of knowledge maturing (see section 5.2), their possible occurrence and potential usage in an organisation. The questions of the interview guideline (see section 7.1) were linked and aligned to this topic, when deemed applicable.

In total, seven interviews with employees in the following roles were conducted by two researchers of UIBK (number of interviews in brackets): head of department (2), project manager (1), in-house consultant (4). The first three interviews were performed in a setting of two interviewers and one interviewee. The remainder of four interviews were conducted in a one to one setting, each. During interviews, field notes were taken. Together with recorded and transcribed interviews, the field notes were used as inputs for qualitative content analysis (e.g., Mayring, 2007) that was performed by interviewers.

The case study UIBK1 was successful in investigating the five common research topics. Furthermore, interviewees provided rich information about knowledge maturing indicators and indicators with respect to performance of knowledge maturing. The qualitative analysis of data gained from interviews and field notes led to highly interesting results. The key findings are briefly summarized in the following paragraphs.

The awareness of employees of knowledge management in general was deemed to be one major point for differentiating between organisational units based on their performance of knowledge maturing. This awareness is seen as being strongly influenced by senior management.

Several interviewees emphasized the importance of people playing the role of a "claimant". This is not a formal role that is recognised by the organisation. It describes someone, ideally in a relatively powerful position who stresses a demand to change and enhance current knowledge and will not accept any behaviour falling short of the agreed changed practice or process, especially not falling back into the routine practice or process before the change. If someone takes up this role, it is deemed much easier to follow up on goal-oriented further development of knowledge related to artefacts, sociofacts or cognifacts.

The legitimation by supervisor(s) is seen on the one hand as a possible barrier to knowledge maturing, but on the other hand as crucial and as "valuable filter" allowing only selected knowledge to develop. This is also closely related to the role of a claimant. As this role is not an official role implemented, e.g., in organisational guidelines, it is taken by volunteers. If there is no employee (ideally in a powerful position) who wants to take up responsibility and claims the further development of certain knowledge, it is not going to happen.

Related to the strong influence of legitimation by supervisors, it was stated that if in phase III (formalizing) of the KM phase model an official commitment is made by a supervisor and/or management panel, the idea will be standardized. Hence, the decision of standardizing or not is already made in a relatively early phase. Once the standardizing phase is reached, new ideas might lead to further improvement through starting a new instance of the knowledge maturing phase model.

An organisational measure deemed important and implemented within the company is supervisors acting as boundary spanners, i.e. leading teams (possibly of other supervisors) in different subsidiaries. This is seen as having a positive influence on the exchange and development of knowledge in general.

Another observation made with respect to knowledge maturing in general is that systems (or locations) where digital resources are stored are deemed to indicate different levels of maturity, e.g., standardized knowledge is located in a dedicated document management system.

4.1.5 UIBK2

Besides addressing the general research topics, the UIBK2 case also aimed at focussing on the appropriation of software for knowledge maturing. The case study was conducted at a large IT service provider in Germany. The organisation was chosen for different reasons. There was a pre-existing relationship between the studied organisation and the researcher, in particular a collaborative research project and prior studies which were conducted there. The company is reflective of knowledge management in general and has already been familiarized by UIBK with aspects of knowledge maturing. Furthermore, the organisation provides two distinct views on the use of IT tools: the view of a user and the view of a producer. The sector of the organisation is classified as highly knowledge-intensive (OECD and EUROSTAT, 2005).

The organisation has about 500 employees, not including two subsidiary companies. Although the majority of employees are located at its headquarters, it has three smaller sites. It provides a variety of IT based services, ranging from consulting, application support and IT solutions to application hosting and outsourcing solutions in its own computing centre. The organisation is active in several sectors but has its focus on the utilities sector. Different business areas within the organisation seem to have individual working cultures which may be explained by different historical developments of these areas and different working requirements.

As a unit of analysis, two different communities of practice within the organisation were chosen: the group of employees using a flexible office space (Maier et al., 2008) and the "innovation group" of the organisation which were both situated at the headquarters. The groups were chosen as they both have a high affinity towards improving with regards to handling knowledge and are also open to using new technologies.

Interviewees were selected according to the general study guidelines (see section 3.3.4). Especially, work experience gained in different departments or gained in different environments (e.g., due to working in

projects with different organisations and team compositions) was emphasized. All in all, five people were interviewed: a consultant, a team leader, the head of HR department, the head of the internal communication department and a project manager.

Data was collected using the following methods: semi-structured interviews, document analysis (of mainly concepts, meeting minutes and presentations), participation in meetings and informal meetings with employees. Interviews and informal meetings were conducted in a neutral and open-ended way.

Interviews were conducted in two sequences: the first three interviews were conducted focusing on knowledge management and knowledge maturing in general. The second sequence of two interviews was conducted using the study guideline following more on the general topics of the in-depth study and the appropriation of software. Interviews were recorded and transcribed. Additionally, field notes were taken during interviews. The data was evaluated using qualitative content analysis (Mayring, 2007).

The general view among the interviewees studied was that they considered themselves successful with respect to KM. Personal relationships were seen as a main factor for performing better with respect to KM than others. This perception was based around key KPIs (i.e. duration of projects or a product development being completed on budget) used in the respective organizational units of the interviewees. Communities (of practice) were seen as a major means of supporting building of personal relationships.

Besides this personal level, communities were also deemed to improve KM on several levels of the maturing model (i.e. II – distribution in communities, Ia - expressing ideas and III – formalizing). Consequently, communities are supported by the organisation through a range of measures (see section 7.2.6). A main challenge seen in the organisation was the transition from topics that evolved in a community-based setting and then needed to be brought into a broader organisational setting, e.g., when contents which were developed in the Wiki would be formalized and therefore used in another context and/or application.

If these communities had to deal with software that imposed too many restrictions or that was inconvenient in some way, they tended to circumvent the software. This was also true for tools officially required by the organisation. It seemed that evolving structures in communication and behaviour of these communities superseded structures imposed by IT tools and organisational measures.

In later phases of the KMM, different backgrounds and contexts of employees working together were seen as main reasons for leading to issues in communication. Although measures (e.g., trainings on working in projects) were introduced to solve this issue, it is still one of the main areas of interest for future improvements with respect to knowledge maturing in the organization.

4.1.6 UPB

For the UPB-case a large, worldwide operating company in the area of management consultancy (NACE-Code 71) with more than 90.000 employees and subsidiaries in over 30 countries was selected. Besides consulting services the company is providing technology services, outsourcing services and local professional services. The interviews were conducted in a Polish subsidiary of the company.

This unit of analysis is mostly engaged in the area of business outsourcing services. Henceforth, we will refer to this company as BPOC (Business Process Outsourcing Company). The main reasons for considering BPOC as a candidate for our in-depth case study were: (1) the company itself is focusing on knowledge maturing in order to restructure and outsource business processes of their clients with regard to quality, time and cost. They simultaneously want to restructure and improve their own consulting processes. (2) This service for lean business process management is highly formalized according to the company's global business process model. It was interesting to identify differences and similarities between the strategy of knowledge maturing of BPOC's transition teams, who are working with their clients, and the knowledge maturing model of MATURE. (3) Based on the specific relationship between BPOC's transition teams and their client's employees we wanted to analyze the impact of social interaction and social networks on knowledge maturing (a) within BPOC, (b) in teams of the clients and (c) between BPOC-transition teams and client teams. (4) Finally, the supportive role of software tools for those knowledge maturing processes could be analyzed with specific regard to the evolution and the maturation of sociofacts.

In addition to interviews with seven representatives of BPOC (L&D Management, HR Business Partner, Compensation & Benefits Lead, IT Department Lead, Delivery Excellence representative) discussions in small focus groups on different topics of KM were conducted. After the transcription of the recorded interviews and discussions and the evaluation of the field notes, these inputs were evaluated using qualitative content analysis methods.

Some of the main findings of our case study can be summarized as follows. The transition (i.e. the process of outsourcing) of business processes of BPOC's clients is organized according to a highly formalized procedure that is based on experiences of former engagements with other clients. Therefore, the transition of business processes can be regarded as a process of approximation to a global best practice concept. Nevertheless, contextual conditions of a specific client are considered. A GPM (global process model) database provides documents which support these efforts and is itself subject to continuous improvement in compliance with quality management regulations. Thus, the related knowledge maturing processes within BPOC can be identified on the artefact level as well as on the sociofacts level. On the artefact level there exist well defined document types which describe on-going transition processes on six different levels of abstraction. These artefacts, which are co-operatively generated and edited, are bases for discussions between the BPOC transition team and the client's employees as well as for internal discussions of the BPOC staff. The maturation of these documents and their status of approval are processed after a pre-defined concept of quality assurance. For the needs of quality analysis of the revised business processes, KPI's (Key Performance Indicators) are provided. The status of approval of documents and processes can also be regarded as a key indicator of knowledge maturation. Furthermore, the interviewees confirm, that the MATURE knowledge maturing phase model is similar to the phase model of business process management within BPOC. For the needs of finding and expressing ideas an 'idea data base' and a wiki are used as a media-based forum for open discussion in the company. Team members represent a broad variety of expertise in order to increase the team's social creativity. Team-related competitions, motivational awards, an incentive system and annually arranged project-presentation and idea exhibitions contribute to reduce communication barriers between teams, support informal training, foster team building and the emergence of a cooperative identity. The subjects of formal training in BPOC are closely linked to the needs which were identified during the implementation phase of approved standardized processes. The communication between clients and the BPOC-team is organized on a governance model and mainly takes place between two persons (single point of contact) who are responsible on both sides for those changes (client: project manager; BPOC: transition team leader). They can be regarded as boundary spanners using boundary objects to achieve a common shared understanding. Finally, we recognized, at the sociofacts level of knowledge maturing, that social interaction within BPOC and with the clients occurs in accordance and in mutual dependency with co-operatively generated artefacts. This also provides evidence for existing artefact actor networks and their important impact on knowledge maturation.

4.1.7 UWAR

Careers Innovation Group (CIG) is formed of individuals (in senior positions involved with career guidance management, training or research) interested in knowledge development, sharing and maturation in careers guidance. Hence all the participants are, inter alia, interested in knowledge maturation, and in the original MATURE application it was proposed that we work with this group. The unit of analysis was interstices of individual and group action (across organisations, perspectives and disciplines).

Methods for data collection comprised 4 interviews (senior career professionals, but all of equal status within the CIG); participant observation by two UWAR researchers; document analysis (minutes of meetings, contributions on website etc.); participation in linked meetings; and researchers talked about the phenomenon with participants in related practice contexts. Interview and other field data were written up as case notes. The CIG started in October 2007, and the two UWAR researchers have been reflexive about knowledge maturation processes and the research has been on-going since the start of the MATURE project in March 2008.

Interpretative Phenomenological Analysis (IPA) was used as the method for data analysis. The insights of the interviewees / participants, in the given context of the CIG were examined as they tried to make sense of the phenomenon of knowledge maturation. The focus on knowledge maturation was because this was

the driving rationale for the group as a whole and it was seen as having personal significance for members of the group as well as for the future development of career guidance as a profession. At one level the iterative process between field data and theory is built into IPA as an approach, and at another level the substantive issue itself (processes of knowledge maturation) is the subject of the MATURE project, which is also theoretically-informed by the MATURE model and the analysis in this report has been organised according to the precepts of the model.

The CIG was chosen as an example of inter-organisational learning selected as additional topic, because it was felt that the MATURE project should consider knowledge maturation processes that occur outside organisations as well as within them.

CIG was set up with the explicit intention of helping individuals in an inter-organisational setting advance their individual and collective knowledge and understanding of careers innovation processes. Member-ship of the group was seen to provide a platform for dialogue between academics and employers in identi-fying 'innovation' and 'ideas' for development activities. It also offered a 'space' for reflection, updates and supporting a community of interest in policy, research and practice. The group is still active and it is interesting that this inter-organisational 'space' was used by participants as a reflective forum where they can return to different issues and themes as these evolve, in a broader socio-political context where the organisational and opportunity structures in which careers guidance is embedded are themselves in flux. A 'space' where members can keep up to date, be self-critical, learn from experience, learn from new knowledge, technology, and reflect on how people are brought up and the kind of lifestyles they seek was seen by group members as very valuable in helping to mature their knowledge, individually and collec-tively, and for that knowledge to help members make sense of the field, contextualise their activities with-in and beyond their own organisations and inform how their own practice might evolve in future.

Key aspects:
- Members were reflexive about the nature of knowledge maturation itself
- Members of the group had particularly strong overlapping personal and professional networks and the group acted as a form of 'bridging social capital' across the field as a whole (which sometimes operates within distinct 'silos')
- Some knowledge maturation challenges have been surmounted but others remain, such as ac-knowledging the gap between current and ideal practice, before the goal of using software tools to support effective knowledge maturation in guidance can be practically realised
- The freely accessible careers innovation site utilises two main elements: a tool for social network-ing (cloudworks) and a tool to allow comments on public documents (write to reply[4])
- Technology-enhanced boundary objects (TEBOs)[5] were software-based resources which supported knowledge sharing across organisational boundaries and were conceived as boundary-crossing tools which could support situated learning
- In order to enhance knowledge maturation processes in future, there will need to be a shift of focus to support knowledge maturation in particular organisational settings as well as supporting learning and development across the field as a whole

Knowledge maturation processes of the group had resulted in members developing a 'readiness to learn or 'readiness to mature knowledge' of how technology might support innovation, learning and development in guidance practice. This learning and knowledge development had been achieved through scaffolding (support) and reflection in face to face settings where peers had been experimenting with technology to collectively develop their understanding, thereby co-enculturating and developing one another. The chal-lenge for the future is whether social software tools can produce similar support to take participants to higher levels of understanding, which in turn makes the artefacts created increasingly useful for practi-tioners. The use of social software to support knowledge sharing for guidance practitioners is already being used in embryonic ways, but maybe to start to transform understanding of what is possible requires

---

[4] See section 4.2.3 for further detail.

[5] The role of technology-enhanced boundary objects (TEBOs) are more fully discussed in section 0

a more 'open pedagogy' in the production of digital boundary objects. This line of development will continue within and beyond the MATURE project. [6]

4.2 Topics of Cross-Case Analysis

For the cross-case analysis, we decided to narrow the focus on the five general topics (see section 3.3.4). Therefore, we jointly revisited the goals of the study in a meeting in which we also shared results of the individual analysis and interpretation of the case studies: With respect to the KMM landscape, we wanted to (1) further refine the knowledge maturing indicators and knowledge maturing activities (2) inform the development of the guidance model and the motivational model as well as (3) provide further inputs for tool development (see figure 8).
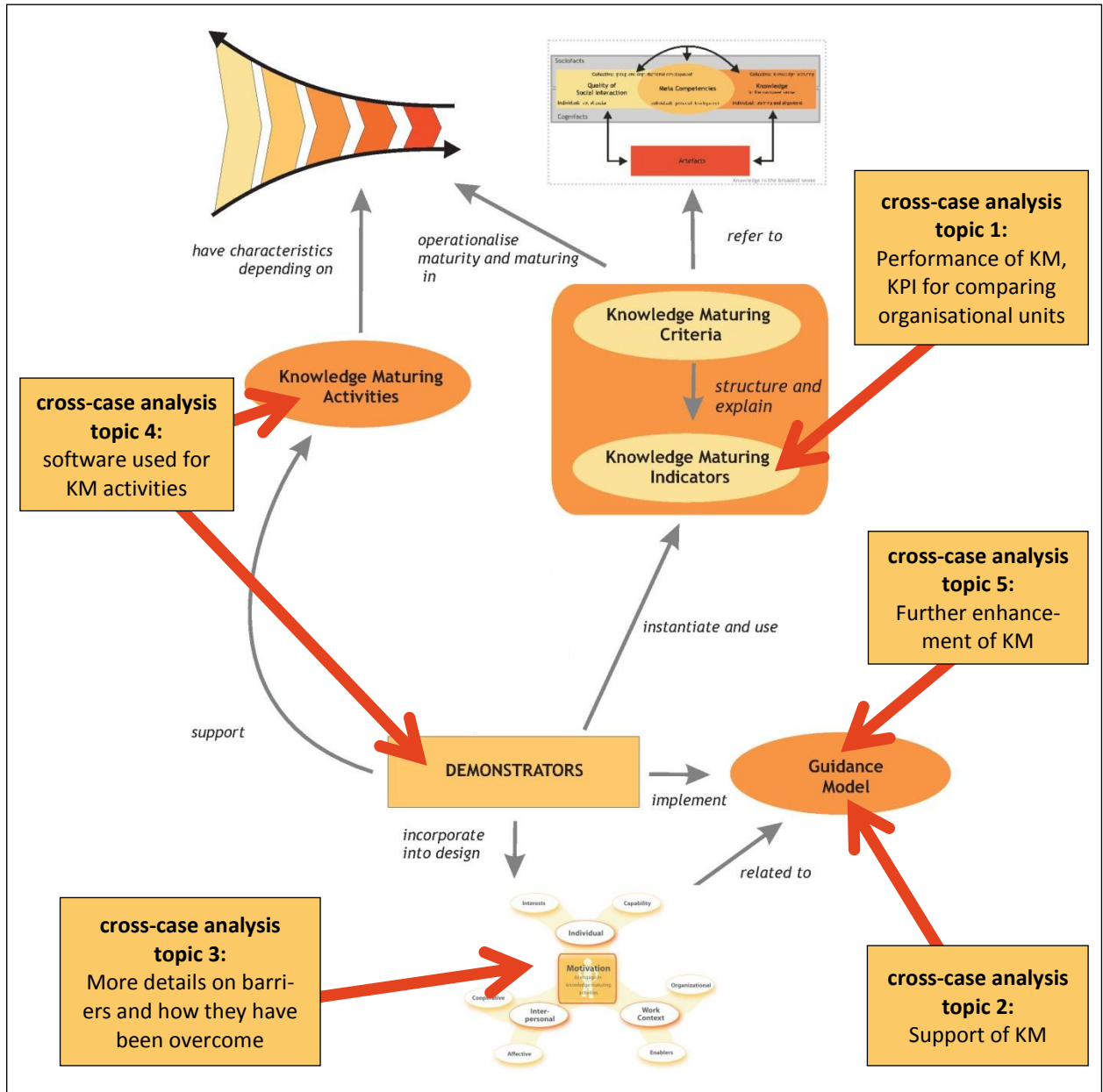
Figure 8: Intended impact of in-depth study results on KM model landscape v3

---

[6] See section 0 for further detail.

As a result of this process, we analysed the five topics of the interview guideline across the cases including a special emphasis on the impact on certain parts of the KMM landscape. In the following, the individual results of the cross-case analysis are first provided individually for the five topics. Section 4.3 then takes on an integrative perspective and amalgamates the findings on guidance of knowledge maturing as well as perceived impacts on performing knowledge maturing in organisations. Table 2 provides an overview of these topics and their relationships to the original topics of the interview guideline (see section 3.3.4) feeding into the cross-case analysis.

topic of cross-case analysis	topic of interview guideline feeding into the analysis
1 reasons for maturing better (more effectively) than others categorized by, e.g., sociofacts, cognifacts, artefacts	1
2 similarities and differences of measures for knowledge maturing aligned to community, organizational (and personal)	2
3 classification of barriers, e.g., technological, personal, organisational and cultural and types of ways to overcome them, e.g., financial, change mgmt.	3
4 software uses in different phases / for transitions between phases of knowledge maturing model; how is software used with respect to KM	4
5 What measures are planned	5

Table 2: Topics of the cross-case analysis

In order to analyse the findings of each individual case study in the context of the cross-case analysis (section 3.3.1), we agreed upon a multi-tiered approach (see figure 9) which we followed for each topic of the analysis: Firstly, we did the initial analysis for two cases (UIBK1 and UIBK2). We then seeded the results (using the MATURE Wiki and email for distribution of results as well as Video conferences for further explaining and reflecting on them) back to the other interviewers who then individually did the corresponding analysis of their case with the UIBK cases as a reference. After all the interviewers had finished their individual analysis, we integrated these results into a first joint analysis. The result of this joint evaluation was then reseeded to all interviewers and again discussed and reflected on together with the responsible interviewer by, e.g., via bilateral voice calls using Skype. After this validation process, we finalised the cross-case analysis. The results we gained were used in order to inform further analyses on guidance and also led and a representation of levers for improving knowledge maturing and their deemed effects which is described in section 4.3.

Final joint evaluation

Validation (bilateral VideoConference)

re-seed

First joint evaluation

Comparison
of "own" case to UIBK cases

seed

Initial example
UIBK1 vs UIBK2

Legend:

ALL

UIBK/ FZI
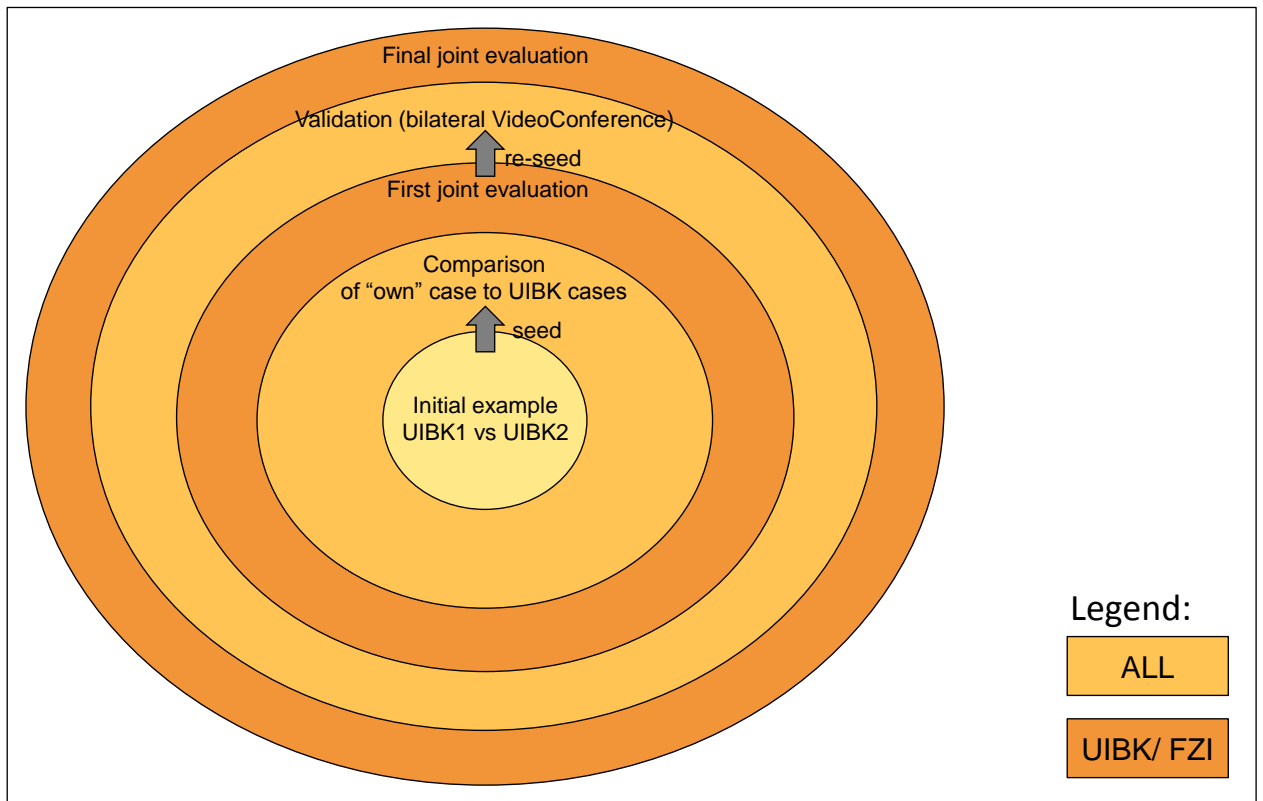
Figure 9: Approach for Evaluation

In the following sections, we describe the findings of the cross-case analyses of each of the five general topics.

4.2.1 Topic 1 – Reasons for better knowledge maturing

The cross-case analysis of this topic was guided by the lead question: Why do people think that they perform KM better than others they compare themselves to? In the following, we present reasons why the studied organisations and network perceived themselves as performing knowledge maturing better than others they compare themselves to. In order to justify the reasons, we also provide short evidence collected from individual cases. Furthermore, the findings are categorized according to sociofacts, cognifacts and artefacts.

Accessibility of knowledge

- FZI2: Knowledge maturation is perceived as being better in the construction departments, because these departments use so called knowledge data bases and Web 2.0 together, to exchange information about project and company-related aspects. Also with these interconnections they can better focus on their own development, instead of departments that are highly dependent on suppliers for the construction process of the cars. This has been put by an interviewee with the following words: *"We are really good at knowledge maturation because we have the processes under control. We invent the necessary tools and technologies ourselves. Other departments, but especially other companies rely too much on their suppliers. And if they do this, they don't have the knowledge, but the supplier has it".* So the creation of artefacts and sociofacts are important at organizational and community level.

- UIBK1: Quick accessibility and easy retrieval of knowledge is deemed to positively affect the goal oriented and non-redundant transfer of knowledge. Mainly, this is related to both digital resource on file shares used by a community or members of an organisational unit, on the Intranet and on the Internet (artefacts) and knowledge bound to people (cognifacts).

- UPB: The members of a transition team have quick access to a classified system of knowledge bases that contain artefacts of different levels of maturity. The global process model database provides a collection of best practice process-descriptions that were approved according to quality assurance procedures. The company's global Wiki is available for all employees and contains not restricted information about all business activities of the company. Employees are encouraged to contribute. The articles will be reviewed and edited similar to processes in Wikipedia. For the needs of expressing and finding new ideas an idea database is used. Employees can entry their improvement proposals and annotate and discuss those of others. For project-related work in the transition teams a project-database with a web-interface (team-room) is as well available as a shared file system with restricted access rights.
- UWAR[7]: The members of the group were drawing on rich stores of personalised knowledge involving public codified knowledge (for example, in relation to guidance theories and theories-in-use); knowledge of people, situations, and contexts; know-how in the form of skills, practices and ways of working; memories of particular episodes, events and relationships; self-knowledge and reflexiveness; and awareness of the role of attitudes, emotions, empathy etc. in knowledge maturation processes. Reflexiveness of group members helped them articulate the importance of taking account of personalised knowledge within the broader frame of innovative approaches to knowledge maturation within career guidance practice, mirroring how practitioners could draw on personal knowledge and personal networks in the construction of shared or at least shareable resources. From this perspective, the Careers Innovation Group (CIG) were interested in processes of people tagging and shared resource development and different members of the group reported back on this and the group experimented with different possibilities for developing these approaches further.

Availability of different channels for sharing knowledge
- FZI2: Aspects like in-house exhibitions and the use of latest technology, e.g. working with real 3D technology, supports the knowledge maturation process by the distribution and presentation of ideas and products within the company and so sharing knowledge with different ways. This helps at a community and organizational level, the construction of artefacts and sociofacts. The exchange of the latest developments in the different departments makes these sociofacts valuable and important for the progress of the company.
- TUG: While the focus is on a physical layout supporting face-to-face communication, which is regarded as the most effective way to convey ideas, the company takes much effort to introduce software-based solutions for externalizing and discussing knowledge units. For instance, the use of a widget-based software combining several tools for different tasks should help to avoid media disruption and to document problem solving as well as the subsequent preparation of learning objects of an internal Wiki. The organization thus relies on interplay between the design of an advantageous physical layout and IT-infrastructure. By considering both environmental factors, different information channels for a shared knowledge construction are provided.
- UIBK1: The provision of an IT infrastructure allowing for transfer of knowledge via different channels is seen as a precondition enabling knowledge work and further development of knowledge. This is mostly related to artefacts (e.g., e-mail, instant messaging, videoconferencing, file sharing) and sociofacts (e.g., organizational structure, projects, team meetings).
- UWAR: the group members had regular face to face meetings and access to a support IT infrastructure, but because of the significance of the issue and activities for their professional identities, sense-making and imagined futures the key channel for sharing knowledge was through overlapping and inter-locking personal networks. The group members were aware that there were other knowledge development currents running outside the formal organisations concerned with guidance delivery. These currents could comprise a mixture of the individual, the social and the organi-

---

[7] Note: some of the sub-categories based on a single organisational structure are not relevant to this case. The Careers Innovation Group (CIG) is formed of individuals (in senior positions involved with career guidance management, training or research) interested in knowledge development, sharing and maturation in careers guidance.

sational in that they could be represented by personal knowledge, personal networks and organisations with membership drawn from many other organisations such as professional bodies.

Best practice model to improve workflows, tasks or processes

- UPB: In the company (BPOC) a variety of activities exist to improve the clients' business processes according to a BPM (Business Process Model) and a best practice model GPM (Global Process Model). After a process of consolidation (alignment with GPM), consolidated processes can be conducted by the client further on or may be outsourced to another company (lean management by transition and outsourcing). The maturing of processes is oriented on a highly standardized best practice model (GPM). It provides benchmarking indicators KPI (Key Performance Indicators) which enables also cross-client comparisons of similar business processes with respect to time, cost or quality. Thus, these benchmarking indicators were used to identify differences in the performance of different projects (different clients) and compare them with regard to efficiency, effectiveness, value, control etc. Also the GPM will be revised after a concept of reflection, continuous improvement, training, and standardization of processes and benchmarking.

Community of practice offering advanced training and expert finding

- UPB: Since BPOC is a worldwide operating company with more than 90,000 employees they operate an internal system of expert finding. According to their topic-related expertise and their position in the company's hierarchy, many business process mangers (subject matter experts, process owners of processes in the best-practice global process model (GPM)) offer training courses for local, regional and sometimes global trainings and events. Thus, the expertise of people is assigned and identified by their role within BPOC and the content domain they are dealing with in their daily work. If local transition teams are looking for improvement of a specific client's processes they use these concepts of expertise assignment either to gather recommendations for process improvements from those experts or for finding appropriate training courses in order to improve group members' competences in the long term. This concept of advanced training and expert finding concurrently establish an internal community of practice (CoP) that forms an internal social network, where only a few external experts are included. The focus on internal experts is justified with the company's huge resources of internal expertise. Nevertheless, occasionally external presenters contribute to international workshops and meetings of the company.

Employees' attitude towards and awareness of KM activities

- FZI1: There is no perceived lack of resources, thus allows the employees to exercise knowledge maturation without limitations except of the own interest of the individuals and community aspects. There are plenty of resources and manpower available in the organization, so that doing the work for an artefact twice is nothing bad but is perceived as *"entertaining and double checking"*.

- FZI2: The interviewees mention that operational departments like vehicle construction perform better because the "results" (e.g., cars and technologies) are used productively. Otherwise, departments like research and development miss a strategy and have no commitment from the management. This is also due to the fact that sustainability is important for the company, which can be seen by an actively undertaken quality management and therefore more and better documented processes. Artefacts, cognifacts and sociofacts are equally affected.

- UIBK1: Performance of knowledge maturing is deemed to highly depend on people involved in daily work activities and their attitude towards KM activities, e.g., knowledge sharing and documentation. This covers also the attitude of supervisors and (top) management of the organisation which is seen as affecting support of, e.g., evolving projects related to the topic of KM. Furthermore, a raised awareness of KM is deemed to result in a better performance. While the attitude towards KM might also influence the development of artefacts and cognifacts, the provided reason itself could be seen as a sociofact.

- UPB: Since the company uses a hierarchical classification system for the approval and the maturity of documents, employees of BPOC are well aware of knowledge maturing on the artefact level. During the transition phases in their daily work they also improve their client's business processes according to a best practice process model that as well is continuously subject of improvement. This provides them awareness with regard to sociofact maturing. Finally, each employee has

his/her own PDP (Personal Development Plan), which define agreed personal learning objectives. Thus, formal an informal learning of the employees, whose outcomes are measured with balanced score-cards, contribute to awareness of knowledge maturing on the cognifact level.

Employees' reflexiveness about the nature of KM itself (inter-relationship of artefacts, cognifacts and sociofacts)

- UPB: It is one of the major tasks of the employees of BPOC to describe the change of business processes in documents of different abstraction levels and of different states of approval. Afterwards the business processes will be changed according to these descriptions. So the employees are very well aware of the strong relationship between the advancement and the maturing of artefacts and sociofacts. Since they themselves are involved in formal and informal learning processes during this phase of organizational change management, they also should consider the impact of these activities on cognifact maturing.

- UWAR: CIG members examined and reflected upon their individual perspectives on knowledge and learning development and differences in what and how people learn and how they interpret and use what they learn. Group members could see the importance of the social construction of knowledge and the different contexts for learning, development and practice when considering innovation in careers guidance. Cultural knowledge in guidance organisations plays a key role in practitioner practices and other workplace activities and members reflected upon how such knowledge could be made explicit and utilised to improve knowledge maturation processes related to practice. The group could perform knowledge maturation in this field more effectively than their own organisations because they were given time and space for reflection on these issues and were able to draw upon and compare how practice varied across contexts and settings.

  The group members were also aware that innovation, learning and development is strongly contextualised and that means what constitutes useful knowledge could itself vary quite widely depending upon the nature of social interactions and organisational culture. This also presented a particular challenge in that those wishing to support innovation in career guidance need to have an implicit or explicit theory of the management of change, particularly when other aspects of context were themselves changing, including how practice is delivered, the nature and reach of different guidance organisations as well as the labour market itself. The group did give considerable time and thought to issues associated with the management of change rather than assuming that innovation would be relatively unproblematic.

Informal Relationships

- FZI2: An important factor for the interviewees was to mention a constructive discussion culture. If the employees have the possibility to participate in different discussions, then this is seen as positive indicator for knowledge maturation in the whole community. This constructive discussion culture is seen as even more important and necessary in multidisciplinary work settings, because artefacts, cognifacts and sociofacts are equally affected.

- TUG: The key factor for knowledge maturing is an organizational culture and structure that is supportive of the formation of informal relationships. The encouragement of employees to collaboratively reflect upon learning processes and a lack of hierarchical structures fosters relationships between employees that are effective to distribute new ideas and information about current activities.

- UIBK2: having the choice at which office space to sit for the week up to a certain extent, interviewees preferred to sit close to colleagues they either had to communicate with often because of tasks or with colleagues they preferred on a personal basis. The created pleasant atmosphere would provide for a positive environment for communication on a personal basis (sociofacts – "rules" of communication being less formal).

- UPB: In BPOC there exists besides a hierarchical approval-system for documents, and complementary to a governance model that regulates communication structures within the company, a culture for open discussions. These discussions, which take place within the transition teams, between them, and on subsidiary- level as well as company-wide, are supported by appropriate IT-tools and by digital and f2f-forums. This mood of 'continuous improvement' is an essential part of the company's corporate identity and is well known and accepted by the employees.

- UWAR: Informal relationships meant that individuals could be involved in exchange of personal knowledge in a number of settings, not just when engaged in group activities. Personal knowledge represented what individuals brought to work or work-related situations that enabled them to think, interact and perform. The personal knowledge stores of members of the group were very rich as all members had played a number of different roles concerned with guidance practice, supervision, management, training, research, development, evaluation and policy advice in different types of organisations. The personal networks were very important in terms of gaining access to various types of resources and support in order to support collaborative learning and development.

Mechanisms de-freezing thought patterns

- TUG: The management strives after an organizational culture that prevents the development of permanent consensus. While formal forms of communication should help to create rich, external representations (e.g., by conducting regular team meetings and making use of collaborative learning software), informal settings should initiate reflections upon them. By caring for an atmosphere of trust and collegiality (i.e. no fear of embarrassment and loss of power when disseminating ideas around the company) the engagement in dialogues revealing different perspectives on one topic should be encouraged and should contribute to a diverging thinking among the employees. This organizational-based measure for enhancing creativity supports maturing processes that iterate between phases Ib (appropriating ideas) and II (distributing in communities) in order to overcome worn-out schemata during problem solving for software development.

- TUG: A further general measure through which the provision of IT-infrastructure should become effective is to guide the employees to reflect upon their work processes. When an internal Wiki was introduced to collaboratively work on software-development and customer support, the employees initially showed a lack of commitment to the use of this tool. In further consequence the management began to address the importance of awareness for learning processes during team meetings. Employees were encouraged to externalize their ideas and problem solutions in the form of Wiki entries and to engage in dialogue about these knowledge units continuously also outside of formal meetings. This measure has already increased the number of Wiki articles and proved to *defreeze organizational thought patterns*. The Wiki-based distribution of ideas among organization's members reveals different perspectives of the colleagues, fostering diverging thinking during work and preparing employees for a constructive discussion of project meetings. Being informed about colleagues' ideas beforehand makes it easier to bring them together for a collaborative and creative problem solving.

- UPB: A strategic action guideline of the company is given by the concept of continuous improvement. This concept not only encourages the employees e.g. to contribute their new ideas to a discussion forum in order to develop innovative strategies but also fosters a change in social interaction. Due to regularly enforced role-changes within the transition teams individual responsibilities were changed from time to time and thus a multi-perspective view on problems should be enabled. Furthermore, the teams are mixed with regard to the competences of their members, which are experts in diverse subject domains. This also could be a mechanism to overcome rigidity of thinking and from sticking in convenient but ineffective action patterns.

Willingness to share knowledge

- FZI1: The interviewees are working together with around ten people which are from the same project. Contacts and communication about artefacts and sociofacts to already known individuals are freely shared. Other contacts are not favoured and therefore the willingness to share is restricted to the people in the same project.

- FZI2: All individuals attend a lot of different meetings. These meetings are necessary to secure technical and other processes for the progress of projects. Most of the other work is done with the help of experienced colleagues, similar projects or data on the intranet, thus the focus is on the individual and community level concerning the construction of artefacts, cognifacts and sociofacts. Usually the interviewees work together with approximately 10 people, but in project meetings this number can increase to up to 50. These people are typically from management level or are software engineers. The willingness to share knowledge has been reported by the interviewees as high, because they need the information from each other for effective project management and therefore are

not reluctant to share. Furthermore, the attendance at a lot of meetings is accepted by the interviewees as necessary and "something good".

- UIBK1: An open minded communication culture was described as ubiquitously recognizable. This resulted in knowledge about colleagues' knowledge and eases the access to it. Hence, it can be seen as a sociofact.

- UIBK2: If employees were more willing to answer colleague's requests, they were seen to be "better" with respect to KM as more people would be willing to answer requests posed by these employees, and therefore create a more communicative environment (sociofacts – creation of "favorable rules" for communication).

- UPB: The interviewees emphasized that for BOPC the sharing of knowledge in the transition teams between them and also on the company-level are crucial for the company's successful activities. Fostering a climate of continuous improvement that implicates knowledge sharing as one relevant factor therefore can be regarded as a contribution to knowledge maturing on the sociofact level.

- UWAR: The group was set up with the express intention of sharing knowledge and the different institutions to which the members belonged displayed a wide range of cultural practices and differences in support for the development of knowledge resources to support individual and organisational learning. In relation to the understanding and use of labour market information (LMI) in different guidance contexts members' organisations drew upon a variety of resources. These resources included codified knowledge embedded in texts, records, databases and repositories related to LMI as well as in the cultural practices involved in developing, understanding and using such resources.

Summary

After collecting the different reasons that are deemed to influence the performance of knowledge maturing, we agreed that each partner maps each reason found in the case according to:

- Scope: Individual (Ind), community (Com), organisational (Org)
- Types of knowledge manifestations: Artefacts (Art), cognifacts (Cog), sociofacts (Soc)

The detailed mappings are listed in appendix 7.3.1 in table 15 (scope) and table 16 (knowledge dimension). Table 3 provides a summary. For each reason, the number of mappings to the specific scope or the relevant knowledge dimension is listed in columns. The column "# of cases" provides the number of cases to which the respective reason was mapped based on the perception of the responsible case-study partner.

Reason	# of cases	Number of cases related to					
		Ind	Com	Org	Art	Cog	Soc
Willingness to share knowledge	6	5	3	1	3	2	6
Informal Relationships	5	1	4	0	2	2	5
Accessibility of knowledge	4	3	3	3	4	3	2
Availability of different channels for sharing knowledge	4	3	3	3	3	0	4
Employees' attitude towards and awareness of KM activities	4	3	2	3	3	3	3
Employees' reflexiveness about the nature of KM itself	2	2	1	1	1	2	1
Mechanisms de-freezing thought patterns	2	0	0	2	1	2	2
Best practice model to improve workflows, tasks or processes	1	0	0	1	1	0	1
Community of practice offering advanced training and expert finding	1	1	1	0	0	1	1
Sum		*18*	*17*	*14*	*18*	*15*	*25*

Table 3: Reasons affecting performance of knowledge maturing and number of cases with reasons related to individual (Ind), community (Com), organisational (Org), artefacts (Art), cognifacts (Cog) and sociofacts (Soc)

Topic one of the cross case analysis resulted in a set of 9 reasons for better performing KM, each observed in between one and six case studies. Many reasons are concerned with employees' attitudes and behavior towards KM which is strongly related to, for example the willingness to share knowledge, informal relationships and reflexiveness about the nature of KM itself as well as informal relationships built between employees. Furthermore, reasons that can be related back to drivers of knowledge work, for example accessibility of knowledge, availability of different channels for sharing knowledge and mechanisms de-freezing thought patterns, are highlighted by several case studies. The perceptions of case study partners with respect to the scope of reasons is fairly evenly balanced between individual (Ind), community (Com), organisational (Org) from an overall perspective. The two reasons identified in most cases, however, can be interpreted as relying primarily on the individual and community level. With respect to the knowledge dimension, sociofacts (S) were particularly often related to the reasons. However, sociofacts often have a manifestation in corresponding artefacts (A) that were also perceived to be involved often.

The reasons that case-study partners highlighted in topic one of the cross-case analysis can be viewed from a bottom-up (i.e. related to grassroots approaches) and a top-down (i.e. related to organisational measures) perspective. There are both, formalized and standardized practices deemed supportive for KM as well as practices that grew out of self-organized communities of experts. The former already points towards the close relationship between reasons of better performing KM and measures that organisations applied in order to foster KM which are studied in more detail in the next section (4.2.2).

4.2.2 Topic 2 – Measures for knowledge maturing

The cross-case analysis of this topic was guided by the lead question: How is KM supported? In addition to the reasons for better knowledge maturing discussed in Topic 1 (see section 4.2.1), we analyzed concrete measures that have been perceived as useful for fostering KM by the organisations. Again, in order to justify the measures, we also provide short evidence collected from individual cases.

Acting as "claimant"
- UIBK1: In order to succeed in developing knowledge further, e.g., established but maybe out-dated practices, a new idea needs someone who claims it. Interviewees called this role "claimant". Ideally, this role is performed by a person who is in a relatively powerful position, formally or informally, who has the capability and authority to stress his or her demand.

Appropriate competency allocation in projects
- TUG: The interviewee characterizes the organization's structure as flat and decentralized since the management is distributed across the chief executive and three part owners who are responsible for different projects, i.e. software products for different branches. A particular group of equal employees is assigned to each project, while in some cases there are some personnel intersections between the projects. These clear and quite small project settings working on software products foster the emergence of communities of practice and an effortless competence-based search within the company as well as the coordination of activities of the identified, experienced people
- UIBK1: In project settings, people from different departments or even subsidiaries with different backgrounds work together towards a common goal and, most importantly, are provided with time to meet in person and discuss and jointly mature ideas. Those settings are perceived as very fruitful not only because time is provided but also because they go along with a legitimation of actions which empower project members to pursue project goals and introduce changes.
- UPB: BPOC forms transition teams of mixed expertise. The different competences in the team of experts from various domain areas are supposed to deliver better performance in terms of innovative social creativity, effective collaboration and stimulation of continuous improvement. Regularly held team-meetings provide an opportunity for open discussions between the members of the expert-team in order to facilitate the group's capabilities.

Formal training at regular intervals

- UIBK1: Selected employees are encouraged to attend dedicated trainings. The topics of training courses are selected with respect to identified gaps between employees' competence profiles and needs of organisational units or projects the employee works for.
- UIBK2: The organization fosters a policy that employees are able to attend at least one formal training activity per year to ensure that they keep up with current developments. The topic typically is chosen by the employee and their team leader.
- UPB: The formal training within BPOC is closely related to the advancement of individuals, the success of the group they belong to and to the organizational objectives. According to a personal development plan (PDP), which is discussed with the personal supervisor of an employee, an individual should select from a subset of courses that are supposed to be useful for the advancement of all the three levels. For those purposes balanced scorecards were used. The scorecards are calculated with regard to the core goals of a project, the benchmark figures (KPIs) of the client's business processes, the customer satisfaction and the innovative contribution of the group member (e.g. contribution to the idea data-base). Thus, the training opportunities of BPOC's employees are closely linked to the business objectives of the company. Participation in formal training on regular intervals is mandatory for employees of BPOC and is considered as an important element of his/her PDP. Nevertheless, additionally optional courses may be selected if they are of special interest for the employee.

Fostering reflection on innovation by enabling purpose-oriented task groups

- FZI2: In order to reflect on current projects and their goals, employees who not take part in the respective project meet in task groups for facilitating knowledge maturing. The task groups meet on a regular basis and discuss several issues that affect the project goals. Additionally, they discuss and manage topics about innovation and process engineering for new ideas and developments for car construction. These groups help to strengthen the phases II (distribution in communities) and IV2 (pilot phase). The task groups are invited to give recommendations which could be considered by the project team. Cognifacts and sociofacts are results of these task groups.
- UIBK2: There is an "innovation group" where employees can take part in regular meetings on a voluntary basis. This group is aimed at exchanging experiences with new technologies for both, internal use and use within projects. Additionally, technologies that may be useful in the future can be a topic for the innovation group.
- UPB: The delivery excellence team is part of the quality management of BPOC. Delivery excellence teams (DET) are publishing targets every year, which needs to be achieved with every specific client. Members of the DET not only are visiting every transition team for discussion and reflection of their daily work with their clients. They also organize monthly meetings with the team leaders of the transmission groups for cross group discussions on the groups' performance and possible improvements.
- UWAR: The CIG was a careers innovation group, but members were aware that the formal group meetings were time-bound and that the 'bridging social capital' of individual CIG members going across different groups and organisations had a variable reach when it came to supporting knowledge maturation. The group therefore believed that one of their key tasks was to see whether it would be possible to use the three years of the CIG as an opportunity to investigate and possibly establish other ways of supporting knowledge maturation processes. One particularly useful aspect of the CIG had been the way it was operating at the boundaries between different communities and they were keen to see whether artefacts (e.g., documents or software tools) could be used to extend and deepen the communication between communities, thus making possible productive communication and 'boundary crossing' of knowledge.

Fostering topics by conducting community of practice meetings

- FZI2: In-house-exhibitions support knowledge maturation, foster transparency and openness at a community and organisational level, besides the usual project meetings. Artefacts and sociofacts are produced.
- TUG: Conducting SCRUM-Meetings is seen as an important measure for KM, because these daily stand-up meetings provide a formal structure for CoPs to discuss urgent tasks and problems, to

evaluate the progress of the software development, and also to exchange lessons learnt. They contribute to an open-minded organizational climate that supports the development of new problem representations, i.e. cognitive flexibility when searching for new ideas. They increase the transparency of relations among team members, artefacts and their approach to solutions and thus, are regarded as an important factor for newcomers to become familiar with socio-cultural practices of the team and the whole company.

- UIBK2: For several topics, employees decided to conduct regular topic-based meetings in which employees dealing with the specific technologies come together and exchange lessons learnt. These communities of interest are mostly based on informal relationships between members of the organisation so that they are not existent for all topic areas of the organisation.

- UPB: During competitions, which are conducted in the company, individuals and teams once in a year submit innovative ideas and projects and publish them in an exhibition or as a presentation on the stage. Thus, all members of a subsidiary of the company will learn about other projects and ideas and discuss top-ranked subject areas. Subject domain experts, who are involved in these discussions, also contribute to subject-related formal trainings. Thus, dynamical changing communities of practice contribute on different levels to topic-related knowledge maturing. Furthermore, the discussion-forums, which occur in the 'idea-database', can also be regarded as CoPs that promote a specific topic.

- UWAR: Members of the group had particularly strong overlapping personal and professional networks and the group acted as a form of 'bridging social capital' across the field as a whole (which sometimes operates within distinct 'silos'). Individuals in the CIG belong to many social groups with an interest in guidance within, across and outside formal institutions. The members also meet each other in many settings, which means it is difficult to isolate the influence of the CIG and the frequency of interactions outside the group and multiple group membership of members and this in turn leads to the patterns of knowledge maturation (acquisition, sharing, development etc.) associated with the CIG which are both idiosyncratic and social. The knowledge being developed within the CIG is interpreted within a personal context and history that has been shaped by these multiple social interactions inside and outside these formal groups and by other aspects of their career and learning biographies. However, the group as a whole also acted as a form of 'bridging social capital' in that it brought together people with diverse interests within the career guidance field.

Guidance by supervisors and management in general

- UIBK1: Guidance by supervisors is seen as an important factor for raising employees' awareness of knowledge management in general which in turn is deemed to highly affect the performance of KM. Furthermore, employees' attitude towards knowledge management is seen as capable of being influenced through guidance of supervisors and management. Another mentioned possibility of providing guidance is the integration of KM-related topics into the process of management by objectives. By doing this, goals of employees can be aligned to goals of departments and goals of the organization. Furthermore, if supervisors foster KM, e.g., by supporting specific KM activities, a positive influence is experienced. This was seen by some as the most important difference with respect to the performance of KM between subsidiaries as well as between the departments in one subsidiary. Examples mentioned by interviewees cover artefacts (e.g., fostering documentation of knowledge), cognifacts (e.g., training of employees) and sociofacts (e.g., setting up recurring team meetings).

- UPB: There exists a specified hierarchy of roles within BPOC, which includes supervisory and guidance functionality. Every transition team has a leader who is responsible for the performance of the team and also supports team members, if help is needed. They all together were measured with KPIs from the client they are in charge of. The transition team's performance is weekly published in a group-dashboard that indicates performance indicators of their project with regard to customer's KPIs, milestones, project-schedule and budget. The team- leaders themselves are guided and supervised by a member of the quality management team (delivery excellence service). The delivery excellence team and transition team leaders together are co-operating with process-owners (who are responsible for a process described in a best-practice model (GPM)) and subject domain

experts. Thus, a social network of supervision and guidance is established within the company that goes beyond the boundaries of a single subsidiary.

Initiatives enabling awareness and orientation for quality management

- UIBK2: There is an (organization-wide) quality management initiative which aims at documenting all business processes and thereby provides transparency for these processes. For this documentation, processes are continuously revisited. The cycle length is about two to three years and only 'typical' (business) processes are focused on and therefore it does not include all exceptions in these processes.

- UPB: BPOC owns a sophisticated quality management system that is involved in the activities of the transition teams. The excellence deliver team members affect the personal development plans of the employees as well as the performance of the transition team or the main objective of the company. Based on assessment (KPIs, weekly dashboard on a team's performance) meetings with team leaders were organized in order to improve the results in compliance with the agreements with the client. Furthermore, monthly and annual competitions between the teams and individuals were organized to foster awareness for the quality their work.

One supervisor for teams in different subsidiaries

- UIBK1: Some supervisors lead teams having similar tasks in different subsidiaries. This fosters the transfer of knowledge between different subsidiaries and has, for example, the advantage that good practices of one team could be adopted by other teams more easily. Furthermore, it enhances transparency and facilitates benchmarking of similar departments in different subsidiaries and could foster the development of communities of practice/interest.

Organisational guidelines for documenting knowledge

- UIBK1: Shared sets of rules regarding common ways of performing knowledge work are implemented and followed by employees, e.g., a shared and standardized way of organizing and naming documents and folders on file shares.

- UIBK2: There are organizational guidelines for e.g., documenting lessons learned or project results. Although these guidelines exist for several situations, time for fully documenting solutions is scarce.

- UPB: A governance model in BPOC defines precisely the abstraction levels of business process related documents (6 levels of abstraction) and their hierarchical status of approval, which indicates also their knowledge maturity. This governance model also regulates the authorship and the workflow for approval of a business process document.

Performing benchmarks

- FZI1: In general the interviewees state that knowledge maturation is performed quite well in the organisation. The interviewees think that phases III (formalizing) to Vb (standardisation) are supported well for artefacts. This perception is argued by the interviewees with an intuitive and implicit comparison with competitors, without any clear benchmark indicators.

- UIBK1: In benchmarks, different departments or different subsidiaries of the organization are compared against each other in order to identify gaps. Also, information sources outside the organisation are considered, e.g., comparable organisations in the same sector. The identified gaps are the basis for further analysis and subsequent measures.

- UPB: Transition teams are assed by benchmarking relevant aspects of the change management they initiated at their clients. For the needs of quality insurance the revised business processes of their clients are benchmarked with KPIs (Key Performance Indicators). These indicators are also used to foster competition between the different transition teams of BOPC and compare the outcomes of the lean and outsourced business processes. The results of the assessment are basis for further discussions with the clients as well as for discussion within BPOC about possible future improvements of transition processes.

Providing office spaces for flexible use and enabling home office

- UIBK2: Employees are allowed by the organization to choose where to sit and are encouraged to sit close to colleagues they need to communicate with often or from whom they want to learn something. By enabling this, employees who for, example want to work together for a new product, or for discussing issues which came up in a project are provided with a much better environment for doing so. Besides the possibility of flexible seating, employees have the possibility to work at home for up to 25 per cent of their time. Although working at home was not done often, interviewees valued this possibility for doing work where a quiet environment was preferred, e.g., writing a project proposal or concept.

Provision of IT

- FZI1: A software and hardware infrastructure is provided that is used, e.g., to host so called project databases which are used to store information about projects in a standardized way. Furthermore, employees can use the Intranet to access information.

- FZI2: The organisation uses a broad collection of different technologies and software. For example a research and development forum and a business innovation forum are key concepts to enhance knowledge maturation. These two forums allow a discussion of the requirements management for new products and therefore enhance the phases II (distribution in communities), III (formalisation) and Vb (standardisation).
  The company thought that a monetary incentive would boost participation but this was not the case for phase Ia of the KM phase model (expressing ideas).
  The forums have quite a high number of participants but because of the lack of experts participating in the forums, the acceptance is not as high as expected.
  But besides this issue, the organisation has established public profiles for every employee in the Intranet and has therefore established some kind of a social network, without the risks of using more popular networks like Facebook, where there is doubt about what happens to the data and how well secured it is. This strengthens the trust in the forums and therefore is a good indicator for high participation.
  Also the discussions at the forums are from time to time topics of discussion in real face-to-face meetings.

- TUG: Prospectively, the company plans to focus on software-based measures in order to foster KM. At the moment, an internal Wiki has been implemented for expressing ideas and creating learning objects. Due to the company's enlargement, the adoption of CSCL tools is planned to facilitate rich communication among members of distributed communities of practice. Currently, a collaboration tool for creating shared files and tagging shared resources is being tried out to prepare formalization-processes and to increase accessibility of knowledge. Additionally, the implementation of a widget-based technology should help to overcome media disruption.

- UIBK1: For supporting knowledge maturing, special attention is paid to the provision of an adequate IT infrastructure and software, e.g., all subsidiaries are connected via a network with high bandwidth and employees are provided with laptops, cell phones as well as software and hardware for conducting voice and video calls via the Intranet and Internet.

- UPB: BPOC applies a broad variety of software tools for the different phases of knowledge maturing. For finding and expressing ideas an idea-database is used for example. While E-Mails are mostly used for communication between individuals or in specific groups (lists) Wikis serve mainly as an open forum for the purposes of company-wide global dissemination of ideas. Furthermore, there are applied: MS-Office tools, web-based virtual team room, shared idea data base, 12i data base on approved processes, MS-share point, shared calendars, file repositories, Video-Conferencing system, documents with workflow macros. A global user management provides restricted areas according to the demands of privacy and business interests. The IT- department of the company is closely involved in the organisational processes and the change-management.

- UWAR: The Careers Innovation Group also has their own website and members experimented with a number of different technologies to support collaboration, including the sharing of ideas and resources (see 4.2.4).

Regular (team) meetings[8]

- FZI1: All individuals share a high involvement in different meetings. Employees share a high awareness of the value of communicating with each other, as most information is exchanged via meetings which are about technical issues and sharing information about the progress of projects. During the meetings junior employees (for more information on identified groups of employees see section 7.2.1.1) mainly search for different project inquiries and create presentations and studies for different projects that can be seen as artefacts. Usually, the junior interviewees work together with around ten people from the same project. Contacts and communication to already known individuals is preferred, enhancing the construction of cognifacts and sociofacts.

- UIBK1: Knowledge transfer between different levels of hierarchy is supported by an established procedure of regular team meetings, ensuring fast and target group oriented diffusion of knowledge in both directions along the hierarchy.

- UIBK2: As not all members of a team would be working in the headquarters at the same time, communication in teams is fostered by regular team meetings (typically every two weeks). These are specifically used to create an awareness of what colleagues are currently working on and also to communicate decisions and information along the organisational hierarchy.

- UPB: Regular team meetings were held within the transition team in order to co-ordinate and improve their performance. For the needs of quality management monthly meeting of the team leaders with members of the quality assurance are organized. Besides these intra-company meetings, f2f meetings and subject related workshops are conducted with the clients and separately with the members of the lean company, which prospectively will be responsible for the outsourced processes.

Technology-enhanced boundary objects

- UPB: In the meetings between members of the transition team and the client-employees different types of documents are presented in order to indicate future developments of the organizational change. Most of the documents are embedded in PowerPoint presentations that also could contain interactive elements. Similar documents were produced for the needs of training for the lean processes at the company, which is responsible for those processes. Thus, interactive and animated digital media provide the basis for communication with client teams and lean companies and may be regarded as technology-enhanced boundary objects (TEBOs.)

- UWAR: The one line of investigation, drawing on earlier work of some CIG members on knowledge sharing in career guidance, which was reported to the group, developed an approach to learning based on the design of symbolic boundary objects which were intended to act as facilitators of communication across community boundaries, between teams and specialists or experts. The argument was that effective learning about key aspects of guidance practice could follow from engagement in authentic activities that embedded models of support for practice which were made more visible and manipulable through interactive software tools, which could be considered as technology-enhanced boundary objects (TEBOs), software-based resources which supported knowledge sharing across organisational boundaries. Members of the CIG were keen to investigate further whether TEBOs could be useful in supporting knowledge maturation processes in guidance. TEBOs were conceived as boundary-crossing tools which could support situated learning with a focus upon sharing ideas about practice in different contexts. One avenue explored (within and beyond the MATURE project itself) was to engage in a dialogue with guidance practitioners about the use of Labour Market Information (LMI) in the development of prototype TEBOs. Knowledge maturation processes were being supported in these developments through the use of co-design

---

[8] Regular team meetings are seen as a recurring form top-down communication focussing on decisions of the organisation and the official business, whereas communities of practice and workshops focus on professional topics

with users; developing conceptual tools to help people understand the models and ideas which are part of LMI; attempts to develop a pedagogy to engage users and boundary objects which are configurable by end-users (practitioners) and by guidance trainers so as being capable of being used in multiple ways. The knowledge maturation processes needed to extend to building an understanding of how TEBOs may be used in ways that are empowering for practitioners, and ultimately for clients, too. The knowledge maturation processes linked to the development work with TEBOs was seen as a potential way of getting individual practitioners to interact more readily with learning resources for understanding LMI and understanding the conceptual challenges in interpreting the output of TEBOs: graphs; labour market predictions; charts; employment data; financial models etc.; and supporting practitioners in how to visualise, analyse and utilise LMI in new ways in the guidance process they offer to their clients. This development work was seen as illustrative of a knowledge maturation process with the potential to support learning through the dynamic visualisation of data and relationships and the consolidation, representation and transformation of knowledge.

Workshops[9] on specific topics

- UIBK1: Besides dedicated projects, workshops on specific topics are used as another measure to foster knowledge maturing. Supervisors meet to reflect on competencies of their employees and initiate workshops where selected employees are brought together to drive a specific topic. Side effects of this measure include the support of development of communities of practice and exchange of knowledge between employees.

- UIBK2: Besides trainings for each individual employee, each team takes part in one joint training event per year for which the team collaboratively chooses the topics. Typically both, soft skills and professional skills are the focus of such workshop.

- UPB: Formal training at BPOC according to a balanced scorecard concept is a mandatory part of the personal development plan of every employee. Besides individual and group related training that is organized in courses workshops on specific topics like new emerging concepts are offered occasionally.

Fostering of shared topic related understanding within a group or between groups in the company

- UPB: In the company (BPOC) there exist knowledge sharing media which are used by members of the transition teams, who work e.g., with a certain client (project). An 'idea data base' is available and enables members of a working group to publish their topic related problem solving ideas. Based on these documents and the personal experiences of the group members, ideas will be improved and finally agreed and approved (face to face discussions, annotation on documents, contribution in Wikis, use of a versioning system, documents in a virtual team room). Company experts from outside the transition team will be included in these knowledge sharing and maturing activities. The final approval is made by the project related content manager. Based on approved documents (consensus artefacts) transition processes at the client will be applied. Final version of solution will be published company-wide and may be integrated after well-defined processes of quality assurance into the standardized GPM (see below). Thus, BPOC has established a mostly company-internal communication system, which comprises direct human f2f-communication within groups, the usage of collaborative tools and a governance model to organize the collaborative workflow of documents efficiently. All in common, these combined measurements for knowledge maturing foster a topic related shared understanding within and between participating groups and so far can be considered as supportive for knowledge maturing on sociofact level.

Competition-based idea management

- UPB: In the company an incentive system exists combined with a competition. Individuals and teams once in a year submit innovative ideas and projects which have been or will be applied at a

---

[9] Distinguishing from community of practice meetings, workshops are seen as formalized and official (top-down), whereas community of practice meetings are seen as voluntarily (bottom-up).

client site. All the contribution will be presented during a one day exhibition (one room for every project). During an Oscar award ceremony ovations and financial rewards will be delivered. Thus, all members of a subsidiary of the company will learn about other projects and ideas and have to be innovative by themselves. By this way a culture of knowledge sharing and continuous improvement should be fostered.

Collaborative activities to increase a group's performance within a company

- UPB: Within the BPOC transition group there is strong reflection of ongoing group activities. This is done for instance by discussion in regularly conducted meetings between the group members and creates a high level of group awareness and corporate identity. Reflection, team building and knowledge sharing is also organized by temporary changes of roles and responsibilities within the group. A member of the team who is responsible for some processes of a client takes afterwards the role of an expert and teacher for the colleagues, sharing his/her problem-related experiences with the client in order to improve further transition processes.Additionally, monthly cross-project meetings of the team-leaders with members of the quality management task force are conducted in order to exchange experiences across the different client-engagements and foster a higher level of responsibilities of the group managers and the group members. Thus, awareness on group activities is not only supported by software with awareness functionality (content change awareness, social awareness in a virtual team room) but also by further accompanying measures. Therefore, also PDPs (personal development plans) are not only oriented on individual needs and interests, but consider team-related requirements in order to strengthen the team's performance. Thus, participation of employees in formal and informal training of the company contributes to the concept of continuous improvement and is linked to group-related quality indicators provided by the quality management department of BPOC. Advanced training within the company is linked with a system of company-specific certificates and is partly included in a competition between teams (team-oriented ovational award scheme: e.g., best lean project, best GPM alignment project, best six sigma project…; financial gratification as part of an incentive system). Thus, BPOC has established a system of individual and collaborative activities, which consists of regular internal and cross-group meetings in order to foster social and quality awareness, a personal development plan, that is aligned to the group's performance an individual belongs to and last but not least collaborative software tools, which support these collaborative activities. All in common these collaborative activities may be considered as a sociofact that improves a groups performance and hence serves general objectives of the company.

Written or unwritten rules which contribute to efficiency and effectiveness of communication

- UPB: In order to organize communication and interaction between clients and the transition team of BPOC in an effective way SPoCs (single points of contacts) are defined. All relevant communication between both sides, especially those who are essential for changes of business processes, is exchanged between these two people who are responsible on both sides for those changes (client: project manager; BPOC: transition team leader). Members of the transition team are supposed to provide the SPoC members with all relevant information. This could be done in face to face communication, via e-mail, entries and comments in a database or changes of documents in the team room.

  Before a decision on new or restructured processes is taken, the final versions of the decisive process-descriptive documents have to be approved. The approval process is organized according to a governance model which defines the workflow of a document until it achieves the status 'approved'. Thus, the two members of SPoC are working as boundary spanners and the approved documents and related materials like ppt-presentations on this specific issue can be regarded as boundary objects. Not only is the alignment of existing processes of clients with the best practice processes of the GPM (global process model) is ruled after a governance model but also the improvement of processes within the GPM. Before a process is approved as part of GPM it is subject to a quality assurance analysis. The workflow of this approval process within BPOC is often supported by workflow-macros which are part of the process-related documents. The macros contain specific information about approval-phases, participating staff, automatic notification to the reviewers and the sequencing of the document in this evaluation process. Thus, BPOC has established a govern-

ance model, which not only defines communication structures between groups but also is directly linked to an approval system in order to improve and certify the maturity-status of artefacts. This system of written and unwritten rules, which influences communication and collaboration within the company may be considered as a sociofact with essential impact on knowledge maturing. Supportive software tools for the activities of boundary spanners and applicable tools for the development of boundary objects hence may be regarded as supportive tools for knowledge maturing on sociofact level.

Summary

After collecting, interpreting and relating the different measures that the studied organisations employed to foster the performance of knowledge maturing, we agreed that each partner maps each measure highlighted in the case according to:

- Scope: Individual (Ind), community (Com), organisational (Org)
- Types of knowledge manifestations: Artifacts (Art), cognifacts (Cog), sociofacts (Soc)

The detailed mappings are listed in appendix 7.3.2 in table 17 (scope) and table 18 knowledge dimension). Table 4 provides a summary for the measures. For each measure, the number of mappings to the specific scope and to the relevant knowledge dimension is listed in columns. The column "# of cases" provides the number of cases in which the respective measure was highlighted based on perceptions of the responsible case study partner.

Measure	# of cases	Number of cases related to					
		Ind	Com	Org	Art	Cog	Soc
Provision of IT	6	2	4	6	6	3	4
Fostering topics by conducting community of practice meetings	5	0	5	2	1	0	5
Fostering reflection on innovation by enabling purpose-oriented task groups	4	2	4	2	1	1	4
Regular (team) meetings	4	0	2	4	1	0	3
Appropriate competency allocation in projects	3	0	2	3	0	1	3
Formal Trainings at regular intervals	3	2	1	2	0	3	1
Organisational guidelines for documenting knowledge	3	1	0	3	3	0	3
Performing benchmarks	3	1	1	3	1	3	3
Workshops on specific topics	3	1	3	3	0	3	3
Guidance by supervisors and management in general	2	1	1	2	2	2	2
Initiatives enabling awareness and orientation for quality management	2	0	0	2	2	0	2
Technology-enhanced boundary objects	2	0	2	0	2	0	0
Acting as "claimant"	1	1	0	0	1	1	1
One supervisor for teams in different subsidiaries	1	0	1	1	0	0	1
Providing office spaces for flexible use and enabling home office	1	0	1	1	0	0	1
Fostering of shared topic related understanding within a group or between groups in the company	1	0	1	1	1	1	1
Competition-based idea management	1	1	1	1	1	1	1
Collaborative activities to increase a group's performance within a company	1	0	1	1	0	1	1
Written or unwritten rules which contribute to efficiency and effectiveness of communication	1	0	1	1	1	1	1
Sum		12	31	38	23	21	40

Table 4: Measures deemed to improve performance of knowledge maturing and number of cases with reasons related to individual (Ind), community (Com), organisational (Org), artefacts (Art), cognifacts (Cog) and sociofacts (Soc) level

The cross-case analysis of topic two resulted in a set of 19 measures which were jointly developed by all in-depth study partners. For each measure, between 1 and 6 cases were mapped based on observations that were highlighted by the respective case study partners. Most mappings of cases are provided with respect to provision of IT. Aspects highlighted by case study partners cover a broad range of measures that are related to the provision of a sophisticated IT infrastructure supporting communication and exchange of knowledge as well as IT especially realizing an instrument for knowledge maturing, e.g., to support formalizing via Wikis. A further and more detailed investigation of IT supporting phases of the KM model is provided in section 4.2.4. There are a number of measures that were observed in a larger part of the case studies which aim at creating opportunities for employees to meet face-to-face or enabling them to connect to each other and extend their social network, e.g., fostering topics by conducting community of practice meetings, regular (team) meetings and workshops on specific topics. Other measures are concerned with competence-oriented team building and competence development. To a lesser extent, measures are concentrated on establishing specific roles by individual employees, who, e.g., act as boundary spanners between different departments or take on the role of a "claimant". This is also reflected by the distribution of mappings, the in depth study partners made with respect to the scope of measure which shows an imbalance between individuals (Ind) that are mapped to a lesser extent and groups of individuals (Com) and organisational (Org) which are mapped to a higher extent. Sociofacts (Soc) are mapped particularly often compared to artefacts (Art) and cognifacts (Cog) which might be because sociofacts were either also represented by artefacts or cognifacts and the fact that the majority of measures can be related to groups of people and their relationships. Compared to the reasons for better maturing, collected in section 4.2.1, measures are more concerned with a top-down perspective, e.g., fostering topics by conducting community of practice meetings and regular (team) meetings.

4.2.3 Topic 3 – Barriers for knowledge maturing and ways to overcome

The cross-case analysis of this topic was guided by the lead question: What barriers have been overcome? This section presents different barriers to knowledge maturing found in the cases. Each barrier is described within the context of the cases it was found in, together with the means of how it was (partially) overcome. In the remainder of this section, the barriers are classified and ways to overcome these barriers are classified into types and related to the motivational framework.

Changing nature of careers

- UPB: avoiding the devaluation of competences by training and fostering carrier advancement BPOC itself is eager to re-organize its customer services according to the criteria they are applying at their clients. Therefore, the employees of BPOC also are facing the possibility of losing their jobs after having finished a project. They cannot be sure, that the expertise they achieved during their work at the current client also will be needed in the next project with another client. The mixture of required expertise in the next transition team could be different from that they actually belonging to. Furthermore, due to the emergence of new outsourcing methods and a different subject domain of the next client's business, their competences could be very quickly out of scope. This puts pressure on them and leads to a strategy for project enhancement (taking over processes from the client or restructure more processes in addition). The team sometimes also tries to achieve an extended appointment from the client or to acquire a new project. Thus, they could provide their competences and expertise for a longer period of time to the current customer. It also increases the readiness of BPOC's employees to participate in training courses for advanced professional training. BPOC on its part offers a variety of advanced courses and certificates that not only serves the improvement of their employees' competence but also stabilizes the working climate in the company by offering the employees opportunities of carrier advancement. This all in common and can be regarded as a relevant sociofact that influences the motivation and action of the members of the transition team.
- UWAR: acknowledging the need to take account of this Participants' knowledge maturation processes had to encompass a dialogue about the changing na-

ture of careers and what are the key messages that need to be conveyed to those unfamiliar with this issue. Group members considered this issue and how it linked to 'What are people going to need to feel equipped to deliver that which is required from their clients or prospective clients?' and 'Where do you go to find a safe space to build confidence and increase professionalism on this topic?' Members highlighted that 'in 10 years' time we don't know what jobs will be available and ways in which career trajectories will unfold. Therefore, how does the careers sector harness knowledge of labour markets and embed this at a grass roots level?' Further questions emerged such as 'what changes in practitioner knowledge, skills, behaviour and attitudes are required to achieve innovation in the workplace?' The group felt that face-to-face meetings had helped them recognise that there was a need to develop an interactive and developmental approach to engaging practitioners with such debates. Overall then, the knowledge maturation processes of the group were useful in scoping the nature of the challenges the profession faced and exploring some possible technologically-enhanced ways of tackling these issues, but for the moment these were seen as some way away from practical realisation. This barrier could, however, be overcome by the creation of dialogical spaces where the community could discuss the changing nature of careers and the implications for this in practice.

Difficulties in communication

- UIBK2:   training   to   provide   a   common   understanding
  Due to different backgrounds, e.g., different jobs, different projects etc., several misunderstandings arose. Common training for all employees dealing with projects on project management / working in a project led to a better common understanding.

- UPB: role taking, simulation of processes and training to foster shared understanding
  In order to overcome possible existing difficulties within the transition team, group-meetings and changes of roles and tasks are conducted from time to time. There also exist language and cultural barriers between transition teams and members of the 'lean company' who will be responsible for the outsourced processes in the future. For instance, mostly technical qualified people from India, who are excellent computer scientists, show a lack of understanding of social processes and workflows in western style companies. That's a relevant sociofact for knowledge maturing. Therefore, BPOPC transition teams try to involve them from the beginning of the project into the change management and provide them in parallel with formal and informal training including role taking and simulation of business processes even on the level of navigating graphical user interfaces.

Discontinuity in different software applications

- TUG: use   of   widget-based   technology
  The use of different software-applications for the same tasks is regarded as a barrier for KM and consequently the company plans to overcome this through the implementation of a variety of, but strongly interconnected knowledge services. This kind of media disruption is particularly pronounced in the task of co-developing documents, e.g. wiki-articles, and especially detrimental to the transition between the phases II (distributing in communities) and III (formalization). By using widget-based technology, which intertwines services for creation, discussion, metadata management, etc., the "task-steps" prepare, coordinate, converge and distribute should engage with each other more effectively and synergistically.

- UPB: enabling dialogues between users and members of the IT departments
  Though BPOC is providing a suitable set of software tools to the employees, the mixture of various tools for the same resp. different purposes and the upgrade to new versions sometimes proves as a barrier. BPOC is fostering and intensifying the dialogue between their employees (users) and members of the IT-department in order to identify the users' requirements with regard to the implementation of new versions of existing software or new software tools. BPOC is anxious to integrate the IT department also in discussions and decisions about further strategies of the company.

Focus only on product-related enhancements

- UIBK1:   relating   process   enhancements   to   products
  From a supervisor's perspective, an interviewee stated that because of the strong emphasis on product related developments, sometimes the enhancements of processes may fall short. Overall,

there are different opinions on this barrier as interviewees argue that enhancing processes also have strong effects on products and vice versa. Hence, this barrier could be overcome by relating process enhancements to products that the company produces.

Gap between 'ideal' practice and what occurs in practice

- UPB: defining alignment processes to a best practice model in order to achieve more quality
  The BPOC concept of knowledge maturing is based on the alignment between the current practice of business process at the clients and a theoretical concept of best practices described in a best practice global process model (GPM). The GPM itself is subject of continuous improvements based on experiences with current transition processes. Therefore, identifying and classifying gaps between current customer procedures and the GPM is a main effort of the transition teams. Furthermore, they have to consider the specific regional and local contexts. The restructuring of business processes for BPOC means bridging the gap between an 'ideal model' and the existing practice of the client. This means that of the 6 different abstraction levels of the business processes (see 4.1.6) the required action of the client's business processes has to be modified according to the alignment concept.

- UWAR: acknowledging the need to take account of this
  The challenges associated with knowledge maturation in guidance are compounded by the distance which already exists between 'ideal' practice and what occurs in practice, because of constraints of time, resources, amount of effort required to improve practice, organisational hurdles and cultural inertia. 'Ideal' theories of practice can be almost impossible to implement given the constraints of particular contexts. Current practice can then be uncritically accepted as an inevitable reality, and any impetus towards improving the service is undermined. Awareness of the barrier means that the approach to innovation could take cognisance of the gap between 'ideal' and current practice and work with practitioners to find a new accommodation in particular contexts. [Note: some practitioners are aware of ideal theories and practice, but cannot implement them for a variety of reasons, whereas in other cases a practitioner's implicit theory of practice over-rides what they should ideally do. For example, in the first case a guidance practitioner may give a client a speeded up version of a client-centred interview, whereas in the latter case a practitioner may actually act as if they are directing the process (giving them the information they think they should have). These differences draw on Argyris and Schön's (1974) distinction between espoused theories and theories in action.]

Geographical distribution of Communities of Practice

- TUG: use of IT tools
  Both the adoption of a second building for the home office and the constitution of branch offices have brought along changes in the physical layout of the distributed cognitive system of the company that require the acquisition of new mediating artefacts to overcome a decreased situation awareness. The absence of physical proximity of the employees obstructs direct observations and overhearing conversations, i.e. direct access to people. Thus, even if their tasks border they are not close by for communication. The use of tools that are suggested for CSCL-situations should help to enrich communication, make it less complicated by making nonverbal gestures and signals available.

- UPB: use of IT tools
  Since BPOC is a global company; meetings of local distributed teams customarily are supported by eligible IT-tools like video-conference-systems and global intranet, which provides access to digital resources to every subsidiary, team and employee according to the governance model and the access rights management system.

Implicit theories which influence practitioners' practice

- UWAR: acknowledging the need to take account of this
  One CIG member drew attention to the implicit theories which influence practitioners' practice and how these might need to be addressed if innovation is to be embedded. If practitioners are able to recognise and reflect upon their own implicit theories about practice, this could be a possible basis for change. Implicit theories may develop for an individual from the partly unconscious aggregation of experiences of what are perceived to be a series of similar situations, but they could also be

derived from the taken-for-granted perspective and the theories in use of a particular group. Awareness of the barrier means that the approach to innovation could take cognisance of the importance of getting practitioners to recognise and reflect upon their own implicit theories of practice.

- TUG: provision of software tools for collaboratively collecting and sharing contents
  This company has also become aware of the ubiquitous influence of experienced users' implicit knowledge on their problem solving behavior. From their opinion, much potential gets lost if it stays internally represented in employees' procedural memories and is not externalized and made available for colleagues and newcomers. Especially in the area of customer support, this barrier for formalization processes should be overcome by the implementation of an internal wiki that should enable an effortless and work-integrated documentation of individual learning processes. Additionally, the company is trying out a collaborative software application that supports collecting and sharing contents among the employees. It is envisaged as a potential service to prepare formalization-processes and to distribute a functioning approach to a solution across the company.

Knowledge developed around effective innovations in practice would have to take cognisance of the range of organisational contexts and cultures in which practice is situated

- UPB: acknowledging the need to take account of this
  The BPOC transition teams have to consider the specific regional and local contexts of their client, when re-structuring their business processes. For instance, country specific legislation and regulations and regional or local specific procedures at the customers have to be taken into account, while modeling new processes. These specific solutions will not be included in best practice model (GPM).

- UWAR: acknowledging the need to take account of this
  Members of the CIG were aware, not least from discussing these issues with a range of practitioners from a variety of contexts, that the knowledge developed around effective innovations in practice would have to take cognisance of the range of organisational contexts and cultures within which practice would have to operate; the conditions under which practice would be performed, e.g., access to resources, scope for collaboration, pressure of time, conflicting priorities, etc.; and the nature of guidance interactions, in terms of client types, demands and interactions, number of sessions, opportunities for feedback, deciding action plans, reporting procedures etc.; as well as the extent to which there are opportunities to continue learning in a context of constrained time and resources, conflicting priorities and complex personal and professional relationships associated with busy practitioners with high caseloads. This barrier is due to the way the situational (or contextual) specificities associated with particular innovations make it difficult to generalise about what constitutes 'effective innovations' - that is, much knowledge in this area is heavily contextualised. Awareness of the barrier means that the approach to innovation should be situated to take account of the particular context in which practice takes place.

Lack of resources

- FZI1: hiring more staff
  This barrier was in former years a real problem in this organisation. By hiring more staff this has been overcome.

- FZI2: budget shifting
  Budget shifting, which was not imaginable some years ago, made it possible to relax the financial difficulties of some projects and therefore lack of resources is no longer a problem.

Lacking usability of tools

- UIBK2: guidelines for usability and corporate identity
  Previously cluttered functionality across different tools and their looks and feels would be exchanged by functionalities built in into the organization's internal portal, following *guidelines for usability (and CI)* so that tools would feel more similar and employees could more easily start using new tools.

Lacking willingness to share knowledge

- UIBK2: communities for fostering informal relationships
Knowledge has been seen as a form of personal capital that is not be handed out freely. The development of *communities* in which people would know each other better and would communicate about a common area of interest would partly resolved this issue.

- UPB: bridging barriers between groups by being perceptive and fostering topic related shared understanding
There are barriers of communication not within BPOC but between BPOC transition teams and the customer's employees. Since BPOC is a global player, its transition teams often are focusing on the transfer of workload from high cost location to low cost location, they are taking knowledge and experience from the customer's employees who are not interested in sharing. *"..most of the people who helped us during the rump up phase are fired… sometimes they lose their jobs, sometimes they are employed in other parts of the companies,.. people had ten or fifteen years their job and loose it…and we take over their jobs within six weeks,.. some young, totally inexperienced people come in their company and try to steal their jobs and taking their roles, that's difficult…"* There is a fundamental role-conflict between members of both groups, which cannot be solved honestly. Nevertheless, the members of BPOC's transition teams try to be 'polite, appreciative, communicative and persuasive' and foster the employees' often unrealizable hopes to get a job in another department of their company. The transition is conducted by intensive common work of members of both groups. After the analysis of processes (with ethnographic study methods) at the customer's site documents were created (process maps, process diagrams) that enable the communication and the shared understanding between the customers and the transition team of the company (BPOC). Based on this continuously changing documents, weekly discussions between customers and transition team take place (organized as f2f or via video-conferences including lots of PowerPoint-presentation, charts and process maps etc.). These social events and the used TEBOs are crucial for a successful change management. The process manager from the client and the leader of the transition team are mainly responsible for the success of these communication processes and have to take their role as boundary spanners. The BPOC people have to convince the customers of the effectiveness and the benefit of the intended changes and transitions though some of them might lose their jobs after the transition. We have to state, that in this specific situation an emotional communication barrier exists between the transition team and the client people, which inflicts the willingness of knowledge sharing. But the barriers most often are resolved on the basis of common work, mutual respect and a shared and increasing subject related understanding between the members of the different groups.

Legitimation by supervisor(s) hindering further development
- UIBK1: convincing supervisors to buy-in to an idea
Some interviewees stated that supervisors could act as a barrier in hindering the further development of selected knowledge. From an individual perspective one way to overcome this barrier mentioned by one employee is being highly motivated to convince supervisors to buy-into and support new ideas. This could also be seen as generating a demand or motivating someone in a powerful position to act as a claimant. Both, from an organisational and individual point of view, this barrier is seen as healthy and an example of goal-oriented selection of knowledge that should be developed further.

Organisational culture not conducive to open KM
- FZI2: provision of IT and resources
The organisational culture was transformed in a way that open discussions are allowed and supported in various ways. This led to several developments: a business innovation forum and the research and development forum with possibly thousands of participants are key factors for knowledge maturation.
In particular the distribution in communities (Phase II) is performed very well, as the new ideas are discussed and therefore also supported in forums. These forums have also replaced traditional suggestion systems in the company. Also more responsibility has been given to the individuals and teams, something that was not possible some years ago.
Although the interviewees rate the phases Ia and Ib as not well supported, at least the financial sup-

port has been improved, although it is still not perceived as perfect. This support is achieved by discussions with different departments about possible budget shifting. This was not possible some years ago, but is now a routine act due to the more open organisational culture. Also transparency and more discussions are the results of this new culture, as well as less hierarchical structures. Finally, a total quality management has been established to avoid new barriers.

Summary

The main purpose of the analysis was to identify and review some knowledge maturing barriers in-depth, which we encountered during the representative study. Our classification of barriers into cultural, organizational, individual and technical, combines the work of Riege (2005) with individual, organizational and technological barriers and of Ahlert et al. (2006) with collaborative (social), technological, cognitive and motivational barriers. We analyzed our rich empirical material and could identify cultural, organizational, individual and technical barriers. In table 5, the individual occurrences of barriers in the cases we studied are assigned to these types of barriers.

Barrier (occurrence)	Type of barrier			
	Cultural	Organisational	individual	Technical
Changing nature of careers	x	x	x	
Difficulties in communication	x	x	x	
Discontinuity in software applications		x		x
Focus only on product-related enhancements	x			
Gap between 'ideal' practice and what occurs in practice	x	x	x	
Geographical distribution of Communities of Practice		x		x
Implicit theories which influence practitioners' practice	x		x	x
Knowledge developed around effective innovations in practice would have to take cognisance of the range of organisational contexts and cultures in which practice is situated	x	x		
Lack of resources		x		
Lacking usability of tools		x		x
Lacking willingness to share knowledge	x		x	
Legitimation by supervisor(s) hindering further development	x	x	x	
Organisational culture not conducive to open KM	x	x		

Table 5: Classification of barriers

Organizational culture is a key aspect for knowledge maturing barriers. This result can be supported by table 5: The classes "cultural" and "organizational" have nine and respectively ten mentions. These two classes have been mentioned together six times, stressing their high interconnected importance. Even more interestingly, the individual aspect plays also a significant role, as four out of six "individual" mentions are connected with the "cultural" class.

We can observe from these results, that organizational culture is a very important aspect for the companies interviewed, which interacts with almost all mentioned aspects of motivational barriers. Organisational culture in the definition of Schein (2003) should be seen for knowledge maturation as a kind of "meta-barrier", i.e. a barrier influencing other barriers. There is always a visible part of organisational

culture (buildings, structure, myths, practices with individual behaviour, values) and an invisible part with core values and basic assumptions (McDermott and O'Dell, 2001).

However, as we already learned from the representative study, other barriers besides organisational culture are also important as they were mentioned quite often. Each barrier has its own justification, which has been confirmed by the interviewees in the in-depth study. Also organisational culture itself has been mentioned individually. But for successful knowledge maturation the organisation needs to adopt a culture that supports transparency and open communication. Organisational culture affects all barriers and thus work context, interpersonal and individual aspects.

Figure 10: Determinants of motivation to engage in knowledge maturing activities

Figure 10 which was introduced in D1.2 displays the determinants of motivation to engage in knowledge maturing activities that were gained through the ethnographically informed and representative study. The results of the in-depth study show that motivational factors are interconnected. Our findings get support from (McDermott and O'Dell, 2001) who emphasised the importance of knowledge sharing and organisational culture. To successfully manage knowledge maturing, the companies created connections between knowledge maturation activities and business goals or results. This is something which we outline in section 4.3. Also, every action taken to overcome a barrier was conducted with respect to the individual cultural style of each company. For example, FZI1 and FZI2 have the same superficial preconditions and could be matched: both companies are large in size and operate internationally. Both companies have partly worldwide leadership in specific areas of their business. But in case study FZI1, money was no real issue and seen as a preferred solution for problems according to their cultural style, instead of changing their organisational culture in general. In contrast FZI2 preferred to change its complete organisational culture, but at a very slow pace, which matched the individual organisational style of FZI2 of "no rapid changes".

Besides the work context with its enablers and organisational aspects, interpersonal aspects and individual aspects, as in UIBK2, played a major role to overcome barriers. On an interpersonal level, communication is supported by fostering communities of practice which cross organizational (departmental) boundaries and at the individual it is level is supported by trainings fostering skills for group and project work. As already mentioned all these aspects are interconnected. Table 6 summarizes the results of ways to overcome barriers uncovered by the in-depth study, which can support companies to introduce and sustain knowledge maturing successfully and overcome barriers.

Barrier for KM	Way to overcome barrier
Legitimation by supervisor(s) hindering further development	Convincing supervisors
Focus only on product-related enhancements	Process enhancements
Lacking willingness to share knowledge	Communities for fostering informal relationships
	Being perceptive and fostering topic related shared understanding
Difficulties in communication	Training to provide a common understanding
	Role taking, simulation of processes and training to foster shared understanding
Lacking usability of tools	Guidelines for usability and CI
Implicit theories which influence practitioners' practice	Acknowledging the need to take account of this
	Provision of software tools for collaboratively collecting and sharing contents
Gap between 'ideal' practice and what occurs in practice	Acknowledging the need to take account of this
	Defining alignment processes to a best practice model in order to achieve more quality
Knowledge developed around effective innovations in practice would have to take cognisance of the range of organisational contexts and cultures in which practice is situated	Acknowledging the need to take account of this
Changing nature of careers	Avoiding the devaluation of competences by training and fostering carrier advancement
	Acknowledging the need to take account of this
Lack of resources	Hiring more staff
	Budget shifting
Geographical distribution of Communities of Practice	Use of IT tools
Discontinuity in software applications	Use of widget tools
	Enabling dialogues between users and members of the IT departments
Organisational culture not conducive to open KM	Provision of IT and resources

Table 6: Barriers and ways to overcome found by the in-depth study

Our findings from the in-depth study support the results from the representative study. Organisational culture (Schein, 2003) spans and subsumes other barriers for knowledge maturing. These barriers are important for knowledge sharing (McDermott and O'Dell, 2001) and are partly covered by (Riege, 2005). Within the MATURE project we identified the most prominent barriers within the representative study and found empirical solutions via the in-depth study for barriers like for example, lack of resources, lack of fitting organisational structure and culture or low awareness of the value and benefit. Table 6 offers ways to overcome barriers that are perceived as successful for knowledge maturing in the organisations we studied. For the UWAR case it is very important to acknowledge the need to take account of the very specific barriers of the Careers Innovation Group. They have taken actions to overcome these barriers but they cannot fully do so, as any solution is necessarily only partial, as there are very many different contexts to take into account, because practice in their constituent organisations varies widely. Although we did not discover any unique ways to overcome barriers, we found measures like trainings or process enhancement, to overcome motivational barriers (see, e.g., Riege, 2005) as well as the use of widget technology (Kirschner and Kreijns, 2005).

4.2.4 Topic 4 – Software used for knowledge maturing

The cross-case analysis of this topic was guided by the lead question: How is software used to support knowledge maturing? The results of the representative study showed a striking similarity of software tools perceived as being useful for knowledge maturing across the size and sector of organizations. How-

ever, as the same piece of software can be used in very different ways, we wanted to explore more into the how software is used then what software is used for knowledge maturing. We thus took up the opportunity of the in-depth study and engaged in a joint reflection with the interviewees on how software has been appropriated and used in different KM phases or for transitions between KM phases of our knowledge maturing model the answers to which are presented in the following pages. For this reason, this section is structured on a per partner/phase basis, rather on a per concept basis.

FZI1:

- For FZI1 the reported diversity of software in use is not very high. It was stated that the company is currently in the process of transformation towards being more IT-oriented.

- Phases Ia and Ib: At a lesser extent the organisation uses the internet for phases Ia (expressing ideas) and Ib (appropriating ideas) e.g. by using technical forums. Also project related forums and blogs exist, but are not used so much by the employees because of lack of time. Of course, shared network storage and MS Office is also in use.

- Phases III-Vb: The employees also have access to different databases with engineering contents. and additional customised software is being used for the later phases (III – Vb) like project databases. The company is very large and operates worldwide, therefore a high level of standardised software is desired, although not really successfully achieved.

FZI2:

- Phases Ia, Ib and II: The company uses software like MS Office (Ia – II), Lotus Notes, Eclipse, and MS-Project, but also has access to different databases with engineering contents. Also additional customised software is being used for the design and construction of vehicles. Especially Lotus Notes and the forums are mentioned as being helpful for communication, which is related to distribution in communities (phase II), because all employees have access to these tools.

- Phases III (formalisation) and Vb (standardisation): the company uses custom software (e.g., "Doors", "ZAM" and "Docmaster"). This software is used for quality management of the construction process, e.g., the software checks automatically if the specifications for the construction process are valid or financially feasible. The software keeps track of all changes in the car chassis, that also allows the employee to rate different variations in the construction process. Shared network storage is also in use. The company is very large and operates worldwide, therefore a high level of standardised software is desired.

- Phase IV_2: A kind of ticket-system for bug-tracking and documentation of changes and solutions in the construction area called "ZEUS" is in use to support the pilot phase (IV_2).

- Phase Vb: To a lesser extent the organisation uses the Intranet for phase Vb (standardisation). Wikis and department- and project related forums exist, but are not used as much by the employees because of lack of time. A database called KBE (Knowledge Based Engineering) with different CAD templates concludes the software available for knowledge maturing.

TUG

- phases Ia and Ib: With respect to customer support (the second main area of the company aside from software development) the processes of expressing and appropriating ideas are triggered by a new and specific customer request that cannot be answered by retrieving information from either the individual or organizational memory, but may instead require contacting experienced colleagues. For that purpose the employees make use of "infoware" and Microsoft Outlook where the former application stores information about customers, partners but also colleagues, such as e-mail addresses and telephone numbers, and is interlinked with the contact directory of Microsoft Outlook. Consequently, insights gained during this early phase of maturation are stored and externalized in the form of e-mails or telephone notes.

- phase II: In case of being repeatedly confronted with the same customer request, the responsible customer advisor may create a FAQ in order to ensure the distribution of the approach to the solution, as well as to make employees who are in charge of the corresponding software functionality, aware of the need for a new training unit in a wiki-based manual, also accessible for customers. Thus, several software developers can be involved as co-authors of several wiki articles. A mediat-

ing artefact, the so-called "manual-new" folder, coordinates their activities. It is a category in the directory of the internal wiki of the company that enables content sharing between the co-authors, and can only be accessed by the employees working on the software. It acts as a kind of information hub where different information resources are stored and can be distributed across the co-authors. Thus, coordination is achieved through a shared electronic repository and the maintenance of access privileges. The software products that support distribution and coordination are the wiki and the wiki directory. The privilege service is managed at the folder level, as only project members have the right to change and create content in the "manual-new" folder.

- phase III: If the ideas to deal with the customer request converge to a solution in the course of meetings (e.g., SCRUM meetings), the knowledge becomes formalized by stitching the wiki-entries into a coherent whole. A particular person of the company creates a structured document by pruning redundant information, renumbering as well as smartening figures and tables, and develops a more pedagogically sound version by rewriting as well as simplifying complicated phrases. Additionally, the software types used for this kind of consolidation are MS Word and the wiki. Changes to figures and tables are made by means of MS Word, MS Excel, as well as by CorelDRAW.

- phases IV-V: After this consolidated version of the co-authors' ideas has met some quality criteria, for instance readability and teachability, its content is released as a new learning object and categorized under a specific chapter of the wiki directory, also accessible by customers. If they approve of this extension of the wiki, it will become a standardized part of the software documentation and procedure for customer support. Thus, the Filebrowser is the main software type supporting the release and dissemination of new content.

UIBK1

- phases Ia and Ib: In these two phases, investigation of the Internet and Intranet play an important role. Employees use the location where a file is stores as an indication for their trustworthiness, e.g. files that are standardized are located at dedicated folders on a file share assessed by the Windows explorer. Furthermore, Microsoft Office tools like Word and Excel are used to document personal knowledge and Outlook is used for managing personal tasks related to topics an employee deems important to follow up on.

- phase II: For synchronous communication, face-to-face meetings are preferred. In cases where this is not possible, besides the telephone, video-conferencing and chatting software, installed at employee's computers at each workplace, is used. For asynchronous communication mostly personal information management software, e.g., Microsoft Outlook, is used for distributing information and setting up appointments.

- phase III: In this phase employees mostly rely on Microsoft Office tools like Word and PowerPoint for creating, e.g., proposals for projects and presentations for team meetings. But also Wikis are used, for example one department has set up its own wiki for collaboratively documenting knowledge for employees that step in for each other. For storing knowledge fileshares anf DMSs (document management systems) are used that provide different access level, e.g. for teams and departments. Furthermore, employees have a private space on a fileshare that is linked via a network drive.

- phases IV-V: For ad-hoc-training (IV_1) and formal training (V_1a) it was reported that software like Web browsers for assessing (e.g. PDFs on the Intranet, Internet),Wikis and Microsoft Office products are used. These tools are deemed to support especially the transfer of knowledge (e.g. by boundary spanners between different subsidiaries). Ad-hoc training can also be performed via chat, video- or telephone conferencing software. In some areas related to production processes, the piloting phase (IV_2) is supported by simulation tools. During the phase of institutionalizing (V_2a), obtained results are compared with predicted simulation results. Besides that, no further software used especially for phases piloting and institutionalizing was named by interviewees. The DMS is one tool used for storing and accessing digital resources containing knowledge is deemed to be highly trustworthy and went through or is currently in the phase of standardizing (Vb). An example that highlights how standardized knowledge is accessed was provided by one interviewee who reported on a rule that affects documents stored on a specific DMS saying that employees must not refer to

print-outs but to the documents themselves. This ensures that the DMS is used as a single source of truth and employees refer to digital resources carrying current, standardized knowledge.

UIBK2

- Testing systems (for IT-related developments): ideas on a smaller scale (phase Ia and Ib) are typically directly implemented in development systems. For these development systems, it is technically possible to track new developments, help approving them via a customizable workflow (phase III) and then transfer them to testing system (phase IV2) and then into a product (phase V2a). Although this support, overarching several phases of maturing, there are several processes which need to happen outside this IT landscape. For example, the decision, whether this idea which was implemented, will be developed into a product the organisation can sell, is taken by several people, i.e. product managers, developers and application managers on the basis of either a discussion or a presentation. The transition from phase V2a to Vb is therefore unsupported. Also, discussions in the development process (phase II) are not supported particular well, as comments are only possible in conjunction with steps alongside the approval process.

- MS Office (developing proposals and documentation): ideas that may involve a larger scale (i.e. bigger projects) that need more planning and elaboration are typically documented in a proposal which is developed using office software. For this process, templates which structure the general document are available and help starting such a task. Support for the co-development (same-time) of documents is not available to knowledge workers. Typically, one main author therefore, collects and edits the information he receives from several authors. For smaller information parts, he may approach prospective authors via mail independently. But for larger involvements, a formal way is defined in which it is decided who will help with what proposal. Due to this process, the standard functionality of MS Word (i.e. track changes, comments) are the basis for collaboratively editing such documents. When the proposal is finished, a pdf version is created and then stored in the organisations DMS. The further development, i.e. that the proposal was sent to the customer, and whether the proposal was accepted is also stored into the DMS, along with possible extensions. However, the document which is basis for such possible further edits remains on a network share and is not directly linked to its DMS copy.

- MS Office (managing and maintaining knowledge base): Office software is also used for maintaining parts of the personal knowledge base and also to maintain the knowledge base, several organisational units created on their networking share for themselves (phase Ia and Ib). These documents have no common structure and can contain (commented) screenshots of customization parameters, how-to-guides, and contents of web pages or also self-created manuals or training materials. The majority of this file share based material which can also include non-editable pdf files provided by software vendors, is not accessible to everybody.

- Wiki (collecting ideas, sharing resources): Besides maintaining a personal (or community-based) knowledge base by using office tools, also a wiki system introduced two years before is sometimes used. Originally intended as storage for FAQs and as a knowledge base, the general usage is still low and only for some topics articles exist. The usage only recently increased, when employees started to use this system as a collaboration space for maintain non-business related topics. But also the intended is deemed to be improved as there are no guidelines on how to maintain written articles or what to do with documents that were developed (phase II) in the wiki and now need to be transferred to another medium like the intranet portal in order for the content to be made official (phase III).

- MS Outlook (communication): MS Outlook/ MS Exchange, together with Blackberries as a mobile front end, are used as a central for communication. Employees use it to collaboratively exchange ideas, maintain their schedule and track tasks and also sometimes as a small knowledge base containing information about ongoing projects. Furthermore, it is used as a base of evidence as artefacts of communication via mail are seen as formal documents.

- Bulletin Board (exchanging problems and solutions): Bulletin Boards are used for exchanging information on very specific problems (phase Ia and Ib) and to communicate with experts (phase II). They are internet-based and seen as a community to go to as a last resort or for researching information which later is to be integrated into proposals.

- Proposal system (improving organizational processes): The organization has implemented a work-flow-based proposal system. Employees may submit short proposals describing what to do better (phase Ib). These ideas are then taken up and discussed. However, this is done outside the system – the actual discussion and the take up, so that the submitting employee is not able to track the status of his/her proposal.

UPB

- BPOC applies a broad variety of software tools for the different phases of knowledge maturing. For finding and expressing ideas an idea-database is used. While E-Mails are mostly used for communication between individuals or in specific groups (lists) Wikis serve mainly as an open forum for the purposes of company-wide global dissemination of ideas. In a worldwide operating company also video- conference systems are indispensible for the needs of communication. MS SharePoint, MS Outlook and MS Office are used to meet the demands of business intelligence (e.g. scheduling, reporting, benchmarking, document access and delivery, content management) and the generation of documents. Visio is used to draw and process concept maps, while Excel serves for calculating and simulating process-related figures. The approval and the status of documents are supported by document-related macros. Furthermore, there are available: i2i data base on approved processes (GPM), file repositories and shared file systems with a versioning system. Most of the software tools can be assigned to different phases of the knowledge maturing phase model (see table 7). Employees are not allowed to install and use software tools of their own.

- Employees who are working in the same client-project or co-operate with other staff members (e.g., domain experts) or process owners (only owners of processes are allowed to approve and change processes in the GPM) exchange and co-operatively generate documents. By doing this, they use different tools (MS-Office tools, web-based virtual team room, shared idea data base, 12i data base on approved processes, Wikis, E-mail, share point, shared calendars, file repository, documents with workflow macros…). Thus, they become part of a topic related AAN (artefact-actor network) and the degree of networkedness (frequency of exchange or contribution, number of contact-persons, topic related profoundness, degree of social and topic-related awareness) is supported by the applied communicative software-tools. Though some of the software tools which are used by BPOC staff provide awareness functionality to the users, there exist no network-specific awareness tool like visualization of AANs and related network activities. In addition to the software-based social network support, BPOC organizes competitions and annual reward meetings where individuals and teams present their ideas and provide information about best practice processes and projects. Thus, also via face to face communication the degree of networkedness and community building is supported within the company. For the needs of exchange and discuss new ideas and idea database (Ia>Ib) and a Wiki is accessible for the employees of BPOC. Animated and partly interactive media (mainly power point) are produced in order to organize informal and formal training with the employees of the client and of the outsourcing company.

UWAR

- Innovation group website site utilises two main elements: "Cloudworks" and "Write to reply": The site uses Cloudworks as the major tool for social networking and discussion. The site is a social networking site for sharing information, ideas and opinions about Careers Work Innovation. Cloudworks itself is a site which defines itself as a place to share, find and discuss learning and teaching ideas and experiences (see: http://cloudworks.ac.uk/). On the careers work innovation site 'write to reply' is highlighted as a site for commenting on public reports in considerable detail (see: http://writetoreply.org/). Rather than commenting on the text as a whole, respondents are encouraged to direct comments to specific paragraphs. The careers work innovation site has acted as a 'proof of concept' about how it would be possible to generate debate and collective action in support of knowledge sharing and development in order to extend the repertoire of possible actions of the careers guidance profession in England.

- For Phases Ia (expressing ideas); Ib (appropriating ideas); II (distributing in communities) and III (formalisation) the group made use of their cloudscape (http://cloudworks.ac.uk/cloudscape/view/1868 FZI1) to facilitate discussion and interaction among community members.

- For Phases III-Vb (formalisation through to standardisation): the group members were introduced to the idea of technology-enhanced boundary objects. The technology-enhanced boundary objects (TEBOs) were software-based resources which supported knowledge sharing across organisational boundaries. The TEBOs were conceived as boundary-crossing tools which could support situated learning with a focus upon sharing ideas about practice in different contexts. The development of these tools was undertaken within and beyond the MATURE project. The prototype TEBOs were co-designed with users and were intended to engage users in the sharing and development of knowledge (of Labour Market Information and other aspects of guidance practice) within and across organisational boundaries.

- Additionally for Phases Ia (expressing ideas); Ib (appropriating ideas); II (distributing in communities) and III (formalisation) group members were introduced to people and resource tagging tools. Because four CIG members (two researchers and two managers) were linked to the MATURE project, and other training centres and research centres were interested in project developments, use was made of tools for tagging of resources and people with particular types of expertise. Such software tools were seen as useful for Continuing Professional Development, supporting people in development of their skills profile and what they might be able to share with others, and, more generally, in encouraging reflective practice, which, in turn, could lead to a sharing of skills and knowledge. People tagging was also seen as having a possible role in leveraging specific types of staff development related to guidance practice, where people might be able to discuss the effects on practice in different contexts. It was felt that once a certain threshold of engagement of practitioners was reached then people might be able to see the value of sharing their knowledge resources and making these accessible through people tagging, and this could then lead to greater use of competency frameworks and links to more systematic forms of appraisal, review and training needs analysis. Overall, these types of software tools were not as yet ready for widespread use in professional practice, but engagement with these ideas and practices were helping CIG members to envision how practice might start to be transformed in future. Such insights, or glimpses into 'what might be', shared within the group were often valuable to individual members when they returned to their own organisations: a dialogue was being established between current practice and future possibilities which ranged across and within the different organisations and groups to which members of the CIG belonged.

Summary

Table 7 provides an overview of the different software types described and the activities they are used for (usage). In the following, the mappings of the software types according to KM phases are depicted by an "X". If a phase transition was observed, this is indicated in the last column. An Entry "Ia>III" would mean, that a transition from phase Ia (expressing ideas) to phase III (formalisation) was observed.

Software	Usage	Ia: expressing ideas	Ib: appropr. ideas	II: distributing in communities	III: Formalisation	IV1: ad-hoc training	IV2: piloting	V1a: formal training	V2a: institutionalizing	Vb: standardizing	Phase transitions
FZI1											
Blogs	Monitoring project progress.	X	X								
Construction software (customised)	Software to construct buildings				X	X	X	X	X	X	
Databases with engineering content	Databases which contain engineering content of different projects				X	X	X	X	X	X	
Forums	For discussions about project and technical related	X	X								

Software	Usage	Ia: expressing ideas	Ib: appropr. ideas	II: distributing in communities	III: Formalisation	IV1: ad-hoc training	IV2: piloting	V1a: formal training	V2a: institutionalizing	Vb: standardizing	Phase transitions
	topics.										
MS Office	Exchange of ideas and proposals for constructions	X	X								
FZI2											
Construction software (customised, e.g. "Doors", "ZAM" and "Docmaster")	Software to construct buildings	X	X	X	X		X			X	
Eclipse	Integrated development environment to support the progress of programming	X	X	X							
Forums	For discussions about project and technical related topics.			X						X	
Intranet	Contacting experts									X	
Knowledge Based Engineering database	Database contains different CAD templates for construction of vehicles									X	
Lotus Notes	Collaboration via Mail and different plug-ins in the early phases of the project		X								
MS Office	Exchange of ideas and proposals for constructions	X	X	X							
MS Project	Exchanging and monitoring of project progress	X	X	X							
Wiki	Discussions about construction related topics									X	
TUG											
CorelDRAW	Smartening figures					X				X	
Intranet	Contacting Experts, storage of ideas	X	X								
MS Excel	Preparing figures				X	X					
MS Outlook	Contacting experts	X	X								
Ms Word	Consolidation of several wiki-drafts; preparing figures				X	X					
Wiki	Expressing ideas; consolidation of ideas		X		X						
Wiki (Filebrowser)	Information hub to share ideas and disseminate learning objects			X						X	
UIBK1											
Adobe Reader	Access especially knowledge that is deemed to be more mature					X		X		X	

Software	Usage	Ia: expressing ideas	Ib: appropr. ideas	II: distributing in communities	III: Formalisation	IV1: ad-hoc training	IV2: piloting	V1a: formal training	V2a: institutionalizing	Vb: standardizing	Phase transitions
Chat, video and telephone conferencing software	Performing (instant) audio and video conference and instant messaging from each desktop			X		X					
DMS and fileshares	Storing searching and accessing knowledge via Web browser and Windows explorer	X	X	X	X	X		X		X	
MS Office (Outlook)	More formal communication and management of group appointments			X	X						
MS Office (Outlook)	managing personal tasks and topics that need to be followed up	X									
MS Office (Word, Excel)	Documentation of personal knowledge	X	X								
MS Office (Word, Powerpoint)	Documentation and transfer of knowledge			X	X	X		X		X	
Wiki	document knowledge, transfer of knowledge between team members, stepping in for each other				X	X					
UIBK2											
Bulletin Boards	Exchanging on problems and solutions			X							
MS Office (Word, Excel, OneNote)	Managing and maintaining personal knowledge base	X	X								Ia>Ib
MS Office (Word, Excel, Powerpoint)	Co-Developing documentation, proposals, etc.			X	X		X				
MS Outlook	Communication			X							
Proposal system	Improving organisational processes		X								
Testing Systems	Testing of new solutions and ideas	X		X	X		X				I>III >IV2
Wiki	Collecting ideas, sharing resources	X	X	X	X						I>II> III
UPB											
Adobe	Status freezing of Documents, Transfer of Documents			X	X	X		X	X	X	
Databases: i21 MS Access Others	Content management with access hierarchy; Approval and Status Assignment			X	X		X		X	X	
Document related Macros	Workflow Management for approval of documents				X				X	X	
Idea data base	Gathering, exchanging and improving ideas	X	X								Ia> Ib

Software	Usage	Ia: expressing ideas	Ib: appropr. ideas	II: distributing in communities	III: Formalisation	IV1: ad-hoc training	IV2: piloting	V1a: formal training	V2a: institutionalizing	Vb: standardizing	Phase transitions
MS Excel	Prepare and transfer calculation, simulation of future developments			X		X	X		X		
MS Outlook	More formal communication and management of group appointments, E-Mail, Joint Calendar			X	X	X	X	X	X		
MS SharePoint	Providing collaborative functionality with web based user frontends (CM, reports, dash boards, performance tracking)			X	X	X	X	X			
MS Word MS PowerPoint	Co-operatively document and transfer knowledge			X	X	X	X	X			
Shared Files-System	Access to different versions of documents with rights management			X	X				X	X	
Video conferencing system	Company-wide virtual Meetings (VM); VM between local distributed teams; with distributed clients and lean companies			X		X	X		X		
Visio	Drawing process maps	X	X	X	X	X	X	X	X	X	
Web-based Frontend (Team Room)	Virtual Content Management and Awareness-System for Groups			X		X					
Wiki	document knowledge, transfer knowledge (company-wide)			X		X	X	X	X		
UWAR											
"Cloudworks" and "Write to reply"	See description above.	X	X	X	X						I - III
People and resource tagging tools	See description above.	X	X	X	X						I - III
Technology-enhanced boundary objects	See description above.				X	X	X	X	X	X	III - Vb

Table 7: Software used for KM phases and transitions

The results of the in-depth study stress the fact that companies and organisations use a number of heterogeneous software applications in order to support knowledge maturing. These heterogeneous applications have not typically been designed with knowledge maturing in mind, e.g., email clients, text processor. Knowledge workers seem to struggle hard with these software applications to appropriate them to fit the purpose of developing knowledge and keeping track of their contributions in the collaborative learning zone. While there is typically support for individual phases, transitions between phases often involve (high) manual effort. For example, in case of UIBK2, contents that had matured through the phase II (distribution in communities) and III (formalizing) in a wiki system had then to be copied and edited for pub-

lishing the content on the Intranet portal. However, several solutions to these transitional problems are in use in the studied organisations, most notably the Wiki and Filebrowser solution to integrate internal and customer documentation of software in the TUG case. Another interesting observation is that large organisations as studied in the FZI1 and FZI2 cases, attempt to standardize the software applications in use. Members of professional networks, such as in the CIG studied by UWAR, very much rely on easy-to-use open collaboration platforms accessible by a Web browser. The movement between those two worlds might benefit from boundary objects that can act as brokers between them.

4.2.5 Topic 5 – Planned Measures for knowledge maturing

The cross-case analysis of this topic was guided by the lead question: What plans are there or what could generally be done to further enhance KM? In the following, we present measures that the studied organisations and network planned to establish for improving knowledge maturing in the future. The measures are classified according to types. Furthermore, some grassroots developments that should be strengthened in the future are also mentioned.

Adapting knowledge maturation for particular organisational settings
- UWAR: The key aspect for the future was seen as the need for a shift in focus to support knowledge maturation in particular organisational settings as well as supporting learning and development across the field as a whole. Innovation and learning within and across organisations are essentially social processes and membership of CIG enabled participants to develop both their personal networks and inter-organisational networks. These networks were developed principally through the face to face meetings which paid attention to the importance of members building relationships to support their own knowledge and understanding of innovation and learning development, as well as focusing upon substantive issues and experimenting with software tools. Such relationship building and deepening meant members were 'positioned' to take advantage of possible organisational developments in the area of technologically-enhanced support for collaborative practice, because they had experienced experimenting in a 'safe' external environment and they had developed their own personal and professional networks of people on which they could draw in the event of their organisations developing support for practice in some of the ways experienced by group members.

Continuing to support scaffolding, reflection and co-enculturation
- UWAR: Knowledge maturation processes of the group had resulted in members developing a 'readiness to learn or 'readiness to mature knowledge' of how technology might support innovation, learning and development in guidance practice. This learning and knowledge development had been achieved through scaffolding (support) and reflection in face to face settings where peers had been experimenting with technology to collectively develop their understanding, thereby co-enculturating and developing one another. The group highlighted how one challenge for the future is whether social software tools can produce similar support to take participants in guidance organisations to higher levels of understanding which in turn makes the artefacts created increasingly useful for practitioners. The use of social software to support knowledge sharing for guidance practitioners is already being used in embryonic ways, but maybe to start to transform understanding of what is possible requires a more 'open pedagogy' in the production of digital boundary objects. Some group members were committed to pursuing this line of development within their own organisations beyond the life-time of the MATURE project. Participation in the group was viewed not only as a possible mechanism for technology and process transfer but also as a means of generating an exchange of ideas about practice, development and innovation. It gave people not only access to innovative ideas, but also opportunities to shape these ideas in ways that were directly useful to them in their practice.

Creating awareness about topics and competences
- UIBK2: In order to increase transparency on projects and therefore what topics are focused on by whom (on individual and organizational level), it is planned to create a dynamic overview of present projects, their topics and the employees that are working on them. Additionally, competency profiles of employees and their presentation are planned to be focused.

Enhancing processes

- FZI2: The standardisation process is also under consideration, because right now only 50% of the documents and information can be used as they are and the other 50% need improvement.
- UIBK1: A joint decision was made to focus in general on the topic of enhancing processes as a major goal. It was stated that this would also involve to further enhance the support of knowledge work by IT.
- UPB: During the phase of restructuring processes at the clients the BPOC transition team takes over the role of the client's employees and later on simulates re-structured processes in their own offices before the new processes are allowed to be outsourced or be re-implemented at the client.

Experimenting with "up-to-date" software

- FZI1: A dilemma exists for the junior interviewees: On the one hand they experience information overload with unnecessary information, but on the other hand they miss important information. Therefore, a Wiki will be introduced to focus on important project data. Also, the junior employees anticipate less spam with the Wiki system and to be able to get the necessary information for their work   faster.
The plans for enhancing knowledge maturing are different. More databases are under consideration as well as an enhanced workflow process for the communication between different departments. The rating of documents by employees is also something that is thought to be useful, although some tests in the near past were not successful. Different services for the Intranet (e.g., internal search engines about construction-related topics or internal blogs) and for the Internet (e.g., Web 2.0 tools like forums) are being discussed. The senior interviewees are neutral towards the introduction of Web 2.0 tools for knowledge maturing. They consider usability aspects as very important for the acceptance of such tools. Also the information needs to be verified by an expert so that the junior employees can trust the information.
- FZI2: More databases are under consideration as well as an improved communication between different departments through an enhanced workflow process. The rating of documents by employees is also something that is thought to be useful, although some recent tests have not been successful and is therefore under responsibility of each department manager. Different services for the Intranet and Internet should help to achieve a higher quality of the documented processes through more communication.
- UIBK1: The company is open to further investigate software that is released in the future to enhance the support of knowledge work. It is planned to continue this course of action.

Improving access to documented knowledge

- TUG: This company also aims at increasing transparency to render storage and retrieval processes of the organizational memory more effective and to address barriers identified in phases II and III. The implementation of an aggregation and collaboration service should help to create shared collections of information sources (PDFs, pictures, web-resources,…) that can be accessed and changed by other employees involved in the same project. Functionalities, such as aggregated ratings that indicate the relevance of a resource for a given topic, or an expert search feature revealing the association between resources and users, should shorten retrieval processes.
- UIBK2: One of the (technological) foci for the next two years for improving KM will be to provide better transparency for finding knowledge contained in documents stored on various network drives. More concretely they plan to evaluate the relevance of documented knowledge and to develop a kind of "knowledge library" that is more easy to access by the knowledge workers than the current stores.

Performance indicators for managing personal knowledge

- UIBK1: Special attention is paid in one department to further developing the system of performance indicators, allowing for the assessment of quality of several services offered within the organization by the department. The same is true for the evaluation of knowledge of employees and monitoring of its development.

- UIBK2: It is planned to introduce additional indicators directly aimed at personnel development. These KPIs should focus on the dimension of organizational knowledge, developing competencies from individual and organizational perspective, and should be presented in an approach similar to a Balanced Scorecard.

- UPB: BPOC uses KPIs not only to measure the team's performance but also relates it to the PDP (personal development plan) by using balanced score cards to identify personal training needs in compliance with the requirements of the team and the company. This system of guided personal development will be enhanced in the future in order to motivate and encourage employees to improve enhance their knowledge and their status in the company.

Opening and resourcing dialogic spaces

- TUG: The company is becoming larger and CoPs are more and more distributed across geographically distributed parts of the company. As informal communication is regarded essential for technology enhanced dialogic spaces, the future ensemble of knowledge services should also be extended by CSCL tools providing ease of communication. Besides passing physical artefacts and factual content, more appropriate communication means have also to convey implicit aspects of communication, such as the situational/emotional state of communication partners and their implicitly expressed appeals. In short, the adoption of services that increase communication bandwidth should help – at least to some extent – to imitate face-to-face communication that imparts more information than traditional computer-based communication means.

- UWAR: The CIG has been successful in creating a space for dialogue (about innovation, learning and development of practice) and the face to face format created multiple opportunities for development of professional networks. For the future the question is whether technology could play a more indirect, but still important, role in opening and resourcing dialogic spaces. The group's experience of experimenting with (Web 2.0) tools to support developing collaborative understanding was that this has helped them 'get ready' for such developments but their practical implementation still faced barriers, but that this was a line of development worth pursuing.

Overcoming motivational barriers in using software support for collaborative learning

- FZI1: Already existing databases will be replaced and enriched with further data, like pictures from construction sites. These pictures will also be verified by experts from the company, so that the employees have transparency about the quality, despite the fact that everyone can add such pictures to the database.

- TUG: Management attributes the low motivation of employees to use collaborative learning environments to the media disruptions in the course of one task. Thus, the implementation of one software product supporting different aspects of a single task is a highly prioritized goal to be achieved within the next three to five years. It is planned to standardize the use of strongly interconnected services for creating, discussing, tagging and collecting resources, e.g., wiki articles. Introducing quality indicators that aggregate the employees' opinions about the relevance, up-to-dateness and accuracy of articles should enhance the commitment to the wiki itself.

- UWAR: One avenue for the further enhancement of knowledge maturation processes would involve a switch in the site of development: from an inter-organisational group which exchanged ideas to one where some members were engaged in the management of change within their own organisations. Overcoming motivational barriers to introducing software support for collaborative learning in the workplace was thought likely to be a pressing concern in many contexts.

Supporting interaction between formal and informal approaches to learning, skill development and knowledge creation

- UWAR: The interaction between formal and informal approaches to learning, skill development and knowledge creation emerged as a particularly effective way forward for enhancing members' personal professional development and positioned them to be able to contribute to discussions as to how such tools might improve organisational effectiveness in future. Membership of the CIG had operated as support for knowledge maturation processes to improve their 'readiness' to handle innovation.

Using technologically enhanced boundary objects (TEBOs)

- UPB: For the requirements of informal and formal training in the future more animated PowerPoint presentation and interactive media should be applied in order to improve training results of the employees of the lean company and to foster a shared understanding of the topics they are dealing with.

- UWAR: There was a 'continuing struggle' to affect a shift in focus from labour market information to labour market intelligence, from raw quantitative or qualitative data to the interpretation and further analysis of labour market information. This strand of knowledge maturation would continue to be supported by efforts within MATURE and related projects. The dynamic integration of different sources of LMI and further development of TEBOs were avenues which were likely to be explored further. However, as well as a shift in focus for some members to situational innovation in particular contexts, for others there was still the more general issue of how to support more effective use of LMI for strategic planning, for policy formulation and for information, advice and guidance (IAG).

Summary

The answers to this question seem to indicate that the organisations are not particularly engaged in future plans for enhancing knowledge maturing in revolutionary ways. Most statements actually reported about the planned continuation of efforts that had already been started. Some even claimed that they intended to retry efforts that had already proven unsuccessful in the past. There were several mentions that organizations aim to integrate activities of generally supporting knowledge work with their established processes which were deemed to support the later phases of the knowledge maturing model and to clarify their relation to performance assessment. Also, the peculiarities of specific organisational settings were more openly addressed in efforts to improve acceptance and assimilation of instruments supporting knowledge maturing. Apart from that, grassroots and community approaches to collaborative learning have been explicitly mentioned several times, and support the earlier phases of the knowledge maturing model. There are no surprises with respect to the software tools that have been suggested, largely the enhancements to Wikis and collaboration software, with for example tagging, rating or aggregating functionality being the most concrete aspects mentioned.

4.3 Discussion of Results

All topics analysed above have in common that they explore which (1) idiosyncratic conditions and (2) initiatives involving organisational and technical instruments organizations perceive as related with reducing barriers, superior performance or improving performance of knowledge maturing. In order to relate topics of the cross-case analysis with each other, we therefore take a closer look on perceived causality, i.e. cause and effect relationships between levers and their results which were either experienced by interviewees in their organizational units or entire organizations and thus deemed to be causes for better performance of knowledge maturing or they were expected and thus interviewees were confident that a lever would cause described effects, at least in the conditions of their organizational environment.

The rich descriptions that we collected from the interviewees typically comprise chains of effects. While there are effects which were actually expected or experienced that directly result from a lever, more indirect effects were also reported. The resulting cause and effect relationships are depicted in figure 11.
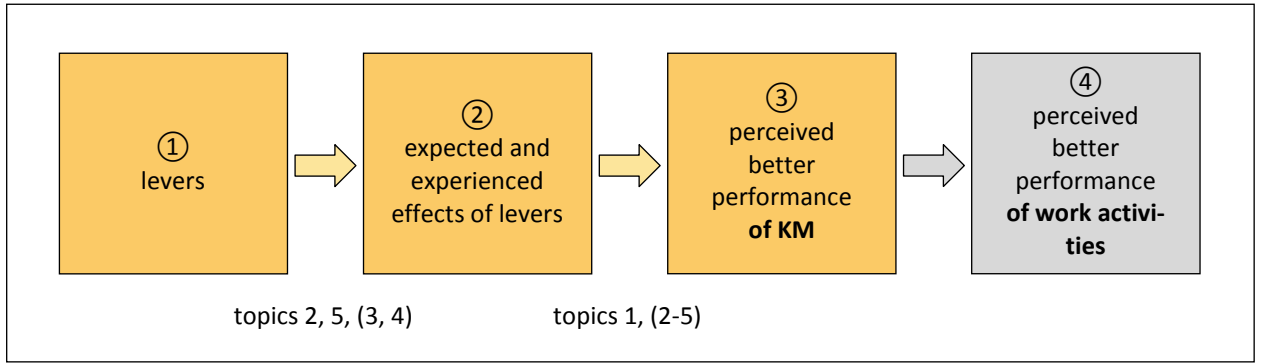
Figure 11: Levers and effects in knowledge maturing

Levers ① represent the kinds of actions, measures and initiatives an organisational unit or a group of individuals in general can perform in order to aim at forcing organizational change to happen ② directly and ③, indirectly. The term lever here refers to measures that can be used in a concrete intervention into an organization's way of handling knowledge that are considered as having effects particularly impacting on knowledge maturing. The expected or experienced effects of the levers, in the first place, can be seen as direct effects of the organisational or group setting ②. Subsequently, these effects are deemed to positively affect certain aspects of the performance of knowledge maturing ③. Finally, better performance of knowledge maturing is perceived as having a more general positive impact on performance of work activities ④ of individuals or, more importantly, of collectives, e.g., work groups, organizational units or entire organizations which has fed into and has been more thoroughly explored in our activities in T9.3 Business model development for an application service provider as part of WP 9 (see D9.2).

Throughout all topics of the interview guideline (section 3.3.4), we aimed at exploring what organizations do in order to foster knowledge maturing and all the more the why they perceive their initiatives and settings as successful in order to collect individual cases of cause-effect relationships concerning knowledge maturing. In the following, the relations of the investigated topics to the causal relationships depicted in figure 11 are described in more detail.

The causal relationship assumed between *lever*s ① and their *effects* ② is strongly related to topics 2 and 5 of the interview guideline. Both topics specifically focus on measures. Topic 2 concentrates on measures that are performed ① and topic 5 on measures that are planned ① to support KM ②. Additionally, topic 3 concentrates on possible ways ① to overcome barriers for KM ② and topic 4 focuses on levers related to software and its functionalities ① aiming at supporting KM ② can provide data feeding into the analysis of causes and effects at this level.

The *effects of levers* ② are analysed in a second step with respect to their effects on *better performance of KM* ③. In topic 1, we asked for criteria which can be used to confirm better performing KM than others in order to trigger a reflection on reasons ② that are deemed to cause this better performance of KM ③. Furthermore, discussions with interviewees related to topics 2-5 of the interview guideline ① and ② in some cases also led to a reflection on effects on better performance of KM ③.

Besides these topics, information collected in addition was used to inform the analysis. This was, for example, additional information provided by interviewees, and field notes that were taken based on observations of workplaces or based on observations made when having the chance to attend meetings. For this analysis, we concentrate on ①, ② and ③. Ultimately, the perceived better performance of the organisation in general ④ is the intended effect and for this, knowledge maturing is a means, not an end. On several occasions, interviewees mentioned purposes about why they deem knowledge maturing important. In D9.2, we relate these effects to business values; here, we concentrate on levers, expected and experienced effects as well as perceived better performance of knowledge maturing in the following.

We take the evidence provided by the interpretation and analysis of perceptions of interviewees in the in-depth studies as justification for the assumed causal relationships which surely would benefit from further testing.

Figure 12 provides an aggregated view of levers, their direct effects and their effects on better performance of knowledge maturing that were collected based on the analysis of the rich data gained through in-depth analysis of seven cases in year three of the MATURE project. We generally mapped measures (realized and planned) that were named in interviews as a lever and reasons for better performance of knowledge maturing as an effect. We regarded levers as something, organisations could "pull" or influence in order to improve knowledge maturing and effects as an outcome that resulting through one or more levers. These outcomes are seen as only indirectly reachable by influencing levers.

A precise distinction between levers and effects proved to be difficult: Interviewees also named the fact that they employed a measure a direct reason why they performed knowledge maturing better. Also, the fact that effects could be seen as a cause for other effects on knowledge maturing adds to difficult distinction.

Levers

Enabling employees and communities by
a) Providing time:
- Fostering topics by community of practice meetings
- Fostering reflection on innovation by enabling purpose-oriented task groups
b) Providing an environment:
- Providing office spaces for flexible use and enabling home office
- Appropriate competency allocation in projects
- Creating awareness about topics and competences
c) Provision of IT
- Technology-enhanced boundary objects
- Experimenting with "up-to-date" software
- Improving access to documented knowledge
d) Special Roles
- Acting as "claimant"

Aligning and structuring practices and processes
- Formal trainings at regular intervals
- One supervisor for teams in different subsidiaries
- Organisational guidelines for documenting knowledge
- Initiatives enabling awareness and orientation for quality management
- Regular (team) meetings
- Workshops on specific topics
- Guidance by supervisors and management in general
- Performing benchmarks
- Supporting interaction between formal and informal approaches to learning, skill development and knowledge creation

Effects

Accessibility of knowledge

Availability of different channels for sharing knowledge

Best practice model to improve workflows, tasks or

Community of practice offering advanced training and expert finding

Employees' attitude and awareness towards KM activities

Employees' reflexiveness about the nature of KM itself

Informal Relationships

Mechanisms de-freezing thought patterns

Willingness to share knowledge

Better performance of KM

KM Activities:
- Find relevant digital resources
- embed information at individual or organisational level
- keep up-to-date with organisation-related knowledge
- familiarise oneself with new information
- reorganise information at individual or organisational level
- reflect on and refine work practices or processes
- create and co-develop digital resources
- share and release digital resources
- restrict access and protect digital resources
- Find people with particular knowledge or expertise
- Communicate with people
- assess, verify and rate information

KM phases:
- Expressing Ideas
- Appropriating Ideas
- Distributing in communities
- Formalizing
- Ad-Hoc Training
- Piloting
- Formal Training
- Institutionalizing
- Standardising

Figure 12: Overview of levers and effects found in the in-depth-study

In order to back up the causal relationships presented in figure 12, we decided to rely on "story-like" descriptions provided by in depth study partners based on the reflections of statements made by representatives of the studied cases. The jointly created model on levers, effects and the better performance of KM was used as a framework for structuring the stories.

We found a plethora of stories connecting levers, their direct effects and their effects on better performance in the data gained during the in-depth study. One reason for this is that each lever directly caused several effects which in turn also had an influence on several aspects of better performing KM. Nevertheless, when writing the stories, we concentrated on main perceived causal relationships that were particularly highlighted by participants of the in-depth study. The resulting stories[10] presented in the following tables (table 8 to table 13) provide additional evidence for justification of perceptions of causal relationships already outlined in the analyses of section 4.2.

	FZI2
	Story: Fostering an open culture of communication
Lever	• Open discussions were allowed and supported by various Web 2.0 technologies, like blogs and forums. • Individuals and teams were given more responsibility. • Use of Intranet is open to all departments and not restricted any more to some of them.
Effect	• After giving individuals and teams more responsibility, total quality management and in-house exhibitions were introduced to enhance standardization of processes. • Documents get updated faster and more regularly, because they are accessible via the Intranet. • The discussions are now more transparent due to the constructive discussion culture. • Finally, the organizational culture changed because of the levers. The organizational culture is now perceived as less formal and hierarchical.
Better Performance of KM	• More ideas are discussed in forums. • Knowledge maturation is perceived as being improved in communities.

Table 8: Levers, effects and better performance of KM – story of case study FZI2

	TUG	
	Story 1: Wiki aiding joint reflection in team meetings	Story 2: Additional channels enriching communication
Lever	• Guidance: During team meetings, employees are encouraged to externalize ideas and problem solutions in the form of Wiki entries.	• Provision of IT infrastructure: Geographically distributed CoPs are provided with CSCL tools.
Effect	• The stronger commitment to the internal Wiki proved to defreeze organizational thought patterns: different perspectives are revealed, fostering diverging thinking	• This extension of IT infrastructure provides additional information channels for rich communication: besides passing physical artefacts and factual contents,

---

[10] Unfortunately, in case of FZI1 no causal relationships have been observed. Previous actions for enhancing KM, like forums and blogs, were cancelled or delayed and an organization-wide reconstruction process was initiated. New measures like the establishment of a business-Wiki are still in progress. The organization is in a phase of transformation towards using more software. A main reason for the company to participate in the in-depth study was to identify barriers for KM in detail.

	during work.	implicit aspects can be conveyed, e.g. situational/emotional states of communication partners.
Better Performance of KM	• The knowledge maturing activity "reflect on work practices and processes" is performed better. • Discussions at project meetings are more constructive. Being informed about colleagues' ideas beforehand makes it easier to bring them together for collaborative and creative problem solving.	• The knowledge maturing activity "communicate with people" is performed better: better imitation of face-to-face communication.

Table 9: Levers, effects and better performance of KM – stories of case study TUG

	UIBK1	
	Story 1: Enforcing change by acting as claimant	Story 2: Networking by workshops on specific topics
Lever	• An employee of the organization who is ideally in a relatively powerful position stresses a demand. The demand can be manifold, e.g., a product should be developed/ enhanced or a process should be changed.	• Supervisors meet regularly to identify employees across different departments or even subsidiaries that might have similar interests/roles/tasks and can also build up on competencies which could complement each other. After having identified such employees, a one or possibly two day workshop with a specific topic/task to work on is set up for candidates to go to.
Effect	• The relative importance of a specific topic (compared to the importance of other topics) is raised, and more attention is paid to that topics. Furthermore, interviewees reported on an increased willingness to legitimate allocating time to perform tasks related to the topic.	• During the workshop, the topic is further developed but this is rather seen as a side effect. More important is the fact that people with similar interests/roles/tasks get to know each other, enlarge their network and build (informal) relationships.
Better Performance of KM	• Acting as claimant leads to faster flow of knowledge through the KM phase model. In particular, a strong influence on the formalizing and institutionalization phases can be recognized. Furthermore, the performance of early phases is influenced as the demand can also affect the development of ideas offered aimed at satisfying the demand.	• This leads to a better performance of KM, especially with respect to the phase "distributing in communities" later on. Also, the KM activities "communicate with people" and "find people with particular knowledge or expertise" are supported.

Table 10: Levers, effects and better performance of KM – stories of case study UIBK1

	UIBK2
	Story: Strengthening social ties by provision of flexible office spaces
Lever	• Employees are allowed by the organization to choose where to sit. They are encouraged to sit close to colleagues they need to communicate with often or from whom they want to learn something, or they can choose a small one-person room if they need to work in a quiet environment, e.g., if they need to write documentation.
Effect	• The social factor of working together is highlighted. Due to the seating arrangements,

	employees also get to know more colleagues and therefore improve their social networks and build (informal) relationships. Also, due to "shorter" communication channels, quicker and sometimes more informal answers including useful hints are given.
Better Performance of KM	• Specifically the phase "distributing in communities" is improved. But also other phases may benefit from this lever. Subsequently, the KM activities" communicate with people" and "find people with particular knowledge or expertise" are supported.

Table 11: Levers, effects and better performance of KM – story of case study UIBK2

	UPB	
	story 1: Applying appropriate communication patterns by boundary spanners	story 2: Revision of processes by simulation of workflow and training
Lever	• SPoCs (single points of contacts) are defined in order to organize communication and interaction between the client's employees and the transition team of BPOC in an effective way. • Thus, all relevant communication between both sides, especially those who are essential for changes of business processes, is proceeded between these two persons who are responsible on both sides for those changes (client: project manager; BPOC: transition team leader).They act as boundary spanners between two communities.	• Before a business process of a client is either outsourced to a 'low cost company' or is re-implemented as a lean process at the client, the transition team of BPOC transfers parts of the original client- process to their own office. • After a phase of adaptation and simulation the process is structured more efficiently. • In this story knowledge maturing and informal and formal learning are closely linked. Not only members of the BPOC learn about client processes by watching workflow processes at the client. The team also has to provide either the client working group or the group of the low cost company with formal training about the new restructured lean process.
Effect	• Based on informal communication and discussions between members of both groups, the boundary spanners as SPoCs are responsible for creating and improving approved and decisive documents for transition processes. • This not only provides transparency for the change management, but also fosters acceptance for those processes within both communities.	• The close linkage between knowledge achievement by informal learning, process maturing and formal training enables a very effective transition of processes and fosters the co-operation between teams from different companies
Better Performance of KM	• The story stresses the strong relationship between sociofacts and artefacts and shows how the transition between phases of knowledge maturing (here from finding ideas to formalization) could be guided by applying appropriate communication practices in and between groups.	• As this pattern is applied to every transition process there are a lot of cycles from learning to application. These numerous changes between achieving and applying knowledge lead to a high level of process awareness and a better performance of knowledge maturing with regard to increased shared understanding of a topic and to the quality of tasks and processes.

Table 12: Levers, effects and better performance of KM – stories of case study UPB

	UWAR
	Story: Creating an inter-organisational space for dialogue (about innovation, learning and development of guidance practice)
Lever	• Creating a safe space to build confidence and increase professionalism on the topic of the changing nature of careers. • Scaffolding (support) and reflection where peers had been experimenting with technology to collectively develop their understanding, thereby co-enculturating and developing one another. • Experimenting with tools for social networking, commenting on public documents and supporting developing collaborative understanding has helped participants 'get ready' for such developments in their own organisations. • Discussing the potential of technology-enhanced boundary objects (TEBOs), software-based resources which support knowledge sharing across organisational boundaries to support change in professional practice.
Effect	• Knowledge maturation processes resulted in members developing a 'readiness to learn or 'readiness to mature knowledge' of how technology might support innovation, learning and development in guidance practice. • The interaction between formal and informal approaches to learning, skill development and knowledge creation was an effective way to enhance members' professional development and positioned them to be able to contribute to discussions as to how such tools might improve organisational effectiveness in future. • Recognition that the use of social software to support knowledge sharing for guidance practitioners is already being used in embryonic ways, but maybe to start to transform understanding of what is possible requires a more 'open pedagogy' in the production of digital boundary objects.

Better Performance of KM	• Through access to innovative ideas, participants also had opportunities to shape these ideas in ways that were directly useful to them in their practice. Membership of the CIG had been a vehicle for:
	
	  ◦ Expressing and appropriating ideas: developing a greater awareness of the issue of innovation, learning, development and knowledge maturation in careers guidance through dialogical exchange.
	
	  ◦ Distributing in communities: the group members had developed a shared understanding and had become actively aware of new possibilities and 'imagined futures' and these ideas were subsequently discussed with other individuals and organisations within the broader community of interest of careers guidance.
	
	  ◦ Formalising was at least embarked upon through a deepening of the collective understanding about the possibilities of knowledge sharing and further development, which were then translated into structured documents available through the group's website.
	
	  ◦ Ad-hoc learning was realised as group members engaged with innovative practices using experimental semi-formalised structures and resources to gain experience and help develop potential boundary objects that could help facilitate knowledge maturation processes across a wider community of interest. These boundary objects had the potential of being carriers of more explicit training and development of practitioners.

Table 13: Levers, effects and better performance of KM – story of case study UWAR

Additionally, the outcomes of this analysis are deemed to be valuable for informing the business model developed in WP9 (T9.3, see D9.2). Specifically, relating levers, effects and better performance of KM to more general, business-oriented level of better performance will be dealt with.

4.4 Limitations

Limitations of the study generally are in line with limitations of comparable empirical studies using purposeful and convenient sampling (Patton, 1990), interviews and observations for data collection and a set of qualitative methods for data analysis. In the following, we concentrate on specific limitations of our study.

Results of the in-depth study generally are not representative as the number of cases is low. This is inherently a limitation of profound studies of single organisations. However, as we had developed the topics to be studied on the basis of the results of the representative study conducted last year, the in-depth study can also be seen as addressing limitations of the representative study. These primarily deal with the fact that we had interviewed a single person representing an entire organisation in the representative study while we made sure that we now get a richer picture of topics deemed important after analysing the data collected in the representative study and a more diverse picture of organisations using interviewees from multiple organisational units. Seen in connection with the representative study, we feel confident that, e.g., the levers and effects that we identified are not limited to those organisations that we studied in detail and that several of the measures and reasons are also applied successfully elsewhere. We also had the chance to collect anecdotal evidence when talking to representatives of other organisations, e.g., at the conference on Professional Knowledge Management 2011 conducted in Innsbruck February 21-23, 2011 which generally were in line with the results presented here.

We decided to not limit ourselves to organisations that took part in the representative study. This is due to the fact that we intended to align the activities in the in-depth study as closely to research interests and questions pursued in other activities in MATURE, particularly the software developments, evaluation and all activities involving application partners. Thus, each partner in the consortium identified organisations that were both, willing to participate and providing an interesting showcase for those aspects of knowledge maturing that were investigated in the connected other research activities of the partner in MATURE. We also agreed on considering a network of individuals across organisations that were deemed to offer interesting aspects both with regard to knowledge maturing exchanged between the professionals who each represented an organisation as well as with regard to the application domain of some of our application partners, i.e. careers guidance. As the organisations were only partly covered by the representative study, we were not aiming at classifying the organisations according to types of organisations resulting from the representative study because (1) we felt that the MATURE project would gain most insights from organisations that were reflexive about knowledge maturing or consider themselves as performing knowledge maturing well; and (2) we wanted to investigate network-based knowledge maturation processes which went beyond the boundaries of a single organisation.

We did not follow the iterative approach described by (Yin, 2009), i.e. after having conducted one case study one selects the following case to be researched and, furthermore, one might consider changing the method of data collection. Selecting cases one after another was deemed to be too time consuming which is why we agreed on a set of five common topics covered in each case and one additional topic, specific for a single case. This approach worked well as the common topics were carefully selected to shed light on the phenomenon of (how to support successfully performed) knowledge maturing from multiple angles based on the representative study and could be investigated well, and as the additional topics allowed for variation. Furthermore, the case studies were conducted in parallel, but the actual times spent on sites differed and so the studies were overlapping. We used this to hand on lessons learned from one case study to the next one. We also coordinated frequent meetings both in person and via videoconference tools within the phase of conducting case studies. This supported the provision of feedback across the case study instances, individual and joint reflection of the collected data as well as the cross-case analysis which was also supported by a series of physical and virtual meetings of those partners that participated in the in-depth study.

Although the interviews aimed at (parts of) organisations, the personal scope (responsibility, interests) of the interviewees may have had an influence on the interviewees' perceptions. Although we excluded the personal background, e.g., technical background versus business or HR background, as a factor influencing answers on knowledge maturing in the representative study, we back then also reported about a potential limitation that different interviewees within one organisation might have given different answers on

the organisation (see D1.2). In order to account for this potential limitation, we relied on at least three interviewees per organisation or network, respectively, in the in-depth study. Thus, we ensured that we got at multiple perspectives on the state-of-play of knowledge maturing and the reasons and measures that had been performed or were planned. We again carefully selected interviewees who had a good command of the knowledge and learning management in their organisation.

4.5 Summary

The in-depth study comprised a multiple case study consisting of six organisations and one network conducted by five partners of the MATURE project. Each case was investigated and summarized in a case report by the respective partner. Besides these individual findings, we employed a cross-case analysis. We relied on five topics for the cross-case analysis: reasons for better KM, measures for KM, barriers for KM and ways to overcome, software used for KM and planned measures for KM.

The majority of reasons for a better performance of KM in the organisations studied are concerned with the attitude and behavior of the employees towards KM, i.e. for example the willingness to share knowledge, informal relationships and reflexiveness about the nature of KM itself as well as informal relationships built between employees. There are also a number of reasons that can be related back to drivers of knowledge work: accessibility of knowledge, availability of different channels for sharing knowledge and mechanisms de-freezing thought patterns, are highlighted by several case studies.

In comparison to the more bottom-up oriented perspective of the reasons for better maturing, measures to foster this are more concerned with a top-down perspective. In several case studies, measures were introduced which aim at creating opportunities for employees to meet face-to-face or enabling them to connect to each other and extend their social network, for example, fostering topics by conducting community of practice meetings, regular (team) meetings and workshops on specific topics. Other measures are concerned with competence-oriented team building and competence development. To a lesser extent, measures are concentrated on establishing specific roles by individual employees.

Although generally in line with results from the representative study from year 2, it became evident that the organisational culture spans and subsumes other barriers. Measures that were undertaken to overcome specific barriers for knowledge maturing bare resemblance to measures generally undertaken for improving knowledge maturing.

The software solutions we encountered were heterogeneous, yet in line with the software we found in the representative study. Tools and services such as the intranet, personal information management software and office software were mostly named as used for supporting knowledge maturing. The in-depth study supports the findings and multiple departments typically relied on a standard software infrastructure throughout the organisation with little variation in the software, yet more variation in the way the software is used for knowledge maturing. Most software seemed not to have been specifically designed to support knowledge maturing. Different phases of the knowledge maturing phase model were supported by different software types so that knowledge which is developed needs to be transferred between different IT systems until it reaches a later phase of maturity.

With respect to measures to improve the performance of KM in the future, the organisations seemed to be not particularly engaged in future plans for enhancing knowledge maturing in revolutionary ways and seemed to focus on the continuation of efforts that had already been started. The focus seems to be both on individual as well as collective actions. Expansive learning and knowledge is seen as the result of multiple intertwining forces, e.g., concerning content, context and community. Of particular interest for future activities in knowledge maturing seem to be collaborative KM processes in multi-institutional settings even crossing organizational boundaries fostering inter-organisational learning and knowledge development. Innovation, learning and knowledge development across organisations are increasingly seen as social processes supported by social computing platforms. These particularly stress the importance of building relationships and connections between individuals in order to analyse and harvest the individually-generated contents on an aggregated level involving a potentially large number of people.

Building upon the results of the in-depth study, we developed an overarching view integrating the different topics of the cross-case analysis by taking into account causal relationships. These causes and effects

were structured according to three levels: (1) levers summarizing the organisational and technical instruments that we found to impact on knowledge maturing, (2) expected and experienced effects of levers as well as (3) perceived impact on better performance of KM. We collected additional stories that are based on the case studies and that are structured according to these levels to provide evidence for cause and effect relationships.

The results we gained by the in-depth study in year 3 of the MATURE project support in general the findings collected during the previous two years of the MATURE project, detail them and address several of the limitations in the previous representative study. Taken together, we now feel confident to have a well-rounded picture of knowledge maturing in real-world organisations that was taken up to develop the knowledge maturing landscape of models final to this project. When we collected reasons for better maturing, the interviewees perceived their organisation as generally good with respect to knowledge maturing. This is in line with the results we gained from the representative study, where most participants agreed to perform knowledge maturing well, with the exception of one case (FZI1) in which the organisation reported on a number of measures that were not implemented successfully yet, but also reported it was confident that the changes that they underwent during the study's time would produce successful results in the future.

The measures (currently and planned) that organisations employed in our case study also reflect the results we gained on knowledge maturing activities. The three knowledge maturing activities that were perceived most supported in the representative study were also supported well by measures that the interviewees of the in-depth study named. We could additionally identify what specific measures organisations performed in order to support these activities in the in-depth study. Firstly, "embed information at individual or organisational level" was facilitated by measures like the introduction of organisational guidelines for documenting knowledge and by formal trainings at regular intervals which specifically facilitate the target-specific take-up of up-to-date knowledge. Secondly, "communicate with people" was supported by workshops on specific topics (same time, same place) and by provision of sophisticated IT infrastructure (same/ different times, different place). Thirdly, "familiarise with new information" was fostered by measures like technology-enhanced boundary objects and fostering topics by conducting community of practice meetings.

Besides measures already in place, organisations also aimed at further improving these activities by, e.g. fostering "communicate with people" by opening and resourcing dialogic spaces. But interviewees also mentioned measures supporting knowledge maturing activities that were deemed comparably less supported in the representative study. The knowledge maturing activity "assess, verify and rate information" is, for example, planned to be supported by introducing performance indicators for managing personal knowledge. Measures like the improvement of access to documented knowledge aim at improving the knowledge maturing activities "familiarize oneself with new information" and "find relevant digital resources".

A number of barriers which were named in the representative study, for example "lack of resources", were known to the organisations we studied and are either already being addressed or there were concrete measures planned in order to address them in the future. In this example, the organisations overcame this barrier by acknowledging the fact, hiring more staff and by improving business processes. Another example would be that, in order to overcome a lacking willingness of employees to share knowledge (which could be traced back to a fear of loss of power), organisations fostered the formation of communities (of practice) for fostering informal relationships.

5 Knowledge Maturing Model

This chapter takes up on and synthesizes the conceptual results from the parallel strands of activities in the MATURE project on the notion of "knowledge maturing", the central concept of the MATURE project. The most obvious source feeding into the reconciliation of the MATURE knowledge maturing model landscape v3 as it was presented in D1.2 has been the results of the in-depth study. However, researchers participating in this empirical activity also directly worked in year 3 activities of other WPs. Additionally, we continuously fed the results of the in-depth study forward to activities in other WPs. Moreover and in line with reviewers' suggestions, we helped other WPs to take up the results of WP1 activities up to year 2 which had been amalgamated in the knowledge maturing model landscape v3. Reflections on this take up also fed into reconciling the knowledge maturing model landscape.

Specifically, this comprises the conceptual, design and development activities in the demonstrator teams, the deployment and appropriation activities in cooperation with the application partners, the conceptual activities leading to a business model for application service providers as well as for consultants guiding organisations with respect to knowledge maturing as well as the evaluation activities. Thus, this chapter represents the underlying basis of the shared conceptual understanding that glues together the different strands of activities in MATURE. The deliverable is entitled to contain the final knowledge maturing model. The term "final" is regarded with respect to the necessary freezing of the model in order for it to be able to act as the internal base line for year 4 activities in the parallel strands of design, development and evaluation activities within MATURE. However, we refrain from calling the knowledge maturing model landscape final in a generic sense, but are more than enthusiastic about submitting our results to the scientific discourse in technology-enhanced learning and knowledge management which will certainly support its further development as much as we plan on continuing reflection on its impact on practice in companies and organizations which also will carry the potential for improving and refining the model.

In the following, section 5.1 presents the final Knowledge Maturing Model landscape together with the final Knowledge Maturing Model. Section 5.2 revisits the KM indicators and helps organisations in re-using and extending the set of indicators as developed in the MATURE project. Section 5.3 is focused on guidance and presents the results of several parallel strands of activities in MATURE that aim at explaining guidance resulting in a consolidated set of guidance activities. Section 5.4 discusses take-up of the results of MATURE empirical and conceptual activities in other WPs. Section 5.5 gives a summative overview of the concepts created as part of the KMM landscape and their relationships to other WPs. Finally, section 5.6 gives a set of recommendations for which we have created artefacts to support implementation targeted at organisations willing to improve their performance of knowledge maturing.

5.1 KMM Landscape

In the third version of the Knowledge Maturing Model presented in D1.2, the scope of the model and the diversity of its elements have expanded into a Knowledge Maturing Model Landscape to account for the insight that understanding and addressing knowledge maturing in a specific context requires multiple perspectives. This landscape consists of

- the knowledge maturing phase model,
- the knowledge maturing dimensions identifying manifestations of knowledge,
- knowledge maturing activities,
- indicators for assessing knowledge maturing,
- a guidance model for interventions into knowledge maturing processes and
- a model for analyzing motivational aspects.

In year 2, the landscape elements were only roughly connected with each other, with this roughness representing our level of understanding of the links. During year 3, we have concentrated on deepening this understanding. The results of this can be seen in Figure 13.

The **Knowledge Maturing Phase Model** describes knowledge maturing along distinct phases. Its main contributions to understanding knowledge maturing are

- (Collective) knowledge has specific characteristics which determine how the development of such knowledge takes place, and how it can be supported.
- Knowledge has to be viewed as part of a development process in which these characteristics change.
- This development process neither is a smooth process with only gradual changes, nor is it a strict linear process. Rather, this process can be structured into phases with a set of characteristics and transitions in between them.

One inherent problem of dealing with knowledge maturing is the fact that it is a phenomenon not directly visible. To solve that problem, we have identified **Knowledge Maturing Indicators**; they operationalise the rather abstract characteristics of phases. Through their potential of indicating in which knowledge maturing phase a certain manifestation of knowledge is, or which transitions have been mastered, they play a key role in monitoring the effects of implementing knowledge maturing support:

- They are used to assess and evaluate effects on knowledge maturing.
- They inform services and widgets about knowledge maturing in a concrete setting.

In year 2, we concentrated on identifying and validating a set of reusable knowledge maturing indicators, which are called **General Knowledge Maturing Indicators**. These indicators observe manifestations of knowledge which are defined in the **Knowledge Maturing Dimension Model**, i.e., artefacts, cognifacts (as individual capability or topics), and sociofacts. They can be divided into indicators measuring certain characteristics or qualities of the manifestations, or activities by or with those manifestations. These The activity-related strand observes **Knowledge Maturing Activities** or **Guidance Activities**, which are activities that typically contribute to knowledge maturing or guide them.

Both, the General Knowledge Maturing Indicators and the Knowledge Maturing & Guidance Activities are scaffolds for designing knowledge maturing support in a specific target context. A configuration of such knowledge maturing support is called an **Instantiation** (of the knowledge maturing toolbox consisting of a set of building blocks as covered in D2.3/3.3). This Instantiation consist of building blocks (i.e., widgets and services). Each of them realizes one or more Use Case (which in turn was designed to overcome specific Barriers) and supports one or more User Activities, which are concretizations of Knowledge Maturing Activities or Guidance Activities. The concrete functionality depends on the characteristics of the maturity phase(s) that the widget or service is targeted at, e.g., "share and release information" rather requires ways of support in the early phases than in the later phases, and frequently these widgets and services aim at facilitating certain transitions, e.g., from the individual to the community (phase 1 to 2), or help to formalize community outcomes (phase 2 to 3).

As for indicators, they are concretized into Specific Knowledge Maturing Indicators. Some of these are calculated with the help of reusable Maturing Services (D4.3) configured for a specific target context. For quality-related indicators, this is achieved using measures (e.g., calculating structuredness based on a concrete algorithm that analyzes a given piece of text). For activity-related indicators, this is based on User Events, which make traceable User Activities during the interaction of the user with the system. This limits the selection of automatically assessable General Knowledge Maturing Indicators to those that are actually observable as user events in a concrete instantiation. In addition, there are not automatically assessed indicators which are concretized into a set specific to an instantiation.

Finally, an Instantiation has an Effect on knowledge maturing, and Specific Knowledge Maturing Indicators (which do not need to be calculated automatically) help to evaluate that effect (covered in D6.3). One way of capturing those effects and providing a basis for reflection is the **Maturing Scorecard** approach as presented in D2.3/D3.3. These Effects can be better understood with the help of the Knowledge Maturing Phase Model and the Motivational Barrier Model.

The ultimate goal of knowledge maturing support in an organization is to create a positive Effect on the organization, which in turn delivers a Business value. This is covered in D9.2.

Figure 13: Knowledge Maturing Model Landscape

In the course of finalising the Knowledge Maturing Model Landscape, we revisited the Knowledge Maturing Phase Model. Results of the in-depth study as well as activities in other WPs in year 3 have not led to a remodelling, on the contrary, phases have been stabilised and are depicted in their final version in Figure 14. The model identifies the different phases of knowledge development, specifically 'expressing ideas' and 'appropriating ideas' on an individual level, i.e. developing new ideas by individuals, personalising and marking them as individual contributions, 'distributing in communities', i.e. sharing, co-developing and refining of highly contextualized knowledge in a collective of knowledge workers who share a common understanding of the topics involved, 'formalising', i.e. creating purpose-driven structured documents in which knowledge is de-subjectified and context is made explicit, 'ad-hoc training' and 'piloting', i.e. refining and didactically preparing a topic in order to improve comprehensibility and ease its consumption or re-use in workplace learning in an instructional setting as well as collecting experiences with a test case before a larger roll-out of, e.g., a product, a service, or new organisational rules, procedures, processes or practices in an experimental setting, 'formal training' and 'institutionalising', i.e. integrating and arranging learning content into using sophisticated didactical concepts in order to guide learners in their learning journeys in an instructional setting as well as solidifying formalized knowledge and implementing it into the organisational infrastructure, e.g., in the form of processes, business rules or standard operating procedures, and 'standardising', i.e. certifying that participants of formal trainings achieved proficiency in the sense of selected knowledge, skills or competency in an instructional setting or that organisations or, e.g., their processes, practices, products or services comply with a pre-defined set of rules.

Figure 14: KM phase model (v3)

5.2 KM Indicators

The knowledge maturing indicators arose as a concept to support the assessment of (changes in) maturity of knowledge and to inform the design of maturing services in the project's prototype development and also as a tool for evaluation. Initially developed in the ethnographically-informed study in year 1 (see D1.1), we tested them for feasibility within 139 interviews in year 2 (see D1.2).

However, the uptake of the up to now mainly conceptual maturing indicators by the development teams and further analysis with regard to related research and related concepts, pointed out, that revisiting the knowledge maturing indicators including a further refinement and restructuring from a conceptual perspective, seemed advisable.

The main issue that surfaced for the development teams in concretizing and applying the indicators was that many similar, but semantically different variants can be created, which lead to combinatorial explosion (when aiming at completeness) or seem arbitrary (when selecting some of the possible variants). A closer investigation revealed the following observations that illustrate the need for a systematic approach:

- As already described in D1.2, indicators can be formulated as states or as state changes (e.g, an artefact has a certain degree of structuredness, or an artefact has changed its degree of structuredness). Furthermore, indicators could refer to a single event (e.g., an artefact has been changed), to a number of events within a time frame (e.g., an artefact has been changed frequently in the last 7 days), or a change in frequency within a time frame compared to previous time frames (e.g., an artefact has been changed more frequently within the last 7 days than in the weeks before).

- Indicators can be aggregated or combined to yield a higher semantic expressivity (through a more concrete understanding of the actual activity), e.g., event sequences like "an artefact has been changed after an individual has attended a training".
- Other context conditions (e.g., specific types of artefact, qualities of individuals etc.) can be used to narrow down a specific knowledge maturing indicator like a drill-down in data analysis.

This will be investigated in more detail in the following sub sections.

5.2.1 Classification of Indicators

Based on experiences of applying the indicators in WP2-4, it has turned out that the original classification (developed in year 1 based on the ethnographically informed study and used in year 2 for the representative study) of indicators into *digital resource*, *person*, *process*, and *combinations* has some difficulties. Particularly the "combinations" category was too heterogeneous, but also the double nature of process (both as a process model artefact and as a sociofact) led to difficulties in practice. At the end of year 2, we had developed the Maturing Criteria to provide a more abstract layer on top of the indicators. These were found useful distinctions so that we have developed these into a classification hierarchy.

Guiding principle for the classification on the top level was to clearly state what is being made traceable (about what do we want to make a statement?), i.e., which manifestation of knowledge. This has led to the distinctions *artefact*, and *sociofact*, while cognifact was split into *individual capabilities* and *topic* (where we could directly observe topics). In this new classification, we have split the process aspect into its artefact part and its sociofact part, which made it easier to distinguish between the two (which is important as KISSmir aims at aligning the two aspects). Additionally we added an output-oriented category *impact/performance* where we included indicators that were suggested in the Representative Study. On a second level (and third level where necessary), we introduced the concepts identified in the Maturing Criteria to clarify what is the conceptual approach so that we can build on the reasoning in D1.2, which explained how this concept we intend to make traceable is related to knowledge maturing. In some case, we deviated from this general approach and merely introduced a grouping (e.g., "individual - organization", "individual – group"). The main reason is that the criteria from D1.2 are too intertwined with the individual indicators so that we have chosen a similarity-based grouping. The resulting structure is given in the following:

I.   *Artefacts*

   I.1   *Artefact characteristics*

   I.2   *Creation and editing context*

   I.2.1   *Creator*

   I.2.2   *Purpose*

   I.2.2   *Creation process*

   I.3   *Usage*

   I.4   *Rating and legitimation*

II.   *Individual capabilities*

   II.1   *Individual activities*

   II.2   *Individual – organization*

   II.3   *Individual – group*

   II.3   *Rating and assessment*

III.   *Topic*

IV.   *Sociofacts*

   IV.1   *Process or task knowledge*

IV.2   *Quality of social network*

IV.3   *Agreement*

IV.4   *Collective capability*

V.   *Impact and performance*

V.1   *Performance*

V.2   *Quality*

V.3   *Impact*

With introducing the topic category, we have also discovered that some indicators in the indicator list need to be interpreted with respect to a topic (e.g., "an individual has contributed to a project"). This can be also seen from the qualitative analysis of the Representative Study. As this has an impact on the use of the indicators in the instantiations, we have marked those.

As a result of this re-classification, we have also introduced a new numbering scheme and we added some indicators compared to those included in the representative study. This was based in most cases on either suggestions from the Representative Study (see D1.2), or experiences from the technical development. Table 19 in the appendix (section 7.3) lists all KM indicators, their unique IDs, their classification according to the dimensions and their level of justification.

An additional observation is that the indicator category V (Impact and Performance) differs from the other indicator categories as they are general indicators that are not specific to knowledge maturing, but can be found in many other indicator systems. This has led us to analyse in more detail how Knowledge Maturing Indicators fit into other organizational indicator systems.

Based on the UNI 11097 standard, (Franceschini et al., 2007) describe a general classification of indicators into initial, intermediate and final indicators which depend on the moment of observation in a business process. Below, each class and its mapping to the context of KM indicators (see figure 15) is described in more detail. As from a business perspective knowledge maturing is a means, an instrument, applied in order to achieve results that comprise a business value, in a narrow sense KM indicators refer to the process of handling knowledge in organisations within core and service business processes rather than to inputs or outputs of these processes
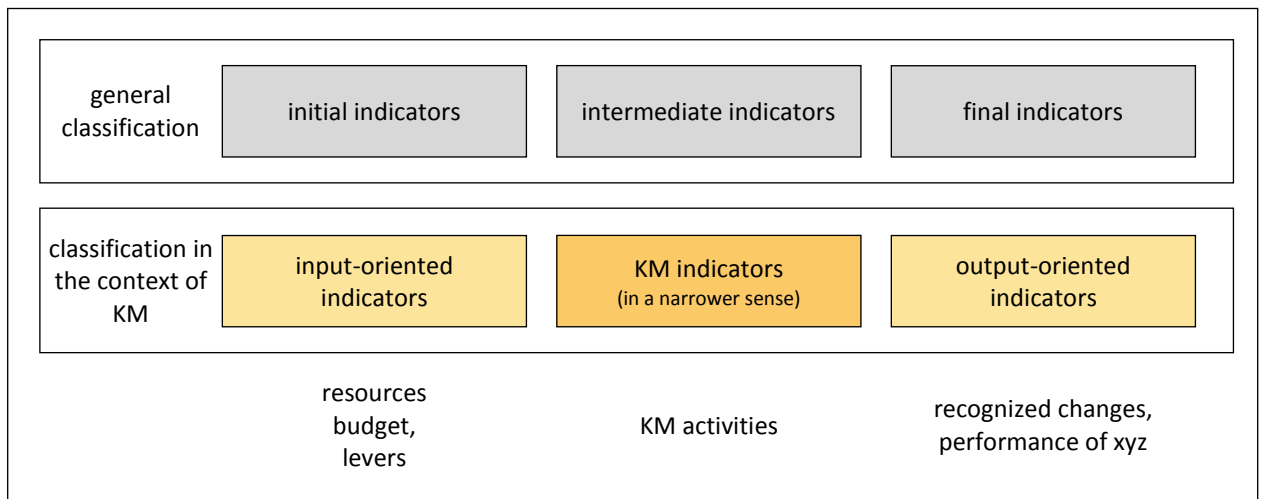
Figure 15: Classification of indicators (Franceschini et al., 2007)

- *Initial indicators:*
  - These indicators consider available organizational, physical and financial resources, e.g., facilities, human resources, technological and financial assets and provided services

- In the context of KM, these are indicators assessing inputs or preconditions that are important for KM to take place or for supporting KM. Examples in the context of KM are related to, e.g., the amount of budget allocated for the training of employees, the amount of time allocated to employees for performing knowledge maturing activities, the level of sophistication of the ICT infrastructure including appropriating software and services.
- *Intermediate indicators:*
    - These indicators consider conditions of how something (the object of interest) works or is done and whether it runs into unexpected difficulties, e.g., providing information on the process state
    - In our context, these can be seen as knowledge maturing indicators in a narrower sense,i.e., . These indicators are informed by an understanding of knowledge maturing, e.g., refer to KM activities. An example is the description of how the frequency of changes or editing in the creation process of an artefact changes over time.
- *Final indicators:*
    - These indicators aim at tangible outcome or result of business processes. They consider the process as a black box, i.e., they do not take into account how the process looks like. For example, they relate to customer satisfaction or production costs of products/services.
    - In the context of knowledge maturing, the final goals stay the same as in a more general business context, however, the primary indicators concentrate on, e.g., improved process flexibility, improved rate of innovation, production of products/services with higher quality.

From these structure of indicators, it becomes clearer how KM Indicators relate to indicator systems for other purposes in a company. Input-oriented and output-oriented indicators can be embedded into or shared with other purposes. The only specific indicators are the intermediate indicators that are informed by an understanding of KM. Consequently, also a tool for monitoring KM initiatives can be integrated with the existing controlling tools used in an organisation in order to increase visibility of KM initiatives and link it to organisational inputs and goals.

As a consequence for the project, we concentrate on the intermediate indicator level with our KM Indicators. Category V represents an output-oriented category that has been included as a small selection of possible output indicators in order to make them available for evaluation purposes.

5.2.2 Aggregation of Indicators

KM Indicators can be used and defined at different levels of abstraction. In a first step, we can distinguish between three different layers, which are schematically represented in Figure 16:

Construct:
- Construct describes the subject, which is in the center of a change or state description. For example, this may be knowledge represented by an artefact. This corresponds to the Indicator categories from section 5.2.1, which in turn are based on the manifestations of knowledge as described in the Knowledge Maturing Dimension model.

Indicator:
- Such a concept has a number of attributes and properties which may be seen as the characteristics. Certain characteristics are deemed to be appropriate to describe what state relevant for KM a concept is in (or by comparing two states what change has happened).
- Indicators can be aggregated into more complex indicators as shown in Figure 16. differentiate between basic indicators and derived indicators (see Franceschini et al., 2007).

Measure:
- This layer describes the model which defines the mapping from an empirical relational system (real world) into a representational system (e.g a numerical system) (Finkelstein, 2003).

- It contains a scale which is used to locate objects upon a continuum (Malhotra, 2004). The Scale has a certain domain or range of possible values, e.g., a 7-point likert scale. ime-frame which is focused.
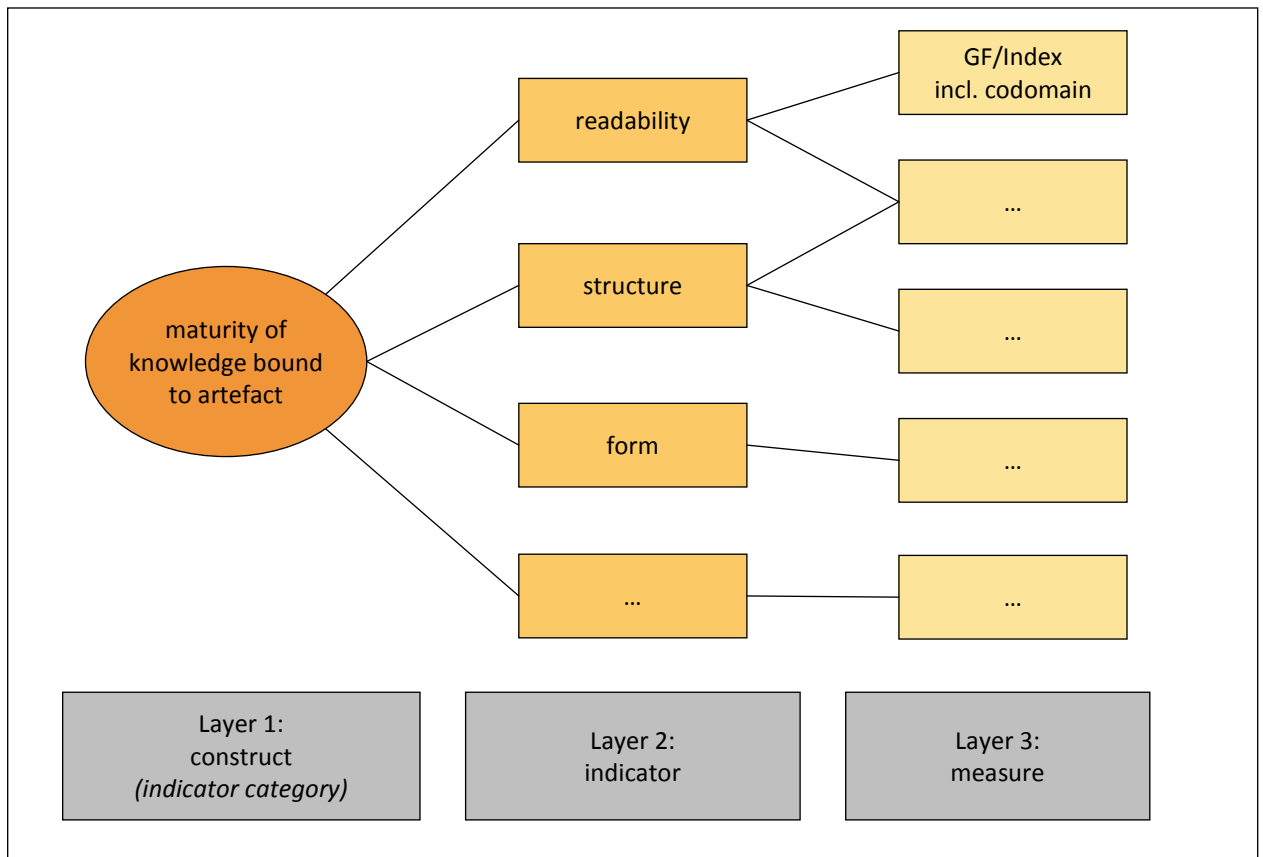
Figure 16: Layers of abstraction for KM Indicators
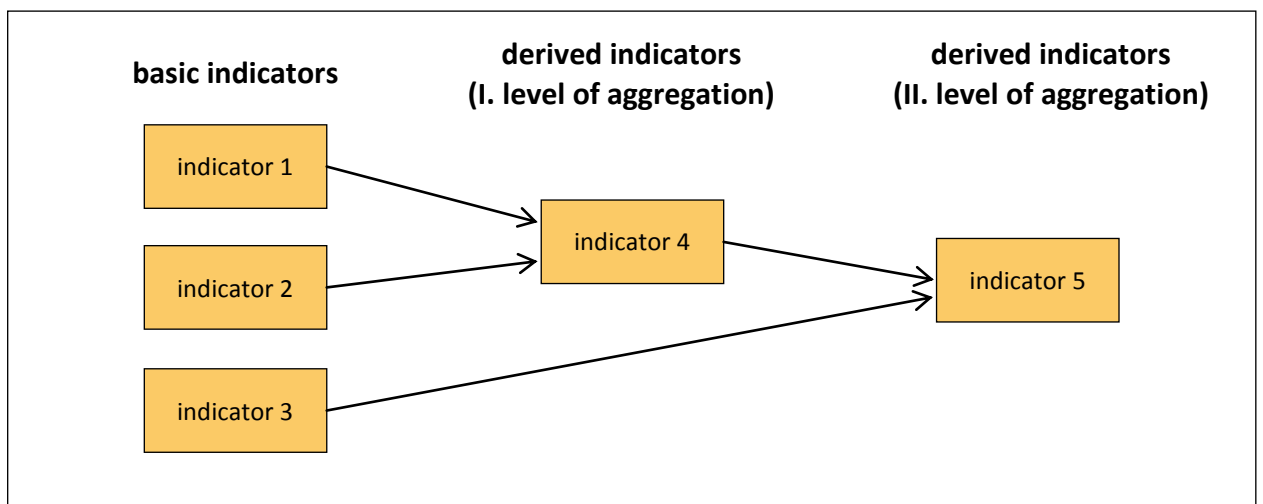
Figure 17: Basic and derived indicators (see Franceschini et al., 2007)

Within WP1, we concentrate on the layer 1 and 2, while measures are part of the Maturing Services (WP4).

5.2.3 Event vs. state

Event vs. state is a classical problem in computer science and in ontological modelling. DOLCE, the most widely used upper level ontology, has the basic differentiation between "endurants" (things which are wholly present at each instant in time they are present) and "perdurants" (things which are only partially present at each instant in time). DOLCE differentiates Perdurants into Event and Stative (which are divided into State and Process). The distinction is made using the notion of cumulativity: "An occurrence-type is stative or eventive according to whether it holds of the mereological sum of two of its instances, i.e. if it is cumulative or not…" (Masolo et al., 2003).

The same categories are used in linguistics for classifying verbs and verb forms which follows a different approach to distinguishing the notions of state and event, e.g. by Vendler (1967) and later modified by Mourelatos (1978):

- States are the counterpart to actions (Vendler (1967): "cannot be qualified as actions at all") as opposed to occurrences.
- Events are related to performances which can be punctual occurrences (achievements) or results of developments (accomplishments).
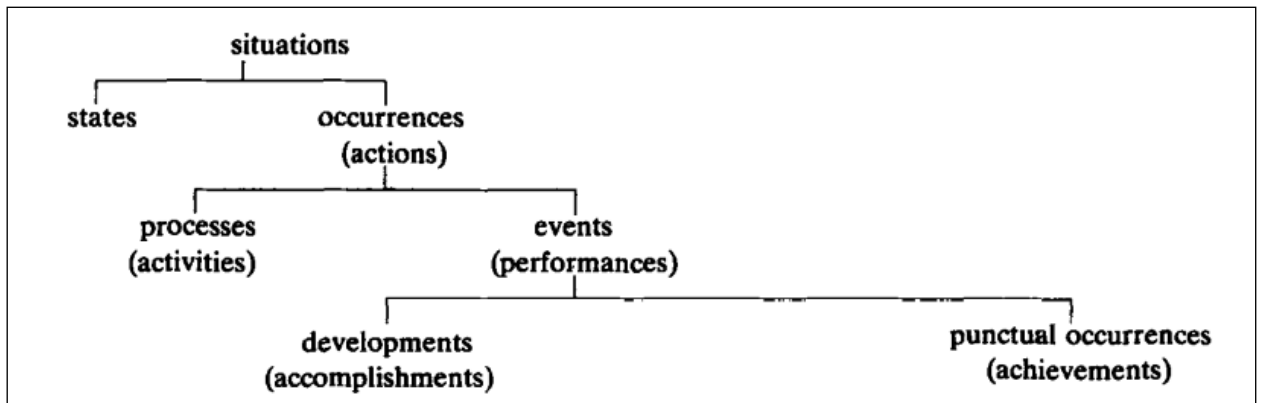
Figure 18: Event vs. state in linguistics (Mourelatos, 1978)

We additionally need to take into account that when it comes to indicators, it is not only about states and events as such, but we can also observe "higher order" phenomena, like changes of state (e.g., an artefact has changed its structuredness), or change of the rate of change (e.g., an artefact has changed its structuredness more often). The same applies to events where we can have frequency of events (e.g., an artefact has changed frequently) or change of frequency (e.g., an artefact has changed more frequently). If we take a closer look at those, we can observe that they are interlinked:

- Events typically result in a change of state (e.g., "an artefact has changed with respect to structuredness" results in a change of the structuredness property which is a state), or a change of state can be interpreted as an event (e.g., when the structuredness of an artefact changes, this can be interpreted as a change event).
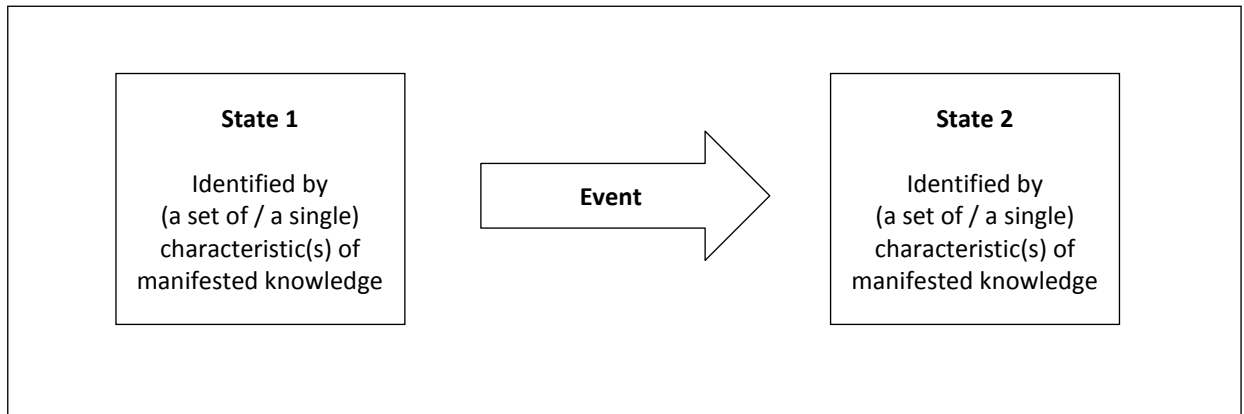
Figure 19: Indicators related to states and changes of states (Balzert, 2001) (Masolo et al., 2003)

- The frequency of events as well as the frequency change rate can be seen as a state by interpreting frequency as a property (e.g., frequency of change of structureness within the last 7 days).

While the distinction between the two arguably becomes blurred in real-world settings, it is still important to consider the distinction for the formulation and interpretation of indicators as the interpretation might be different: in case of events, we focus on the fact that something has occurred in a specific instant in time, while for the state perspective we look at the result.

As a conclusion for the systematization of indicators: we need to take into account state and event variants of indicators (as defined by DOLCE) as well as their higher order derivations. These are linked to each other with respect to the real-world, but are associated with different interpretations with respect to knowledge maturing.

5.2.4 Structure of Indicators

Within the course of contextualizing the General Knowledge Maturing Indicators (in section 7.5) by the workpackages 2-4 (see 5.4.1), it has been realized that indicators can be concretized in many ways that are similar and somehow related, but constitute a distinct specific knowledge maturing indicator, which results in a huge list of specific indicators, which is difficult to handle on the technical side. At the same time, it could be observed that patterns of variants emerge that suggest that indicators have a common structural principle. Therefore, we have started to dissect indicators into its elements.

First of all, the distinction between context-independent **General Knowledge Maturing Indicators** and contextualized **Specific Knowledge Maturing Indicators**[11] was fundamental (see figure 20), but they have the same internal structure.

---

[11] In D2.3/3.3, mainly Specific Knowledge Maturing Indicators are considered which relate to knowledge maturing phases and transitions between them. Therefore, the descriptions frequently use the term "Transition Indicator".

Figure 20: Indicator Systematization

This internal structure can be decomposed into:

- **Subject.** This represents which manifestation of knowledge the indicator statement is about and is described by the classification developed in 5.2.2.
- **Base form.** It could be observed that indicators have a conceptual core (like "change", "legitimate", "be involved") and variants. Similar to verbs from which sentences can be built, we called this conceptual core the "base form" of the indicator. This base form exists both on the General Knowledge Maturing Indicator level and on the Specific (where instantiation-specific aspects become relevant such as "tagging a person").
- **Variant.** From the base from, the indicator can be generated by applying variants. This takes up the event vs. state discussion in section 5.2.4 because indicators could be described in all cases in both variants (and their higher order derivatives like frequency, change of frequency or change of state ad rate of change of state). Each variant can be interpreted in a slightly different way with respect to knowledge maturing although they can be in most cases calculated based on the same data by Maturing Services.
- **Context Conditions.** Furthermore, indicators can be formulated with restrictions on the variant. Such context conditions can take the form of:
    - *Time frame.* Particularly for higher order variants, it is important to specify the time frame in which the change takes place.

◦ *Aggregated indicators* (see section 5.2.3). In this case existing indicators are used, e.g., as part of an event sequence ("after a tag has been created by an individual"), as characteristics of the individual ("an individual has been tagged by an individual has been tagged frequently with the same topic") or of the artifact (e.g., a specific type of artifact).

◦ *Purpose/goal.* This captures the intention of an observable event (e.g., "prepared for a meeting", "sent to a customer"), but can be derived in some cases from analyzing activity streams.

Furthermore, we have observed that there are two groups of indicators:

• **Quality-related indicators.** These indicators refer to qualities of the associated subject, like formality, or readability for artefacts, or experience, responsibility, or membership for individuals.

• **Activity-related indicators.** The majority of indicators is based on observing activities by individuals or groups.

This distinction is important for the Maturing Services (WP4) where activity-related indicators are calculated based on user events, while quality-related indicators are calculated on the artefact using measures.

For the activity-related indicators, there is relationship to knowledge maturing activities: activity-related indicators make knowledge maturing activities traceable. We have therefore related the base forms of the General Knowledge Maturing Indicators to the Knowledge Maturing Activities:
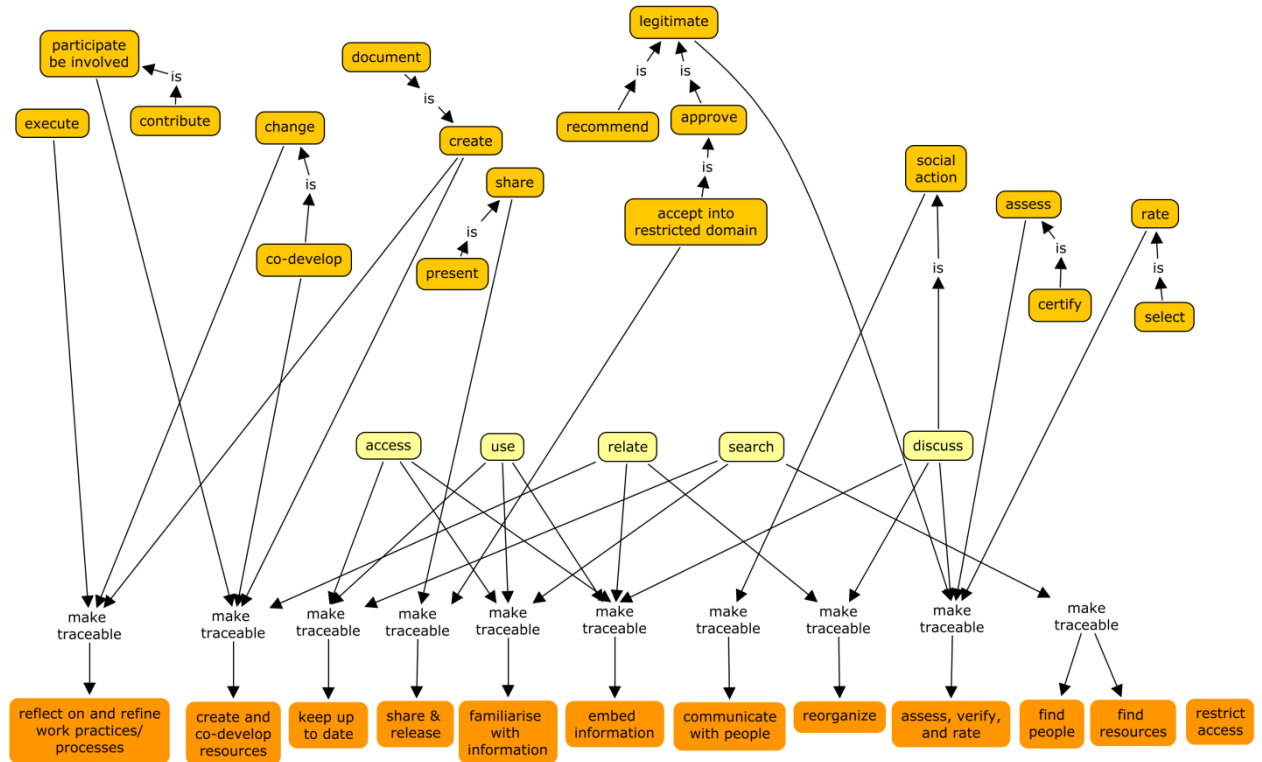
Figure 21: Relating indicator base forms to Knowledge Maturing Activities

This has led to an interesting insight: there are indicator base forms like *access*, *use*, *relate*, *search*, or *discuss* that can refer to multiple knowledge maturing activities, while other base forms are more specific and refer to one or two activities only. This means that those indicators that refer to multiple activities are less specific and thus need more contextualization by additional context conditions or by the concretization of the base form (with instantiation-specific activities).

Furthermore it has also become obvious that all knowledge maturing activities have corresponding indicators – except for one "restrict access". This correlates with the results of the Representative Study where this activity was found to be the most controversial. Although one could think of additional indicators that refer to this activity, but in our instantiations, this activity also does not play a role so that we have not included any indicators.

5.3 Guidance

Guidance is a vague term in management science and we deliberately used it in order to give it a specific meaning in MATURE. In MATURE year 2, the term guidance was defined as any influence on the direction ("goal") or the quality (in terms of effectiveness and efficiency) of knowledge maturing processes by entities not directly involved in them (D1.2). This definition of guidance neither specifies that this influence is intentional nor that it has positive effects on knowledge maturing. We also distinguished between artefact-based, sociofact-based and managerial guidance.

In year 3, we had several parallel activities aiming at identifying guidance for knowledge maturing in practice, both in the in-depth study as well as at application partners. With respect to the latter, we had the specific situation that some of the application partners' main area of activity also has been on a specific form of guidance, namely careers guidance. We also collected data about in-depth study partners' reflections on observed situations of guidance. The outcome of this is listed in the appendix (section 7.3). Furthermore, based on the results of the formative evaluation as well as reviewers' inputs, designers and developers of MATURE software also engaged in thinking about the influences they were expecting from applying MATURE tools.

Section 5.3.1 presents and discusses the results of a survey conducted among partners in the MATURE consortium taking up on the interdisciplinary backgrounds of the representatives of partner organizations in MATURE. Section 5.3.2 then contrasts the diverse perspectives on guidance with similar concepts from the literature and structures guidance according to varying levels of granularity. Finally, section 5.3.3 presents a consolidated list of guidance activities as found in the representative study (year 2; see D1.2) as well as the in-depth study (year 3) of the MATURE project.

5.3.1 Project internal survey

In order to explore deeper about the impact of guidance on MATURE, we collected the various perspectives of partners in the consortium on guidance in MATURE with the help of the following questions:

1. What is your understanding or definition of guidance from your background? Which approaches/concepts/instruments/theories/ideas do you think are relevant for MATURE's understanding of guidance?

2. Which forms of guidance do you consider relevant for MATURE? Feel free to add concrete examples or any more elaborate explanations to it.

In the following, we briefly summarize the (partly extensive) answers to these questions that we collected:

Statement 1

My view on guidance is that it is an overlay to the management structure and that every member of an organization or also a collective of committed individuals potentially can act as (a) guide and at the same time as a guided person. From the perspective of knowledge maturing, guidance is related to a domain of knowledge which is developed. Whether a person acts as a guide or as a guided person is thus influenced by the level of expertise that that person holds. Following up on Nonaka's model of a hypertext organization, an organization consists of three layers:

- business system layer: business processes and practices with traditional management
- project team layer with project management including task forces, influence management and matrix management
- knowledge base layer While there are numerous management styles, concepts and theories as well as instruments describing the first two, it is much more obscure with respect to how the third layer is managed.

In my view, MATURE should offer support for guidance and this is at the core of the OLME. Specifically, I would envision support of potential and actual guides in: making sense of happenings, current state and developments in knowledge maturing, selecting guidance instruments to be applied, deciding on whom to guide, performing guidance activities or keeping track of their results. Summing up, guidance in

my view is an overlay to management structure, potentially can be performed by every member or a collective of members of an organisation and is domain-specific. Relevant forms of guidance in MATURE include:

- guidance for adopting MATURE concepts and tools in the organisation, for adapting them and for helping boost acceptance and assimilation into organisational processes, practices and infrastructure
- guidance for introducing concrete arrangements of MATURE (or other) tools, services or organisational measures targeting specific issues in knowledge maturing or conrete barriers along the phase model
- guidance within MATURE, i.e. MATURE tools directly support guides and guided people in guidance activities.
- Examples for guidance activities are recommend, encourage, suggest, irritate, challenge, create opportunity, share contact, mentor, coach, feedback, comment, evaluate, assess, create awareness of guides and guided people about their learning activities, co-existence, communication, coordination, cooperation and immersion of guides and guided people.

Statement 2

The concept of guidance is closely linked to the introduction of new ideas, processes, organizational strategies and concepts and constructs within an organization (on organizational, department or group level). According to our theoretical approach (KM-Model) guidance is related to artefacts, cognifacts and sociofacts and needs social action, communication and meta-communication. Thus, guidance itself belongs mainly to the sociofacts.

Guidance Activities could be e.g.: inform, advise, manage, supervise, influence, intervene, lead, training, exercise These activities mostly are done within communication scenarios but also by delivering topic related artefacts.

Statement 3

My context relates to professional practice in careers guidance - so this term has a very specific meaning: guidance helps individuals understand their options related to training, education and work so that they can make decisions about their future. This is not relevant to MATURE. The definition developed in management contexts (see answer to question 2, below) seems to have more relevance.

Relevant forms: In the English language, this terms had multiple meanings when applied in different contexts. Generally, it refers to supporting and/or directing conduct. It also has connotations around leadership, instruction or direction. But also has very specific meaning in relation to counselling or advice on educational, vocational, or psychological matters. For MATURE context, the first seems most relevant.

Statement 4

Guidance is (computer) support that a person (or group) receives in developing knowledge artefacts and own competencies.

Relevant forms: Suggestions to bring artefacts to the next stage when a certain status is reached as depending on knowledge indicators.

Statement 5

For me, guidance is anything that influences a human's behaviour during (knowledge) work. I would propose to distinguish between 4 types of guidance:

- hard-wired tool guidance, i.e. tool functionalities built in by the developers (i.e. the MATURE consortium, potentially informed by organisational representatives and their requirements) in order to stimulate or restrict certain behaviour. Example: when creating a new resource, tool asks to provide tags (but could also be more trivial, e.g., tool allows collaboration).
- crowd-sourced tool guidance, i.e. recommendations that stem from algorithms built into tools that analyse data provided by other users. Example: tag recommendation based on previous tagging actions.

- hard-wired human guidance, i.e. rules for desired behaviour or prescriptions of other kind defined by selected organisational representatives. These may become manifest in certain data structures that cannot be changed by end users. Examples: process model or SOP defined by knowledge engineer or ontology engineered by group of experts.
- crowd-sourced human guidance, i.e. prescriptions or rules that have been defined collaboratively by many end users. Examples: task patterns or collaboratively created ontologies.

This means that my definition of guidance uses two dimensions:
- hard-wired (or static) vs. crowd-sourced (or dynamic) - where static means that desired behaviour of tool or users is defined a priori by some (alleged) experts and dynamic means that the tool tries to "compute" commonly agreed desired behaviour (that could be called a sociofact) from usage data or that it supports explicit derivation of agreement.
- tool vs. human - where tool means that the guidance is built into the code of the tool (simple functionalities or complex algorithms) and human means that the guidance is manifest only outside the code, possibly in some artefacts such as documents or process models.

Relevant forms:

Since we are a technology-based project, I would consider all forms of guidance as relevant that somehow become manifest in artefacts and that can thus be detected and influenced by (use of) software.

Statement 6

Contextual learning objects / activities which can help scaffold learning around a particular document or activity. Based on idea of scaffolding (Star, 1971) allied to Vygotsky's idea of the Zone of Proximal Development. However here, rather than the Zone of Development forming part of a formal learning programme, activities would be based on actions undertaken through work.

5.3.2 Guidance and its relationship to other concepts

There are a number of similar concepts that relate to the term guidance, e.g.,
- *governance*: specifying the decision rights and accountability framework to encourage desirable behavior (Weill and Ross, 2004),
- *influence*: generally meaning that a system, e.g., an agent, can impact on another system's behaviour, e.g., another agent's, behavior (Cialdini, 2008),
- *intervention*: meaning an external agent systematically attempts to induce a desirable change of a system by applying a specified set of instruments,
- *scaffolding*: describing a form of cognitive learning support to help learners to solve tasks that they would not be able to solve on their own (Wood et al., 1976). This support takes place within the learner's Zone of Proximal Development (ZPD, Vygotsky, 1978), i.e., the zone between what the learner currently is capable of and the potential developmental level which can be achieved through guidance and support.
- *leadership*: comprises among others traits (Eysenck, 1992), attributes, styles (Lewin et al., 1939), behaviour of leaders in organizing collectives of people to pursue a joint goal,
- *management*: comprises analysis, decision, evaluation and control (Ansoff 1966) and, with respect to change, creation, adaption, and coping with change (Leontiades, 1982)

The analysis of definitions of terms that are related to guidance also supports a closer look at the dyad of guide and guided system. For example from **leadership theories**, we can learn that personality traits, attributes, styles and behaviour of the guide with respect to the guided system will impact on the relationship between the two and the extent to which the guided system will feel inclined to accept the guide's influence on the decision taken by the guided system. In case of supervision/subordinate and thus hierarchical relationships between guide and guided system, the view that guidance leaves the decision with the guided system can be overlaid by a postulated congruency between the goals of the guided systems and those of the guide.

From **management theories** we can learn that also guides might pursue a part of the management cycle of analysis of the situation, decision of whom, what and how to guide as well as evaluation of what happened to the guided system afterwards. From governance theories, we can learn that implementing and using MATURE concepts and software tools might require or, if not considered appropriately, simply bring with it changes to the decision rights and accountability framework in which decisions concerning knowledge maturing will be taken.

From **theories on the psychology of persuasion**, we can learn that guidance can influence human behaviour by exploiting "weaknesses" of the guided system so that it commits to the guide's goals which might even contradict the goals of the guided system. From psychological theories on intervention, we can learn that guidance might even become a more or less systematic intervention into the guided system with the more or less explicit goal of change in order to prevent or to resolve a disorder or to confine its negative consequences.

From **scaffolding** and the **Zone of Proximal Development**, we can learn that when approaching guidance from an individual learning perspective guidance should be (a) temporary (i.e., learners should be on their own again when they have learnt to master a task or problem) and (b) within the Zone of Proximal Development (i.e., it should be outside the current capabilities of the learner, but still within reach) to avoid a patronizing effect and mental overload – both of which stifle motivation. In our view, this can be generalized to a team level, where ZPD would be defined on the collective level.

As much as these terms can be seen on varying levels as the object system might be a single individual, a group, a project team, a department, a division, an organization or even a group or a network of organizations, as much guidance can be exerted on varying levels of intervention. However, with respect to the MATURE concepts and software, the following guidance levels are of primary importance:

- **knowledge maturing capabilities**: guidance means here that participants, organizational or technical infrastructures of an organisation as a guided system are influenced with the aim that this organisation can improve its general capabilities useful for improved knowledge maturing, independent of a specific domain, topic, project, process or other concrete initiative in which these capabilities should be applied.

- **knowledge maturing process type**: guidance means here that participants, organizational or technical infrastructures are influenced with the aim that the process of knowledge maturing is improved in general, as laid out in the knowledge maturing phase model, i.e. independent of a specific domain or topic,

- **knowledge maturing process instance**: guidance means here that participants, organizational or technical infrastructures are influenced with the aim that a specific process of knowledge maturing is improved, i.e. concerning maturing of knowledge on a specific domain or topic,

- **knowledge maturing activity type:** guidance means here that participants, organizational or technical infrastructures are influenced with the aim that a knowledge maturing activity is generally improved, e.g., reflect on and refine work practices or processes or find people with particular knowledge or expertise.

- **knowledge maturing activity instance**: guidance means here that participants, organizational or technical infrastructures are influenced with the aim that a specific knowledge maturing activity is improved, e.g., reflect on and refine work practices or processes or find people with particular knowledge or expertise concerning knowledge on a specific domain or topic.

From this categorization, it becomes easier to distinguish between different forms of guidance. The more general levels (general capability, process types, and activity type) are typically the target of tool support or structural interventions as they need to have a generic effect, while direct human interventions are also effective on a less abstract level (like giving advice).

5.3.3 Guidance Activities

In year 2 as part of the interview study, the interviewees were asked to provide additional activities we have not covered as knowledge maturing activities. As observed in D1.2, some of these addressed the aspect of guidance as shown in the following table:

suggested new activity	number of comments	Guidance activity?
support individual development	5	Yes, but too coarse-grained as it includes various activities
interact with external contacts	4	No. Knowledge maturing activity
provide enabling tool	3	Yes, it is about creating opportunities for knowledge maturing
develop human resources	3	Yes, but too coarse-grained as it includes various activities
involve management	2	As such, not a knowledge maturing activity, but management can through its involvement guide by giving legitimation
meet people	2	No. Knowledge maturing activity
evaluate practice	2	Yes.
reflect on an organisational level	2	No. Knowledge maturing activity
Archive	1	No. Could be knowledge maturing activity
involve external expertise	1	No. Knowledge maturing activity
guidance - give free time	1	Yes, is about creating opportunities
guidance - shape culture	1	Yes, is about developing organizational conditions
guidance - perform team building	1	Yes, addresses several activities: could be coordination
create problem awareness	1	Yes.
product - testing and evaluation	1	Partly, while testing is more an operational activity, a thorough evaluation from an external perspective would be a guidance activity
project work	1	No. Knowledge maturing activity.
update process roles	1	No. Operational activity.
Sum	**32**	

This has been combined with the activities mentioned in the analysis of the in-depth studies (see section 7.3) and clustered. The result is the following set of knowledge maturing activities:

1. **Provide feedback.** This refers to external input on the progress and development. It can be based on an assessment, but could be also a form of information, e.g., how one's own ideas and contributions are used by others.

2. **Respond.** Responding to inquiries from others is a form of guidance. This does not necessarily include recommendations (can be also a response to a question without any opinion part).

3. **Recommend, suggest & advice.** This activity comprises various forms of influencing the direction of development where a peer, a more senior counterpart, or a superior recommends changing direction, using certain artefacts, executing certain actions.

4. **Irritate & challenge.** Here, the guiding entity does not suggest a certain route, but rather provides a possibility for reflection by challenging the status quo and the associated assumptions and beliefs.

5. **Structure & organize**. This can be a preparatory guidance activities (seeding), but also a form of reseeding where the knowledge area or certain artefacts are structured to reduce the complexity. The structure itself as the result of the guidance activity also has a guiding effect.

6. **Make aware.** In this activity, the guided person is made aware of new or changed developments, existence of other items outside his current perspective, the need or potential for action in a certain area. This is typically done through informing, or peripheral awareness facilities. In contrast to recommendation, it is non-judgmental.

7. **Encourage.** This refers to targeting at the motivation of individuals, particularly to overcome uncertainty and doubts associated with new fields. This encouragement can be on a peer level, but can be also effective in a hierarchical setting.

8. **Evaluate & assess results**. Within this activity, results (or partial results) are more closely examined by the guiding entity. While it usually is also a form of feedback, it is based on a more thorough assessment.

9. **Coordinate.** Particularly for managing the complexity of parallel knowledge maturing processes, coordination is an important guidance activities as it might create links between different strands and avoid duplication of efforts. Coordination can be personal or structural; in the latter case coordination is institutionalized through team and collaboration structures.

10. **Create opportunities.** This is typically not an activity that targets at the individual knowledge maturing process instance, but it rather refers to decisions like giving free time, institutionalizing regular meetings, introducing tools like new collaboration platforms etc. that represent enablers for effective knowledge maturing processes. It could also refer to changing cultural conditions that block opportunities as part of an organizational development process.

11. **Reward.** This refers to giving someone credit for an achievement in the past. This is more typical for hierarchical structures to signal appreciation of the work done so far. This can have a positive motivational effect for future activities, and it

12. **Monitor activities & progress.** This refers to observing ongoing developments and can serve as a prerequisite for other guidance activities.

13. **Give legitimation.** This refers to an organizational activity which is particularly important for advancing from earlier phases of knowledge maturing to later phases – phases IV and V cannot be achieved without a form of legitimation. With legitimation, the organization signals that this activity is in line with organizational goals. It usually implies also that it is easier to get additional resources.

We can observe that for guidance activities we can distinguish between activities that are based on the organizational hierarchy and those based on peer influence. Guidance activities 1-8 are clearly independent of the company hierarchy, while the activities 10-13 are embedded into the hierarchical system of the organization. Activity 9 can be both, depending on the form of coordination. Coordination can happen in a self-organizing system, but it can be also the role of management.

A second observation is that some knowledge maturing activities are closely related to a guidance activity, such as *assess, verify & rate* and *evaluate & assess results*, *respond/provide feedback* and *communicate with people, structure & organize* and *reorganise information at individual or organisational level*, or *make aware* and *keep up-to-date with organisation-related knowledge*. The main distinction between the two that in case of guidance activities, the actor takes an external perspective on the knowledge maturing process while in the case of knowledge maturing activites, the actor forms part of the knowledge maturing process.

5.4 Take-up of Results
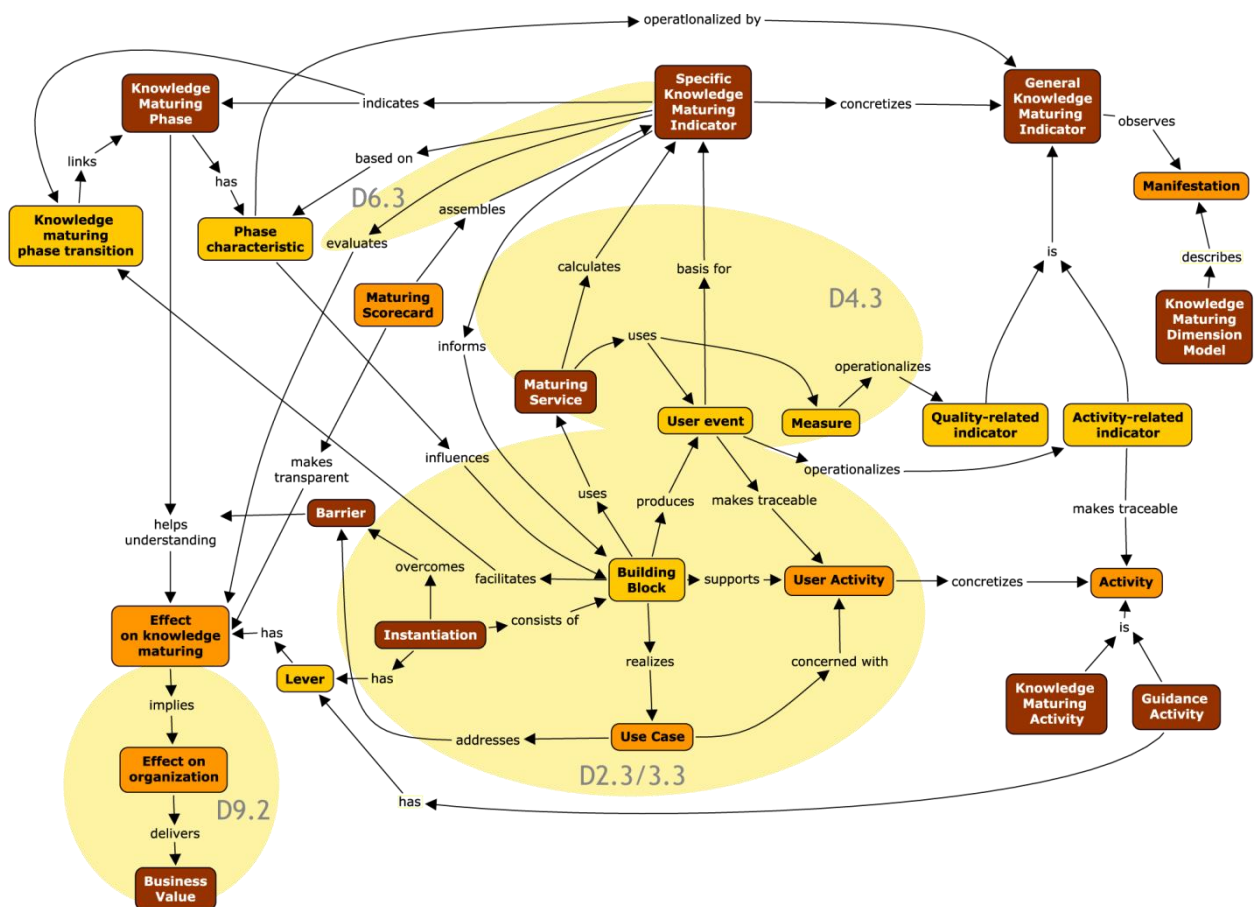
Several results of WP1 activities, i.e. results from the representative study and the in-depth study, were taken up in other work packages in the MATURE project. For example the KM indicators (see sections 5.2 and 5.4.1) and a set of hypotheses (see section 7.6) which were developed based on findings of the empirical studies fed into the evaluation of MATURE software and services (WP6).

The take-up of selected results which are deemed to have the largest impact is presented in the following sections in more detail. Section 5.4.1 provides an overview of the procedure taken in order to facilitate the mapping of KM indicators to Specific Knowledge Maturing Indicators developed in the instantiations. KM activities and guidance activities that represent further concepts of the KM model landscape were also mapped to different software functionalities. The taken approaches for these initiatives are presented in section 5.4.2 and 5.4.3. Furthermore, software development teams reflected on experienced and expected impacts of MATURE software and services at application partner sites. The adapted approach used to support this activity is presented in section 5.4.4. Finally, section 5.4.5 provides a detailed view on sociofacts as one manifestation of knowledge.

5.4.1 KM Indicators

The KM indicators as instruments supporting the assessment of knowledge with respect to its (change in) maturity by observing its representations or manifestations were taken up by WP2, WP3 and WP4 early on in the MATURE project. In year 2, the software development teams together with UIBK representatives contextualized and evaluated KM indicators as part of the design activities for further developing MATURE software and services (see D1.2, section 5.3.1). As a result of this process both, the software development teams and members of WP1 deepened their understanding of KM indicators and of ways of integrating them in the on-going software design activities.

In year three of the MATURE project, we continued the mutual activities of taking up results in both directions. As described in section 5.2, FZI and UIBK further developed, i.e. restructured and complement-

---

ed the set of KM indicators that was developed during the first two years of the project. Therefore, special attention was put on feedback from WP2, WP3 and WP4 teams who provided a technical perspective and the organisational perspective based on experiences gained at application partner sites. This feedback particularly revealed the requirement for further systematization of the indicators.

As part of the continued adoption of Knowledge Maturing Indicators, it has been important (also with respect to planning the summative evaluation) to (a) select those indicators that are suitable for measuring KM in the respective application context, and (b) distinguish between indicators that can be automatically assessed (e.g., by observing and analysing user activities), and indicators which have to be tracked manually. The latter category (tracking manually) does not mean that they are not considered, but they require additional means (e.g., questionnaires) to make use of them.

To facilitate the reflection on the usage of indicators in the instantiations at the end of year 3, the KM indicators presented in section 5.2 were mapped by WP2, WP3 and WP4 teams to specific KM indicators used in the instantiations, i.e. concrete configuration of MATURE software implemented at five different application partner sites (see D2.3/3.3). Therefore, UIBK proposed an approach for performing these mappings with respect to two dimensions; one consisting of the KM indicators and the other one consisting of the phases of the KM model v3 (see section 3.1). The former dimension is structured according to the KM indicator classes, i.e., artefacts, individual capabilities, knowledge/topic, sociofacts and impact/performance (see section 5.2.1). The latter dimension distinguishes two different types of changes in maturity of knowledge, i.e. transitions between phases and inner-phase maturing. Each indicator was mapped to one of those two types of knowledge maturing. An indicator signifying that knowledge performed a transition from one phase of the KM model to another was mapped to the target phase. Inner-phase maturing relates to an increase in maturity of knowledge without reaching a subsequent phase.

The mappings were performed using an Excel spreadsheet proposed as template by UIBK. For each mapping, the classification according to the two dimensions and an explanation including reasoning was provided. The mappings were performed in two steps. In a first step, the software development teams were asked to map the KM indicators to instantiations' indicators. The results of these mappings were analysed by UIBK and, in a second step, discussed and refined in a series of meetings (e.g., in person and via video conference calls) between software development teams and UIBK. While the actual mappings are presented and described in detail in D2.3/3.3, below we present and discuss an aggregated view on the mapping outcomes (see table 14).

Table 14 (Snapshot of the use of indicators and their proposed mapping to phases). Orange-filled cells are marked with ■; empty cells are blank.

Instantiations and class of KM Indicators	transition (target phase)									inner-phase maturing									not m.	over-all
	Ia	Ib	II	III	IV1	IV2	V1a	V2a	Vb	Ia	Ib	II	III	IV1	IV2	V1a	V2a	Vb		
Connexions Northumberland																				
Artefacts		■	■	■						■	■								■	■
Individual capabilities		■	■							■	■								■	■
Knowledge/topic																			■	■
Sociofacts																			■	■
not mapped				■															■	■
overall		■	■	■						■	■								■	
Connexions Kent and Structuralia																				
Artefacts		■	■	■	■					■	■	■	■							■
Individual capabilities			■							■	■									■
Knowledge/topic											■									■
Sociofacts			■									■								■
not mapped										■	■	■	■						■	■
overall		■	■	■	■					■	■	■	■						■	
FHNW and SAP																				
Artefacts	■	■	■	■	■	■	■	■							■					■
Individual capabilities																				
Knowledge/topic	■									■										■
Sociofacts				■	■	■	■	■			■	■								
not mapped																				
overall	■	■	■	■	■	■	■	■		■	■	■			■					
All instantiations																				
Artefacts	■	■	■	■	■	■	■	■		■	■	■	■		■				■	■
Individual capabilities	■	■								■	■	■							■	■
Knowledge/topic	■	■								■	■								■	■
Sociofacts			■	■		■					■	■							■	■
not mapped				■															■	■
overall	■	■	■	■	■	■	■	■		■	■	■			■				■	

Table 14: Snapshot of the use of indicators and their proposed mapping to phases

The presented mappings represent a snapshot of the usage of indicators and were used as an artefact for the reflection of the instantiation teams on the usage of indicators and the role of the summative evaluation in this process In a first discussion on the mapping, this has already had an impact on the indicator systematization in section 5.2 (e.g., event vs. state and the respective variants). It has also shown that instantiation teams' knowledge about the relevance and applicability of indicators requires data analysis from the summative evaluation.

As deeper insights on the instantiations' contexts and rich experiences of handling the concrete configurations of MATURE software will be gained at application partner sites during the fourth year of the project, it is planned to repeat this mapping by WP2, WP3 and WP4 teams.

At this point of time, the software developing teams see no differences with respect to KM indicator mappings between the instantiations Connexions Kent and Structuralia as well as between FHNW and SAP, hence only a single mapping was performed in both cases. As part of the summative evaluation data analysis, differences might become visible.

As each instantiation focused on a certain part of knowledge maturing and takes context at application partner site into account, only a part of the KM indicators could be mapped. A detailed view of the three mappings can be found in section 7.5 in the appendix (table 20 to table 23). In sum, 430 mappings be-

tween specific KM indicators of instantiations and conceptual KM indicators were made. Orange cells in table 14 indicate that at least one mapping was made to (1) one or more KM indicators of the respective class and indicator class and (2) the respective phase of the KM phase model.

From the analysis of the indicator mappings, it becomes obvious that the instantiations concentrate on transitions to phases of the KM model (I-V_2a are covered). Less phases (Ia-III and IV_2) are covered in case of inner phase maturing. The broadest spectrum of KM phases is covered by the instantiation FHNW and SAP. Compared to that the instantiations Connexions Kent and Structuralia as well as Connexions Northumberland cover a smaller range of phases and concentrate on phases Ib-IV1 and Ib-III, respectively. This is not surprising as already in the design studies in the first year and the demonstrators in the second year the highest need and potential for tool support was in the earlier phases. This can be traced back to mainly two reasons:

- In phases IV and V, barriers to knowledge maturing are more related to company processes, which can only partially be addressed by tools.
- Furthermore, current enterprise systems already focus on the phases IV and V, particularly ERP and BPM and support them well. As MATURE aims to establish a more bottom-up oriented perspective, this calls for solutions in the earlier phases.

However, this does not imply that the instantiations do not have an effect on later phases. As part of the summative evaluation, indirect effects (e.g., by increasing transparency) will be evaluated (as far as this is possible within the limited time frame of the summative evaluation). Another aspect that should be highlighted is that the Connexions Northumberland instantiation exhibits several mappings that could not be related to a specific phase of the KM model. In a subsequent discussion between the instantiation teams, it has been found that this shows a different approach to indicator usage; while the Connexions Northumberland team has derived indicator candidates based on the traces of user activities and quality characteristics of the shared vocabularies and analysed them with respect to how these traces suggest a particular maturity phase, the other two instantiations have started with the knowledge maturing phase model and aimed at operationalizing the phases. This had led to differences of optimistic vs. pessimistic mappings, which will be evaluated during the summative evaluation.

With respect to the second dimension, i.e. classes of KM indicators, the instantiations of Connexions Northumberland, Connexions Kent and Structuralia cover the complete range. Instantiations SAP and FHNW focus on indicators related to artefacts, knowledge/topic and sociofacts. While individual capabilities are addressed there using the people tagging component, it is not in their focus. It is used as a support for the maturing of process knowledge.

It is also interesting that the SAP/FHNW instantiations have indicators for phase Ia, while the other instantiations have assumed that this phase cannot be detected. This has been subject to discussion between the teams that clarified the understanding of activities in phase Ia. While in Connexions Kent/Northumberland, and Structuralia, there are activities in phase Ia supported, they are not specific to this phase (like searching), in case of SAP/FHNW there is support for "dumping" tasks without appropriating them so that this phase can be detected. Both perspectives will be subject to evaluation in the summative evaluation.

5.4.2 KM Activities

In conjunction with the indicator mapping described in the previous section, the building blocks described in D2.3/3.3

Building Block	KM Activities
Content Dimension	
Resource Search	find relevant digital resources
	familiarise oneself with new information

Resource Collection	reorganise information at individual or organisational level
Resource Rating	assess, verify and rate information
Resource Tagging	embed information at individual or organisational level share and release digital resources
Discussion Assistant	communicate with people create and co-develop digital resources
Awareness Provider	keep up-to-date with organisation-related knowledge
People/Semantics Dimension	
People Search	find people with particular knowledge or expertise
People Tagging	find people with particular knowledge or expertise embed information at individual or organisational level assess, verify and rate information create and co-develop digital resources
Aggregated People Profile	familiarise oneself with new information
Organizational Expertise Analysis	*(only guidance)*
Ontology Editor	reorganise information at individual or organisational level create and co-develop digital resources
Process Dimension	
Task Search	find relevant digital resources
Task Management	reflect on and refine work practices or processes
Resource Assignment	find relevant digital resources
Resource Categorization	reorganise information at individual or organisational level
Personal Metadata Publisher	share and release digital resources
Task Monitor	familiarise oneself with new information

All the Knowledge Maturing Activities are covered – except for "restrict access and protect resources" as observed before with respect to the indicators. While the Representative Study has shown that there can be a positive value for knowledge maturing, this highly depends on the context. In the case of our application contexts, this did not play a role.

5.4.3 Guidance Activities

Guidance activities are supported in the various building blocks (as described in D2.3/3.3) in two ways:

- The tool itself guides its users with respect to knowledge maturing, i.e., the tool itself executes a guidance activity *(tool-induced guidance)*.

- The tool enables its user to guide others, i.e., the tools gives the user the possibility to execute a guidance activity *(tool-enabled guidance).*

If we take the example of the instantiation at Connexions Northumberland, guidance activities are supported in the following way:

- When tagging a person, or a digital resource, the system displays tags used by others, shows tags based on the content of digital resources, and provides auto-complete functionality. This implements a *recommend, suggest, and advice* activity with the goal of fostering the emergence of a shared vocabulary while respecting the required flexibility of phase I + II of the knowledge maturing model. This is particularly effective for phase II of the semantic strand.
- Providing the possibility to users to share their knowledge about the expertise of others, enables users to recommend people to others; similar functionality is available for digital resources.
- Similarly, the embedded rating functionality for digital resources enables users to *evaluate & assess* resources.
- The ontology editor itself can enable *structuring & organizing* guidance activity, e.g., when HR representatives structure the vocabulary. Not all gardening activities, however, are guidance activities: it is a knowledge maturing activity ("reorganize") when the actor has an active role in the knowledge maturing process; if the actor is just a moderator, then it is the guidance activity.
- Within the ontology editor, gardening *recommendations* are displayed to motivate users to structure the vocabulary. This ranges from usage information (for setting priorities) up to concrete gardening actions like making a concept a narrower concept of another one or suggesting synonymy.
- Users can subscribe to topic-specific RSS feeds so that users become *aware* of development within their topic area of interest. Furthermore, the user is presented a list of individuals that are considered similar by the system, which can trigger the formation of communities.
- The aggregated person profile *provides feedback* to the individual about what the system has collected from the activities and how others have tagged the individual.
- An aggregated overview of topics that have been searched for and topics associated with persons (Organizational Expertise Analytics) allows HR representatives to *monitor activities*, i.e., to see which topics are in demand, but low on supply. These would prepare HR interventions.

A more extensive analysis of the building blocks introduced in D2.3/3.3 is found in the following table:

Building Block	Tool-induced guidance activities	Tool-enabled guidance activities
Content Dimension		
Resource Search	recommend, suggest, and advice	
Resource Collection	recommend, suggest, and advice *(using collections)*	recommend, suggest, and advice *(creating collections)*
Resource Rating		evaluate & assess results
Resource Tagging	recommend, suggest and advice *(tags)*	recommend, suggest and advice *(resource)*
Discussion Assistant		*Depends on the content of the discussion:* provide feedback respond

		irritate & challenge make aware encourage
Awareness Provider	make aware	
People/Semantics Dimension		
People Search	recommend, suggest, and advice	
People Tagging	recommend, suggest and advice *(tags)*	recommend, suggest and advice *(people)*
Aggregated People Profile	provide feedback	
Organizational Expertise Analysis		monitor activities & progress coordinate
Ontology Editor	make aware recommend, suggest and advice (gardening)	structure & organize
Process Dimension		
Task Search	recommend, suggest, and advice	
Task Management	make aware *(of recurring tasks)*	
Resource Assignment	recommend, suggest, and advice	
Resource Categorization	recommend, suggest, and advice *(tags)*	
Personal Metadata Publisher		recommend, suggest, and advice structure & organize
Task Monitor	evaluate & assess results	monitor activities & progress

From this analysis, it becomes obvious that there are guidance activities that are very bound to social interaction. In this case, tools play only a limited role in supporting this form of guidance. Within our collection of building blocks, this is mainly achieved through computer mediated discussions. Other guidance activities are much more suited for that. This is especially true for "recommend, suggest, and advice", "evaluate & assess results", "make aware", and "monitor activities & progress", which are used in multiple building blocks.

5.4.4 Levers, Effects and Better Performance

In order to reflect on the influences of using MATURE software and services, we proposed to rely on a similar approach to the one described in section 4.3 which already led to interesting results when connecting topics from the in-depth study. Together with representatives of those partners that have been involved in designing and developing MATURE software and services (WP2, WP3 and WP4), we reflected on ways to take up the approach used in the cross-case analysis that focused on observed causal relationships between levers and their expected effects at organisations investigated in the in-depth study. In the

context of MATURE software and services, the relationships on the one hand are also based on observations made during test phases at application partner sites. However, on the other hand, cause and effect relationships are also based on expectations made by WP2, WP3 and WP4 teams, i.e. anticipated influences of using MATURE software and services as levers. This is visualised in figure 22. The figure also shows a mapping to further selected concepts of the KM model landscape v3 that were deemed useful for supporting the elicitation of cause and effect relationships.
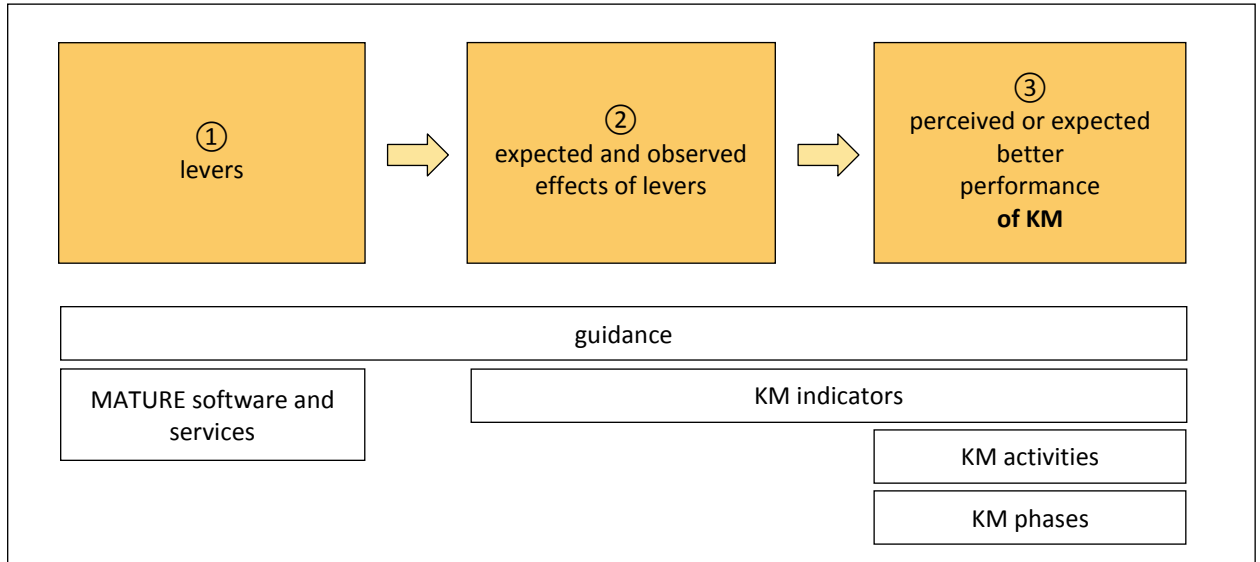
Figure 22: Observed and expected effects of MATURE software and services

The provision of MATURE software and services thus can be seen as lever ①. For describing observed and expected influences of this lever, it was deemed valuable to also reflect on them in two steps. Firstly, we concentrated on observed and expected direct effects ②, which can be seen as closely related to the usage of MATURE software and services. These direct effects are seen as reasons for a better performance of KM in a second step ③, i.e. results of using MATURE software and services. KM indicators are deemed to be related to both, direct effects and better performance of KM. As described in section 5.2, KM indicators can be used to assess the performance of KM. Additionally, as observation of performance of KM itself can be difficult, KM indicators, especially their instantiations in specific organisational and technical contexts, can also be related to direct effects ② deemed to add up to better performance of KM. Similar to describing results from the in-depth study, special attention is paid on better performance of KM activities and KM phases. This model guides organisations with respect to select MATURE software and services as levers the functionality of which supports the anticipated effects on KM, particularly KM activities and phases.

Causal relationships have been employed by partners that have been involved in designing and developing MATURE software and services (WP2 and WP3) to describe observed and expected effects of MATURE software and services on (transitions of) KM phases and support of KM activities. More information on results of these activities is provided in section 3.3 of D2.3/3.3.

5.4.5 Manifestations of Knowledge: Sociofacts

In Deliverable D2.1 we had introduced the distinction between cognifacts, sociofacts, and artefacts based on the theory of symbolic interactionism. In (Riss et al., 2011) we have then concentrated on the concept of sociofacts, which appears as that of the three, which is most difficult to grasp, and elaborated on the concept and the specific structure of sociofacts. In the following we summarize the results of this investigation and draw some conclusion with respect to knowledge maturing theory. Similarly to cognifacts the 'carriers' of sociofacts are individuals, however, in their social context.

While artefacts are directly accessible – even by machines – the access to and the description of cognifacts and sociofacts is much more complicated. We understand sociofacts in a general sense as capacities to perform specific individual and collaborative actions (Newell, 1982, Riss, 2005, Riss et al., 2009).

Contrary to an individual activity, sociofacts always include the capacity to act in a social context so that social interaction and collaboration become relevant indicators for the identification of sociofacts.

Following this concept, repairing a car's engine together in a team is the observable part of a sociofact. Working seamlessly together in the appropriate order even without explicit communication indicates that the members of the repair team share a common knowledge how to coordinate tasks during the process of repairing. Similar examples are surgery teams or project teams in a company. Sociofact-related capacities become manifest in activities as their externalization in a social context. We also identified those types of activities in our cross case analysis: e.g. **'**Fostering of shared topic related understanding within a group or between groups in the company', 'Collaborative activities to increase a group's performance within a company' or 'Written or unwritten rules which contribute to efficiency and effectiveness of communication'. (see section 4.2.2)

Sociofacts are generally accompanied by associated artefacts, which mainly result from corresponding social activity, e.g., delivering emails in a working group, we also generate artefacts. These associated artefacts allow us to analyze the topic of sociofact-related communication and the collaboration. In this respect sociofact theory is closely related to so-called Artefact-Actor-Networks (AANs) (Reinhardt et al., 2009). The analysis of changes in an AAN along a timeline may help us to gain information about knowledge maturing on a sociofact level (e.g. with regard to a higher degree of common understanding of a topic within a group, changes in internal communication structures of the group, changes in external activities regarding organizational hierarchy, changes in used vocabulary, coherence of produced artefacts).

Based on theoretical assumptions and empirical findings we can state, we can summarize the current knowledge of sociofacts as follows:

- Socifacts have a group of people as **carriers**, where the relation to the sociofact is established by communicative or collaborative actions within such groups.
- They are actualized in these **communicative or collaborative actions**.
- They include **mutual expectations**, **common understanding** and **shared values** of individuals as members of such sociofact related group. This concept includes 'unwritten'normative orientations (e.g. you should always meet the expectations of your supervisor) and regulating norms for actions (e.g. don't communicate directly with a person from a higher level in the organizational hierarchy).
- The social character of the activities related to a sociofacts in often accompanied by **topics**, a common understanding of which appears as the basis of joint action.
- They can be (externally) **represented** through their observables manifestations such as social interaction and activities of individuals within a group.
- They imply a double duality: firstly a duality of internal representation of social interaction (capacity to act) and an externally observable manifestation of this interaction (performance of action); secondly a duality between the associated topics and the formal structure of actions.

A graphical representation of relevant concepts and described relations has been represented in a sociofact-ontology (Riss et al., 2011) that is shown in Figure 23:
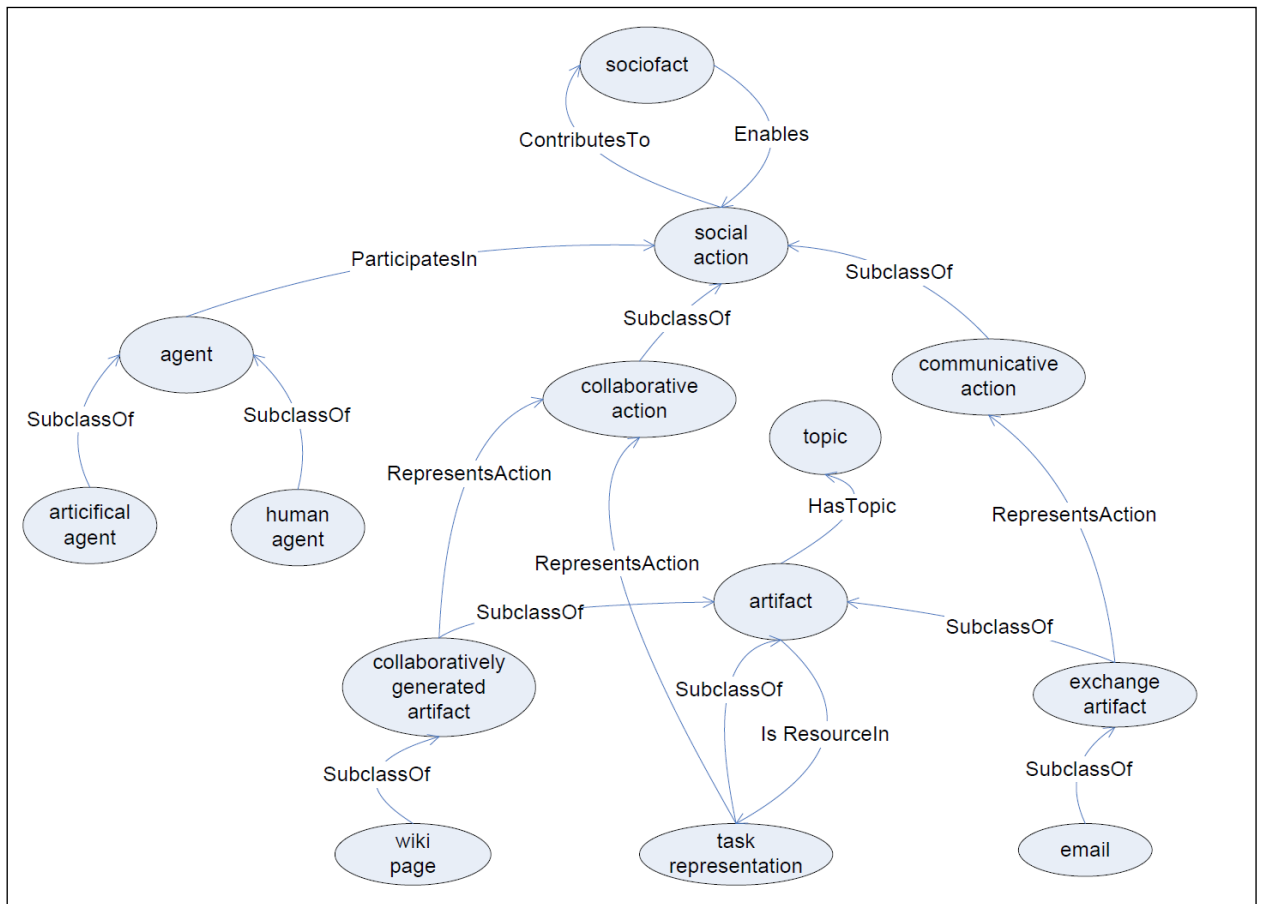
Figure 23: Graphical representation of relevant concepts and relations for a sociofact ontology (Riss et al., 2011)

Sociofacts become manifest in activities in different types and degrees of complexity. They may become manifest in only one single action between two participants (A writes an email to B). However, they can affect lots of similar activities over a certain period of time including several participants (email exchange between various participants $P_1 \dots P_n$ related to the same topic) or even may determine the way of communication of a core group using different media (email, intranet, microblogs, wiki, communicator chats...) with different participants (depending on the used media) and even changing topics over the time elapsed. Therefore a particular challenge regarding sociofacts concerns the question how to identify a common sociofacts behind various individual actions. Technical solution can help to make socifact development visible and consequently accessible to automatic processing. The instantiations that are described in Deliverable D2.3/D3.3 give various examples how the maturing of sociofacts is supported:

- **Discussion Widget**: The Discussion Widget supports the discussion of resources and topics, which becomes manifest in a reusable discussion object. After starting a discussion the variety of contributions to it indicates the formation of a sociofact since the discussion establishes at least a common understanding of individual positions and agreement.

- **Task Patterns**: Another kind of sociofact consist in the agreement of certain procedures to perform a complex task as it becomes visible in workflows and task sequences. Users are encouraged to document an agreement on such common procedure in a task pattern (Schmidt and Riss, 2009). This means that a task pattern to which several users contribute or which is used by several users represents a sociofact.

- **Ontology Building**: The ontology editor allows users to agree on relationships between tags as the starting point for an ontology. Also in this case the contribution or usage by several users indicates that a sociofact has come into being.

- **Social People Tagging**: This has to be seen as the formation of a common understanding of the competencies of individual persons. Especially the agreement of specific tags describing a person indicates the formation of a sociofact on it.

- **Knowledge Maturing Scorecard**: The Knowledge Maturing Scorecard can be regarded as a guiding tool for knowledge maturing that can be used in different ways: Guidance by increasing awareness, guidance by leadership and guidance by management. Each of these guidance concepts affects the capacities to act and the social interaction of the involved individuals and hence they represent an instrument to foster knowledge maturing on the sociofact level.

All mentioned applications support the formation of sociofacts and make them visible at the same time. Obviously these tools cannot enforce the formation of sociofacts. For instance, if one person has started a discussion or a task pattern and nobody contributes to it, it will remain an individual artifact that might represent a cognifact at best. Only the social activity makes them sociofacts. To foster contribution people can be invited to join in the formation of such artifact as an active sociofact formation support.

5.5 Summary

The Knowledge Maturing Model Landscape co-evolved with the design process of the concrete tools that were developed to support knowledge maturing. A rich and productive dialogue between the conceptual and the technical strands of activities has taken place, and there has been take-up of the empirical results in the technical developments. The following figure shows how the Knowledge Maturing Landscape relates to the various activities of the project:

- WP2 and WP3 are concerned with concrete instantiations for a specific target context (see D2.2/3.3). They represent configurations of building blocks which are based on use cases and support user activities. These are concretizations of knowledge maturing activities and guidance activities.

- WP4 and its maturing services (see D4.3) use the user events that are produced within the instantiations and calculate from those specific knowledge maturing indicators (also called transition indicators). These indicators are in turn used by the instantiations.

- WP6 uses the specific knowledge maturing indicators to evaluate the instantiations (see D6.3). These can be automatically or manually tracked.

- WP9 finally uses the levers & effects and connects them to business values (see D9.2).

Figure 24: Knowledge Maturing Model Landscape and other Work Packages

5.6 Recommendations

Based on the activities in WP1, i.e. methods developed and results gained by the empirical studies, we provide recommendations for organisations willing to improve their performance of knowledge maturing. In coming up with these recommendations, we wanted to be as explicit and supportive as possible and thus have only included recommendations for which we have created artefacts to support implementation.

1. The knowledge maturing model landscape can be used as a general lens on focusing knowledge-intensive organisational processes and practices. Organisations can use the model landscape in order to model their organisational and technical infrastructure from the perspective of knowledge maturing as-is or as-planned and to analyse what resources, roles, tools, channels or objectives they have to support individual phases, transitions between phases or knowledge maturing activities.

2. The set of knowledge maturing indicators, the levers and effects model and the MATURE Scorecard (see D9.2) can be used in order to generally align measures and initiatives which aim at improving the performance of knowledge maturing on organisational goals.

3. Knowledge maturing indicators can be used for helping to make knowledge maturing observable and therefore to support knowledge maturing-aware tools as well as instruments for monitoring knowledge maturing.

4. Although we provided a list of indicators that were generally deemed to be suitable, organisations should be prepared to adapt and possibly extend these indicators in order to reflect their idiosyncratic positions and intentions. This process can be supported by our deliberations on building

and structuring knowledge maturing indicators that guide in specifying new knowledge maturing indicators.

5. Besides employing official (top-down) measures, it seems also helpful to foster guidance-oriented roles, activities and artefacts that are deemed to positively influence knowledge maturing.

6. For eliciting the requirements of knowledge workers, organisations can employ personas which describe how people perform knowledge work, for example how they interact with colleagues, answer to requests, structure their workplace, search, access or store information. Wherever possible, these personas should be based on immediate experiences, e.g., gained by observations.

7. Specific knowledge routines (on a short-term basis) and knowledge processes (on a long-term basis) were identified which contribute to the development of knowledge and also support its documentation. They can be used as building blocks or examples when designing knowledge-intensive processes and practices.

8. Organisations can focus their support on knowledge maturing activities that are deemed to be important and, compared to others, are less supported or less successfully performed.

9. Reasons for better performance of knowledge maturing are diverse and complex. We suggest considering several levels of cause and effect relationships, i.e. levers, effects on general handling of knowledge, effects on knowledge maturing and finally effects on business goals.

10. We found different types of barriers for knowledge maturing. It is suggested to increase awareness for existing barriers hampering knowledge maturing and to employ measures to overcome them. We have provided a general analysis model, and collected an exemplary list that could inform such initiatives.

11. We suggest concentrating on how people perform knowledge work and how they appropriate generic tools and systems, such as office systems or collaboration systems. According to our results, these are the predominant tools supporting knowledge maturing which are widely used across professions, organisational units, organisations and even industries. Given the complexity of knowledge work, this seems to be more promising than crafting specialized solutions that prescribe how work routines should look like in specific cases with limited range of potential users.

In addition to these specific recommendations that are all supported by artefacts created in the MATURE project based on the series of empirical studies, more general recommendations can also be given, e.g., for increasing chances for successful *adoption* of MATURE concepts and software by organisations, *acceptance* by individual employees as well as *assimilation* into organisational processes and practices based on corresponding theories, such as technology-acceptance model (Davis, 1989), UTAUT (Venkatesh et al., 2003) diffusion of innovations (Rogers, 1995) or technology-organization-environment model (Tornatzky and Fleischer, 1990).

6 Conclusion

This deliverable presents the evidence we collected in the in-depth study which supports the results we gained from the studies that were conducted in the previous two years of the MATURE project. The deliverable lays out the design of the empirical study, the methods used, the results we gained and the interpretation that we performed on the basis of the results. By conducting the in-depth study, we were able to take a multi-stakeholder perspective on the concept of knowledge maturing which enabled us to extend our understanding of knowledge maturing.

Specifically, we found the same software used for knowledge maturing in organisations and encountered the same barriers. We again made the experience that the idea of knowledge maturing is new to people, yet meets with substantial interest, that people are not fully aware of maturing of knowledge in their environment (i.e. their organisation or community) and that it is challenging to transport the main ideas in a short timeframe, but that, after being explained, people can straightforwardly reflect on knowledge maturing and relate it to phenomena they have experienced in their work environments.

We were able to gain a much clearer picture about reasons why knowledge maturing is performed better in some settings. Furthermore, we collected a number of measures that have proven successful when being employed in a certain constellation. Out of those, we were able to elicit levers and clearly describe the effects those levers would create with respect to general handling of knowledge, their effects on knowledge maturing as well as on general business goals. This causal perspective and aspects of guidance enriched our knowledge maturing model landscape.

Another source for developing a deeper understanding was again the application of conceptual results in the technical strand of the project. In year 3, particularly the knowledge maturing indicators and guidance activities were in the focus of cross-WP integration activities. The implementation of knowledge maturing indicators has opened a clearer perspective on the concretisation of the General Knowledge Maturing Indicators that have been validated through the representative study in year 2. But it has also shown the need for a better systematisation with respect to variants and differences between quality-related and activity-related indicators which has also been accomplished and is presented in this deliverable. As for guidance, a lot of development efforts focused on implementing tool-induced guidance (e.g., recommendations given by MATURE software and services) and tool-enabled guidance (supporting users to perform guidance, e.g., for gardening). Here, guidance activities have helped to better design tool functionality and user interface.

Figure 25 provides a summative overview of activities performed in year three of the project and depicts important concepts developed or refined during this year. Furthermore, it presents also activities and concepts of the project's first and second year and sketches main relationships between them.
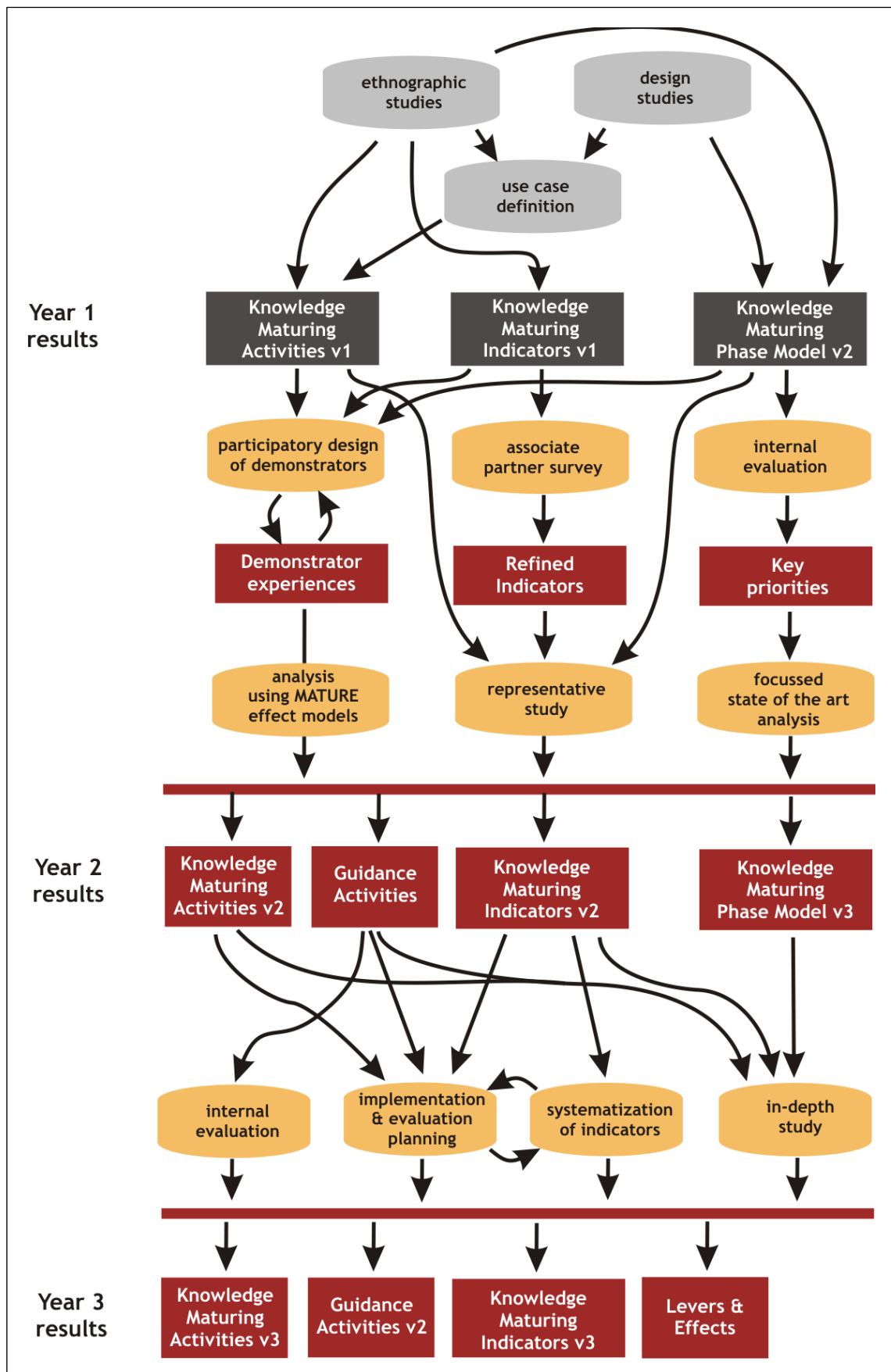
Figure 25: Summative overview of year 3 activities and results

This deliverable presents the final results of WP1 activities. The Knowledge Maturing Model landscape is considered final as an instrument to influence activities in year 4 of the MATURE project. Next to continuing to submit our findings to the discourse in the scientific community, we intend to use this as the basis from where we develop our understanding of knowledge maturing further. For example, further research seems promising on how measures for improving the performance of KM can be selected. Also, it is interesting to clarify roles and responsibilities in the dyad between guided entity and guiding entity. In our understanding, guidance generally can be performed by any user of MATURE software and services and thus one user might act as both, guide and guided person in different contexts. In addition, it would be interesting to analyse the similarities and differences concerning needs, practices and outcomes of guidance activities performed by different types of users distinguished, e.g., according to different levels of authority, e.g., peers, seniors, experts, supervisors or project managers. Another aspect that deserves further consideration is how to deal with knowledge maturing in general or guidance in particular towards a wrong goal/direction. This could be both, a mass phenomenon (group-think), or the result of decisions by people or units who enforce developments with positional authority. It would be interesting to develop indicators for such developments in order to encourage collective reflection, or to promote activities that balance collective alignment with critical deviations. As part of the development of maturing services and related experiments (e.g., the tag mortality service described in D4.3), it turned out that some phenomena of knowledge development in companies can only partly be explained by the knowledge maturing model. Further research might investigate the aspect of relevance of knowledge which can change due to environmental conditions. This can be observed for example for semantic strands of knowledge maturing, e.g., by non-usage of tags and concepts (see D4.3). Consequently, it seems to be promising to investigate more closely the relationship between relevance and knowledge maturing.

Furthermore, MATURE results have already been taken up in other TEL projects such as ARISTOTELE and MIRROR. These will develop MATURE concepts further, specifically relating to services for reflecting knowledge work practices and processes (MIRROR), supporting team building with services supporting finding people with specific knowledge or expertise as well as assessing solidity of knowledge with services supporting assessing and rating knowledge (ARISTOTELE). These are the three knowledge maturing activities that have been identified as having the most potential when contrasting their perceived importance with perceived support and success of performance in the representative study (see D1.2).

After three years, the knowledge maturing model landscape has reached stability. All elements of the landscape are semantically related to each other and together provide a consistent picture. We were able to empirically validate many of these elements and provide rich examples for each of them.

7 Appendices

7.1 General Interview Guideline

Knowledge Maturing

MATURE Project

MATURE is an interdisciplinary project aimed at: understanding knowledge maturing activities in a social context within and through companies; and providing supporting tools that help to overcome barriers in maturing processes.
Knowledge can be represented in many ways, including for example:

- embedded in a <u>digital resource</u>, such as a word file containing a project report or procedure;
- held by a <u>person</u>, such as an individual organisational member with an experience of a certain topic;
- embedded in work <u>processes</u>, such as an established process, practice or routine shared by organisational members.

We define knowledge maturing as <u>goal-oriented learning on a collective level</u>, where:

- <u>goal-oriented</u> describes knowledge maturing as a process with a direction (goals can be individual, team and organisational, they can be vague, concrete or adaptable changing over time);
- <u>collective level</u> can refer to a team, an organisation, a community etc., knowledge maturing is not necessarily the result of individual activities, but the result of an interconnected series of activities.

Knowledge Maturing Phase Model

Ia expressing ideas	Ib appropriating ideas	II distributing in communities	III formalizing	IV_1 ad-hoc training / IV_2 piloting	V_1a formal training / V_2a institutionalizing	Vb standardizing
New ideas are developed by individuals either in highly informal discussions or by browsing the knowledge spaces available inside the organisation and beyond, such as on the Internet.	New ideas or results found in the expressing ideas phase that have been enriched, refined or otherwise contextualised with respect to their use are now appropriated by the individual.	Driven by social motives and the benefits that people typically attribute to sharing knowledge, ideas are shared, discussed, combined, and further developed within teams or communities.	In this phase, structured documents are created in which knowledge is de-subjectified and context is made explicit to ease transfer to collectives other than the originating community.	IV_1: Improve comprehensibility in order to ease its consumption or re-use. Learning objects are arranged to cover a broader subject area. IV_2: Deliberately collecting experiences with a test case before a larger roll-out of, e.g., a product or service.	V_1a: Courses make subject area teachable to novices. A curriculum integrates learning content into a sequence using didactical concepts. V_2a: Documents are implemented in the form of processes, business rules and/or SOPs. Products or services are launched.	Covers forms of standardisation or certification confirming that participants of formal trainings achieved a certain degree of proficiency or allow organisations to prove compliance with a set of rules.

Figure 26: General interview guideline (page one)

Topics

1 **If you compare different units in your organisation:**
   Which one performs(ed) best in your opinion with respect to knowledge maturing?
   Why do you think that this unit performs(ed) knowledge maturing better than others?

   a) To whom do you compare the unit to?
   b) Which criteria would you use to confirm this?
   c) What is the relation to KPIs, if any?

2 **How is knowledge maturing supported?**

   a) What measures ○ community,
                       ○ organizational,
                       ○ software
      are employed   ○ informally,
                       ○ formally in projects or initiatives (e.g., quality management,
                         innovation management, human resource development),
                       ○ formally with knowledge management in general or knowledge maturing
                         in particular in mind?
   b) How are these measures aligned with other initiatives?

3 **What barriers have been overcome?**

   a) What barriers do you think affect ○ all or several phases
                                          ○ transitions between phases
   b) Can barriers be further specified   ○ (inter-) personal level
                                          ○ work context
                                          ○ technological barriers
                                          ○ caused by organisational culture
                                          ○ personal interdependencies (personality, traits, etc.)
                                          ○ organisational structure

4 **How is software used for knowledge maturing?**

   a) Which software is used ○ within all or several phases
                             ○ for transitions between phases
                             ○ to support knowledge maturing activities
                             ○ (in)formally
   b) What are the differences between units in appropriating software for specific knowledge
      maturing purposes, i.e. how is software actually used?

5 **What plans are there or what could be done to further enhance knowledge maturing?**

   a) Timeframe 1-5 years.
   b) What goals and strategy are pursued?
   c) What measures are employed ○ community
                                 ○ organizational
                                 ○ software
   d) How are these measures assessed?

Figure 27: General interview guideline (page two)

7.2 Case Reports

7.2.1 FZI1 – Case Study Report

7.2.1.1 Introduction

From 22nd of April until 4th of May, FZI represented by interviewer Athanasios Mazarakis visited a construction and multi service company in South Germany. The company is distributed around the globe and serves worldwide and is well known. Criteria for selecting this company are that it is a large company (criteria used from (OECD and EUROSTAT, 2005)), that employees and management are interested in knowledge management and FZI had already established contact with this company in an on-going project about the usefulness of Web 2.0 tools for some departments.

The method for data collection was twofold. Interviews in dedicated rooms were conducted and the working places of employees were visited. The mean duration of each interview was ca. 50 minutes with 25 minutes minimum and almost two hours maximum. Data collection was done with a flexible and open-ended inquiry, at which the interviewer adopted a stance that was curious to discuss spontaneously emerging topics in more detail. The main focus of the interviews was to identify existing barriers and to examine the possibilities for the introduction of Web 2.0 tools in the organisation.

In total fifteen individuals were interviewed. All of them have experience with different departments and/or different projects like construction or knowledge management. Also, each individual has been working for at least two years in the company and also some of them have more than eight years of experience (up to 44 years) in the construction sector. The professions of the individuals are mixed: construction engineering, knowledge management and communication sciences are some of the professions.

The results indicate that we need to analyse the findings according to two groups: The first group consist of six persons that we call "junior" and the other group consists of nine individuals that we call "senior". The junior employees are between 20 and 40 years old and the senior employees are 40 and older. Also, two persons in the senior group are already on retirement and almost all seniors are/were department managers. The two groups differed in some answers, so that it is sensible to analyse these two groups separately.

All individuals share together a high involvement in different meetings. These meetings are necessary to secure technical and other processes for the progress of projects. Most of the other work is done with the help of experienced colleagues, similar projects or data on the intranet.

The junior employees mainly search for different project inquiries. Also they create presentations and studies for different projects. 2/3 of the juniors prefer Google and Intranet as the main source for their searches. The Intranet consists of different customised databases. Usually the junior interviewees are working together with around ten persons which are from the same project. Contacts and communication to already known individuals is preferred.

The senior interviewees are more involved in personnel management. Also consulting and project controlling are main aspects of their everyday work. The main sources to get the necessary information to do this work are personal contacts and contacts to universities. The use of databases and other technical tools is only at a low level exercised. The personal contacts are not only subject to a particular project but are across the company and consist of around 100 individuals.

7.2.1.2 Topic 1: Why do people think that they perform KM better than others they compare themselves to?

In general the interviewees state that knowledge maturation is performed quite well in the organisation. The interviewees think that phases III to Vb are supported well. This is argued by comparison with competitors.

Also there is no perceived lack of resources. This allows the employees to exercise knowledge maturation without limitations except of the own interest of the individuals. There are plenty of resources and man-

power available so that doing the work two times is nothing bad but is being perceived as "entertaining and double checking".

7.2.1.3 Topic 2: How is KM supported?

The organisation uses Intranet, personal contacts, phone calls and emails for their knowledge intensive work. The information is usually stored at **shared network storages,** filled primarily with PDF files**.** Unfortunately only a few departments have access to files of other departments, because **every department has its own** network space. So usually the data stays at the same department although the other departments would benefit from the information as well - they even need it for their work.

Beside this fact, also a lot of information and data is "stored" on printed pages. These pages are almost the property of an individual employee. Others don´t have access to them, as they even don´t know that they exist. Also project databases and Intranet are deemed to support the knowledge maturation.

7.2.1.4 Topic 3: What barriers have been overcome?

We start by giving a brief overview of actual barriers, which still hit the organization. The junior interviewees had difficulties to identify barriers for knowledge maturing, which could resolve just from the fact of not belonging for a long time to the organisation.

Organisational culture is an issue for this company. Although barriers like organisational structure, e.g. far away located departments, are mentioned, more often the "leading without hierarchy"-phenomenon is a serious challenge. This phenomenon is characterised by different contact persons and that the individual cannot really exercise power to other persons because of his missing position in the hierarchy. However if the person is e.g. in charge of a project, then adherence to his or her orders is seen as pure coincidence, without real commitment.

But also worth mentioning is that the junior employees experience at the same time too much hierarchy. This barriers means that for some decisions it takes too long to be taken. At the same time, the communication between different management levels is not sufficient. This is in conjunction with the barrier lack of time, consistent with the finding of the representative study. Surprisingly, this barrier is not in conjunction with the barrier lack of resources. In this company almost no monetary nor time or personnel resource barriers are present.

Missing transparency at all phases of knowledge maturation is also a big barrier. This makes it impossible to rate and assess the quality and timeliness of the information and therefore the junior employees don't trust the information. This barrier is linked together with a lack of usability, in particular with the customised software. But this barrier is not only associated with customised software, but also affects off-the-shelf software like Microsoft Outlook. The company-wide address book gets no regular update and therefore the junior interviewees are unsure if the data is up to date or accurate. This affects again all knowledge maturing phases.

There have been also additional barriers: holding information back because of fear of conflict with other employees; no common language; decisions are taken confidential, but the information that lead to the decision are not; too many departments with overlapping responsibilities; no overview about the work of the colleagues; don't want to share; no time and interest. These barriers have been mentioned not so frequently (1-3 times in sum).

For the senior interviewees it was quite easy to mention actual barriers. The most prominent barrier was personal interdependencies, like personality traits or the background of the profession and skills. Interestingly, this barrier was mentioned together with fear of losing power and lack of time.

The senior employees rate the barrier lack of time equivalent to the barrier no interest. Also fear of embarrassment is an issue, although at a lower level. Also the organisational culture aspect is important, like already stated by the junior interviewees.

Other important barriers for the senior interviewees are lack of usability, organisational structure with far away located departments and finally hierarchy (organisational culture) in conjunction with "respect for

the board of directors". In contrary to the junior interviewees, resources are a barrier, especially for the phases Ia-II.

After this overview of current barriers, we now focus at barriers that have been overcome. This has been in particular only one barrier, lack of time. This barrier was in former years a real problem in this organisation. By hiring more staff this has been overcome.

7.2.1.5 Topic 4: How is software used for knowledge maturing?

In general the company uses software like MS Office for the phases Ia – II. The employees also have access to different databases with engineering contents. Also additional customised software is being used for the later phases (III – Vb) like project databases. As already said, the company is very large and operates worldwide, therefore a high level of standardised software is desired, although not really successfully achieved.

At a less extent the organisation uses the internet for phases Ia (expressing ideas) and Ib (appropriating ideas). Also project related forums and blogs exist, but are not used so much by the employees because of lack of time. Of course, shared network storage is also in use.

7.2.1.6 Topic 5: What plans are there or what could generally be done to further enhance KM?

For the junior interviewees there exists some kind of dilemma: On the one hand they experience an information overload with unnecessary information, on the other hand they miss important information. Therefore a Wiki will be introduced to focus on important project data. Also the junior employees anticipate with the wiki system less spam and to get faster the necessary information for their work.

The plans for enhancing knowledge maturing are different. More databases are under consideration as well as an enhanced workflow process. The rating of documents by employees is also something that is thought to be useful, although some tests in the near past have not been successful. Different services for the intranet and internet should help, e.g. Web 2.0 tools or better search engines.

The senior interviewees are neutral towards the introduction of Web 2.0 tools for knowledge maturing. They consider usability aspects as very important for the acceptance of such tools. Also the information needs to be verified by an expert so that the junior employees can trust the information.

Finally the company thinks about enriching the already entered information in databases with more qualitative information, like pictures from construction sites. These pictures should be verified as well by experts, so that the employees have transparency about the quality. Also feedback mechanisms to increase participation to provide such information are under consideration, which means to show how many information the other employees have provided and/or information of others of the usefulness of the data.

7.2.1.7 Summary

In this case study we interviewed fifteen individuals of a large construction and multi-service company in South Germany. The findings show the employees perceive the company as somehow successful in knowledge maturing, particularly in the later phases and that it knows where it needs improvement. Lack of time is a barrier that has been partly resolved and only exists at a low level, although it is still perceived as important.

The missing support for early Phases Ia to II are something, that all interviewees mentioned. Surprisingly, it does not really affect knowledge maturing in this company. The later phases are supported very well.

For the junior interviewees main barriers are lack of information and communication that leads to lack of trust. For the senior interviewees personal interdependencies were the most important barrier for knowledge maturing.

The current organisational culture does not really fit for the introduction of Web 2.0 tools for knowledge maturing. Most work processes are not clear for the early phases of the knowledge maturing model. This is beneficial for the employees as it is therefore difficult to find a responsible person for mistakes because of the missing processes and therefore with the missing standardised control.

Also personal contacts are favoured. By this only a small group of individuals can profit from knowledge exchange – knowledge maturation is handicapped. This is accompanied by the fear of losing power. Further steps should focus on transforming the organisational culture to more open discussions and transparency. This process has been acknowledged by some interviewees and they consider this a process, taking some years.

7.2.2 FZI2 – Case Study Report

7.2.2.1 Introduction

At 26th of July, 21st and 28st of September, FZI represented by interviewer Athanasios Mazarakis visited a large car manufacturing company in South Germany. The company serves worldwide and is well known. Criteria for selecting this company are that it is a large company (criteria used from (OECD and EUROSTAT, 2005)) and prior contact had been established with this company. The company performs very well in the context of knowledge maturation and it is therefore useful for MATURE to see, how former barriers have been overcome. Also the knowledge management department launched recently some innovative tools and wanted to assess with the in-depth-study how knowledge maturation has developed since the representative study.

The method for data collection was interviews in a separated room and by visiting the manufacturing site. The mean duration of each interview was ca. 100 minutes with 75 minutes minimum and almost two hours maximum. Data collection was approached from a position of a flexible and open-ended inquiry, at which the interviewer adopted a stance that was curious.

In total five individuals were interviewed. All of them have experience with different departments (e.g., construction and knowledge management) and/or different projects like car body pressing or knowledge management. Also, each individual has been working for at least two years in the company and also some of them have more than six years of experience (up to 22 years) in the car manufacturing sector. The professions of the individuals are mixed: software engineering, knowledge management and design engineering are some of the professions.

All individuals share together a high involvement in different meetings. These meetings are necessary to secure technical and other processes for the progress of projects. Most of the other work is done with the help of experienced colleagues, similar projects or data on the intranet. Usually the interviewees work together with 10 persons but in project meetings this number can rise up to 50 persons. These persons are typically from management level or software engineers.

7.2.2.2 Topic 1: Why do people think that they perform KM better than others they compare themselves to?

In general the interviewees state that knowledge maturation is performed very well in the organisation. All interviewees think that phase Vb (standardisation) is supported best, although other phases don´t get supported significantly less.

The interviewees mention that operational departments like vehicle construction performs better because the "results" (cars, technologies, etc.) are used productively. On the other hand departments like research and development miss a strategy and have no commitment from the management. The operational departments have a clear advantage, because sustainability is important for the company, which can be seen by an actively undertaken quality management and therefore have more and better documented processes in the construction departments.

Also as an important factor the interviewees mention a constructive discussion culture. If the employees have the possibility to participate in different discussions, then this is seen as positive indicator for knowledge maturation. This constructive discussion culture is seen as even more important and necessary in multidisciplinary work settings.

Also knowledge maturation is perceived better in the construction departments, because these departments are better connected with each other. Also with these interconnections they can better focus on their own development, which are highly dependent on suppliers for the construction process of the cars.

This has been put by an interviewee with the following words: "We are really good at knowledge maturation because we have the processes under control. We invent the necessary tools and technologies ourselves. Other departments, but especially other companies rely too much on their suppliers. And if they do this, they don't have the knowledge, but the supplier has it".

Finally aspects like in-house exhibitions and the use of latest technology, e.g. looking at computer constructions via 3D technology, support the knowledge maturation process. Especially the phases Ia, Ib, II, III and Vb are best, with an emphasis on Vb because of many iterations in this phase.

7.2.2.3   Topic 2: How is KM supported?

The organisation uses a broad collection of different technologies and software. For example a research and development forum and a business innovation forum are key concepts to enhance knowledge maturation. These two forums allow a discussion of the requirements management for new products and therefore enhance the phases II (distribution in communities), III (formalisation) and Vb (standardisation).

The forums do **not enhance knowledge maturation for Phase Ia (expressing ideas)**, because there is **no perception of a monetary value of new ideas in these forums**, although the employees can get a monetary incentive. So in this case these company-wide open forums do not help for expressing ideas. The **forums** have a quite **high number of participants but** because of the **lack of experts participating in the forums**, the acceptance is not high. For example asking specific expert questions leads to requests about clarification of the issue, what makes the discussion not perceived as fruitful. For a better acceptance, more experts would be needed.

But besides this issue, the organisation has introduced public profiles visible on the Intranet and has therefore **established yellow pages without** the risks of using more popular networks like Facebook, where there is **doubt** about what happens **to the data** and how well secured it is. The interviewees mentioned that the fact that the profiles are only visible on the Intranet strengthens the trust in the yellow pages and is deemed to be a major factor for a high participation.

In this case study also **task groups** are used to facilitate knowledge maturing. Although they are not optional, they allow **clustering knowledge, to shape ideas and to give quick feedback** to those. **This helps to strengthen the phases II (distribution in communities) and IV_2 (pilot phase). Also in-house-exhibitions support knowledge maturation, fostering transparency and openness.**

7.2.2.4   Topic 3: What barriers have been overcome?

We start by giving a brief overview of actual barriers, which still hit the organization. Because of the size of the organization, so called "political motivations" are important in the decision process. In this case it means that it is very important to discuss and decide about what an individual in the organization can decide. If someone has not the right to make a decision, any progress is in danger. The fear to conduct a decision is a big barrier in this company, because a decision always has further consequences.

Another big issue is the lack of resources, which often means missing money and persons that work on a project. It is always a never ending struggle with the management to show that some resources are necessary for the project, but the management always needs to know if the money will "return at the end of the year".

Technological barriers are in this organisation always visible and are due to the size of the company. So the IT department applies very strict rules and guidelines about hardware and software usage. This is due to the fact that the company works in all parts of the world and they want to have some standard. Because of this, young and recently hired employees experience difficulties in this company, as they have to use specially programmed software and may not use any open source software.

A combination of a technological and monetary barrier is for the company the existence of thousands of different government rules of different countries for the same part of car. This is because the company sells worldwide. For example the exhaust pipe of car in China has to be 3 cm away from the bottom at a maximum. In India the opposite rule exists: the exhaust pipe has to be at least 3cm away from the bottom. Although this sounds trivial, such rules are a real barrier for this company and can cost a lot of money if not observed carefully at the beginning of the construction process.

Also organisational culture is an issue for this company. Although barriers like organisational structure, e.g. far away located departments, are mentioned, more often the "leading without hierarchy"-phenomenon is a serious challenge. This phenomenon is characterised by different contact persons and that the individual cannot really exercise power to other persons because of his missing position in the hierarchy. However if the person is e.g. in charge of a project, then execution of his orders can be just random.

Another example of organisational and country culture is that information needs to be up to date in every country, but the individuals in India read everything because they consider that written information is important. Instead the employees in Germany don't read everything, because they consider the information partly obsolete.

Finally, consistent with the findings of the representative study, lack of time is a barrier, that is always mentioned, most of the time in conjunction with the lack of resources. This barrier is also "supported" by the company through the multidisciplinary nature of the individuals working at the organisation. This can be observed, when different professions come together, but only the experience from the own profession is followed instead of being open to other ideas. By this, only familiar ideas are supported.

After this overview of current barriers, we now focus at barriers that have been overcome. The organisational culture was in transformed in a way that open discussions are allowed and supported by various ways. The already mentioned business innovation forum and the research and development forum with possible thousands of participants are key factors for knowledge maturation.

In particular the distribution in communities (Phase II) is performed very well, as the new ideas are discussed and therefore also supported in forums. These forums have also replaced traditional suggestion systems in the company. Also more responsibility has been given to the individuals and teams, something that was some years ago not possible.

Although the interviewees rate the phases Ia and Ib as not well supported, at least the financial support has been improved, although it is still not perceived as perfect. This support is achieved by discussions with different departments about possible budget shifting. This was some years ago not possible, but is now a routine action due to the more open organisational culture. Also transparency and more discussions are the results of this new culture, as well as less hierarchical structures. Finally, a total quality management has been established to avoid new barriers.

7.2.2.5 *Topic 4: How is software used for knowledge maturing?*

In general the company uses software like MS Office (Ia – II), Lotus Notes, Eclipse, MS-Project but also has access to different databases with engineering contents. Also additional customised software is being used.

Besides the already mentioned forums, the interviews stated that Lotus Notes is helpful for phase II (distribution in communities). For the phases III (formalisation) and Vb (standardisation) the company uses custom software ("Doors", "ZAM" and "Docmaster"). Of course, shared network storage is also in use. As already said, the company is very large and operates worldwide, therefore a high level of standardised software is desired.

Also for the phases III – Vb the construction department uses custom software, that keeps track of all changes in the car body, that also allows to rate different variations in the construction process. Finally, some kind of "bug-tracking-system for construction" called "ZEUS" is in use to support the pilot phase (IV2).

At a less extent the organisation uses intranet for phase Vb (standardisation). Also wikis and other department- and project related forums exist, but are not used so much by the employees because of lack of time. A KBE (Knowledge Based Engineering) with different CAD templates concludes the software for knowledge maturing.

7.2.2.6 Topic 5: What plans are there or what could generally be done to further enhance KM?

The plans for enhancing knowledge maturing are different. More databases are under consideration as well as an enhanced workflow process. The rating of documents by employees is also something that is thought to be useful, although some tests in the near past have not been successful and is therefore under responsibility of each department manager. Different services for the intranet (e.g. forums) and internet (e.g. search engines) should help to achieve a higher quality of the documented processes.

Also more work groups are to be established and standardised PowerPoint presentations that mature through adding and removing of slides from other departments. The KBE tool is currently under further development and will be improved.

The standardisation process is also under consideration, because right now only 50% of the documents and information can be used as it is and the other 50% need an improvement. The KBE tool is definitely something, which the company will improve, as on the one hand the construction departments are vital key points for the car company and on the other hand the KBE already managed to save around 10% of resources that the prior process needed.

7.2.2.7 Summary

In this case study we interviewed five individuals of a large car manufacturing company in South Germany. The findings show that the company perceives itself a successful in knowledge maturing and that it knows where it needs improvement. Organisational culture, lack of time and lack of resources are barriers that have been partly resolved but also still exist and are perceived as still important.

The missing support for Phase Ia (expressing ideas) is something that all interviewees mentioned. Surprisingly, it does not really affect knowledge maturing in this company. The phase II (distribution in communities) and Vb (standardisation) are supported very well. In particular, phase Vb is not static but is subject to many iterations and modifications. Knowledge is not static but something fast paced with almost every day changes to construction processes.

Also, some work processes has been changed only slowly and over a longer time period. Open discussions as part of the organizational culture are something that was "twenty years ago not imaginable". Although the interviewees can't determine the exact start of this transformation, still they all said that is it a long term process.

7.2.3 TUG – Case Study Report

7.2.3.1 Introduction

This case report is based on a meeting with the company's manager held in advance of the case study and on one interview through which general information about topics 1 to 5 were been gathered. In the course of the meeting with the manager several aspects of KM-related barriers and initiations were discussed to get a first impression and overview as well as to set up the timeframe for conducting the study. Data were collected by observing and making field notes of work processes at the company and by conducting the interview that was audio recorded, transcribed and finally, analyzed by means of a qualitative content analysis. The interviewee is 42 years old and an experienced employee who has been working for the company for around 10 years in the field of customer-support.

The case described by this report is a small company that has around 20 employees and belongs to the sector of computer programming and consultancy (NACE-Code 62 (see EUROSTAT, 2008)). The two main and interacting areas are the development of software-products for different branches, such as horticultural production and trade, reservation systems and event management, and the customer-support. The company consists of a home office situated in Graz and two branch offices for customer-support abroad, one in Germany and one in the Netherlands.

All in all, the case will summarize the results gathered from the meeting and interviews and will analyze knowledge actions involved in two kinds of maturing processes that have been identified in the company.

KM takes place both in the area of *software development* and *customer-support*, while this case report focuses on collaborative learning processes in the latter one.

7.2.3.2 Topic 1: Why do people think that they perform KM better than others they compare themselves to?

Topic 1 is discussed by giving an overview of KM in the two areas of customer-support and software development. On the whole, organizational considerations behind initiations to improve work practices are in line with ideas and notions of the MATURE-model. The management strives after an organizational culture conducive to formal as well as informal communication, as e.g. becomes evident from the implementation of daily SCRUM-meetings. Due to a lack of hierarchical structures much informal communication can take place, supporting the distribution of ideas across the employees. The focus is on a physical layout supporting face-to-face communication and on software-based solutions for the improvement of formalization processes, i.e. externalizing/visualizing and discussing knowledge units. For instance, the implementation of an internal wiki and widget-based collaboration services should foster the documentation of problem solving and the subsequent didactical preparation of the artefact that can be disseminated to customers as learning modules in order to make customer-support more efficient.

As previously mentioned, there is a good correspondence between the sequence of learning-processes in the company and the MATURE-model. The second and third rows of figure 28 show activities and artefacts associated with the five phases of the maturing process in the areas of software-development and customer-support, respectively. While maturing in the area of software development aims at the development and continuous improvement of products, maturing in customer support consists in the development of knowledge of how to convey information about these products to customers as well as internal employees. Our attempt was to map the typical activities of support personnel and of software developers and the artefacts typically created to the Knowledge Maturing Model. We used the language of the company's representatives so as to gain a shared understanding of the activities and to structure the subsequent interviews and observations.

Collaborative learning-processes with respect to customer-support (third row) is triggered by a new and specific customer-request that can't be answered by retrieving information from either the individual or organisational memory but may instead require contacting experienced colleagues or exploring and searching internal databases or the web. Insights gained during this early phase of maturation are stored and externalized by means of e-mails or telephone notes. In case of being repeatedly confronted with the same customer-request the responsible customer advisor may create an FAQ in order to ensure the distribution of her/his approach to solution, so to crystallize procedural/implicit knowledge and to shorten the future process of searching for functioning operators in the problem-space of the distributed cognitive system of artefact-mediated interactions between employees and customers. If the idea to deal with the customer-request gets support/legitimization and is enriched by contributions of other team members in the course of meetings (e.g. SCRUM-meetings) the knowledge becomes further formalized by turning the FAQ into a new chapter of the software documentation realized in form of a wiki-based manual. This formalization-step consists of the consolidation of several drafts: Wiki-articles of different employees are firstly collected in a file only accessible by employees of the company and secondly stitched into a coherent whole. After this document has met some quality criteria, for instance readability, its content is released as a new learn-module and categorized under a specific chapter of the wiki-directory, also accessible by customers. If they approve of this extension of the wiki it will become a standardized part of the software documentation and procedure in customer-support.

phases		Ia expressing ideas (investigation)	Ib appropriating ideas (individuation)	II distributing in communities (interaction)	III formalizing (in-for-mation)	IV ad-hoc training (instruction)	V standardizing (institutionalization)
Software-development	Activities	explore, generate ideas		share, discuss and evaluate ideas	create design	develop prototype	develop product
	Artefacts	personal notes, weblog entries, applied ticket		discussion notes	design document	prototype	product
Support, Docu & Training	Activities	to answer a specific customer-request		write FAQ	create software documentation	create learning module	create course
	Artefacts	Email to customer, telephone notes, ticket		FAQ entry	software documentation	learning module	course

Figure 28: Two maturing processes in the company of the case-study

7.2.3.3 Topic 2: How is KM supported?

The interviewees put emphasis on organizational-based and informally employed measures supporting collaborative learning processes. By caring for an atmosphere of trust and collegiality that encourages participation and cooperation, much informal communication can take place. This key factor for the company's information flow plays an important role to propagate information about current activities and news and is conducive to the knowledge work steps *discuss* and *distribute*, as the employees do not have to fear disgrace or the loss of power when disseminating their ideas around the company. Additionally, the formal, organizational structure allows for a good overview of the employees and their main domain of expertise and consequently helps the company and its project managers to *identify* the right people to involve in projects or endeavours to solve customer-requests. The interviewee characterizes the organization's structure as flat and decentralised since the management is distributed across the chief executive and three part owners who are responsible for different projects, i.e. software-products for different branches. A cross-functional group of employees is assigned to each project, while in some cases there are some personnel intersections between the projects. This clear and quite small composition of employees working on a product fosters the emergence of communities of practice (CoPs) and a competence based search within the company as well as the *coordination* of activities of the identified, experienced people.

Conducting SCRUM-Meetings is seen as an important formal measure for KM. A Scrum is an iterative methodology in software development where a self-organizing team of 5 - 7 employees regularly meets to decide about priorities in the work to be done during the next 7 - 30 days (Planning Meetings) and to talk about work-progress, plans and problems (daily standup meetings)., Particularly, the daily stand-up meetings provide a formal structure for CoPs to *discuss* urgent tasks and to *evaluate* the progress of the software-development. They contribute to an open-minded organizational climate that supports the development of new problem representations, i.e. cognitive flexibility when searching for new ideas. They increase the transparency of relations among team members, artefacts and their approach to solutions and thus, are regarded as an important factor for newcomers to become familiar with socio-cultural practices of the team and the whole company.

Prospectively, the company plans to focus on software-based measures in order to foster KM. At the moment intranet based services and office software are essential for processes within phases I to III. While MS Excel and Corel Draw are software types supporting expressing and appropriating ideas, "Infoware",

a directory storing contact data, is used together with MS Outlook to distribute ideas among employees and customers. An internal wiki and its wiki-directory (Filebrowser) have become inherent parts within phases III to V and contrary to results of the representative study, the wiki is less important for processes within phases I to III. It is used for the purpose of formalization and the collaborative creation of training modules and courses for customers and newcomers within the company.

7.2.3.4   Topic 3: What barriers have been overcome?

In this case the discussion of Topic 3 overlaps with Topic 5, since on the one hand the company has become aware of clear barriers for KM and has started software-based as well as community- related initiatives to find solutions. On the other hand, even if their planned endeavours are in progress, at this point employing measures is in need of advancement and barriers haven't been overcome.

Lack of time, *geographical distribution* of employees and the *discontinuity in different software applications* are the main barriers for information flow in general and KM in particular. Lack of time especially is detrimental to phases III to V, so that implicit knowledge of employees, e.g. knowing how to solve customer-requests, stays internally represented in their procedural memories and doesn't become formalized. Consequently the wiki has been implemented as a knowledge service that should enable an effortless and work-integrated documentation of individual learning processes. At the moment, there is still some lack of employees' commitment to the wiki and – as will be discussed at topic 5 – an extension by quality indicators and other features helping to filter information is planned anytime soon. Moreover at the moment a software application is tried out (see Topic 5) that helps to easily collect and share contents and is envisaged as a potential service to prepare formalization-processes.

Both the adoption of a second building for the home office in Graz and the constitution of branch offices in Germany and the Netherlands have brought along changes in the physical layout of the distributed cognitive system of the company that require the acquisition of new mediating artefacts to overcome a decreased situation awareness. The absence of physical proximity of the employees obstructs direct observations and overhearing conversations, i.e. direct access to people. Thus, even if their tasks border they are not close by for communication. The use of tools that are suggested for CSCL-situations should help to enrich communication and make it less complicated.

The discontinuity in different software-applications for the same tasks is regarded as a barrier for KM and the company plans to overcome it through the implementation of a variety but strongly interconnected knowledge services. This kind of media disruption is particularly pronounced in the task of co-developing documents, e.g. wiki-articles, and especially detrimental to the transition between the phases II and III. By using widget-based technology, which intertwines services for creation, discussion, metadata management, etc., the "task-steps" *prepare*, *coordinate*, *converge* and *distribute* should engage with each other more effectively and synergistically.

7.2.3.5   Topic 4: How is software used for knowledge maturing?

In this chapter the knowledge action of creating and co-developing a wiki-article is described in more detail and in terms of the steps suggested by Hädrich (2007), since the description of this action covers all most phases of the maturing-model and consequently reveals in which way the software is used.

Prepare and Create

Basically, this co-authoring activity encompasses the steps *prepare*, *create*, *coordinate*, *converge* and *release,* while the interviewee is mainly involved in the later two steps. As mentioned above, the occasion prompting the knowledge action is a customer request making the advisor aware of an unclear handling of particular software's functionality that has to be documented in the wiki-based manual. Subsequently, the project manager – the person mainly responsible for the software-development – prepares the creation of the new training unit. Therefore, he initiates the phases of "expressing and appropriating ideas" by identifying the employees who are in charge of the corresponding functionality and assigns the ticket to them, in order to both solve the customer's problem and to create a new draft for the wiki-manual. Thus, several software developers can be involved as co-authors whose activities must be coordinated both by the assignment of responsibilities and by mediating artefacts.

As mentioned above, the organizational structure allows for the identification of responsible employees without the use of software for a competence-based search within the company. "Infoware" and Microsoft Outlook support collaboration, among and the notification of employees about customer-requests and pending wiki-updates. "Infoware" stores information about customers, partners but also employees, such as e-mail addresses and telephone numbers and is interlinked with the contact directory of Microsoft Outlook. Finally, the wiki is used as a creation and change service to store and distribute updates of the software documentation.

Coordinate

The co-authoring of the software-developers is coordinated by the "manual-new" folder, a category in the wiki-directory that enables sharing contents between co-authors and can only be accessed by the employees working on the software. It supports the phase of "distributing ideas" by acting as a kind of information hub where different information resources meet and can be distributed across the co-authors. Thus, coordination is achieved through a shared electronic repository and the maintenance of access privileges. The interviewee in turn stays aware about the wiki-content-changes either by direct face-to-face and telephone-conversations or by receiving e-mails that inform her about new drafts in the manual-new folder.

The software-products supporting coordination are the wiki and the wiki-directory (Filebrowser). The privilege service is managed on the folder level since only project members have the right to change and create content in the "manual-new" folder. Microsoft Office is applied as a collaboration service to send e-mails to the interviewee in order to obtain notifications about content changes.

Converge

The interviewee mainly participates in the step converge that aims at creating a structured document and she starts this activity by copying the new wiki-entries for reasons of safety. Since – at least in some cases – several co-authors have contributed, their drafts have to be consolidated. They are stitched into a coherent whole by pruning redundant information, renumbering and smartening figures and tables in a consecutive way and rewriting as well as simplifying complicate phrases to enhance the document's readability and teachability. Hence, the step converge can be regarded as the phase of the co-development process where "formalizing" takes place.

The software types used for consolidation are MS Word and the wiki. Changes to figures and tables are made by means of MS Word, MS Excel, as well as by Corel Draw.

Release

In the last step of this co-development of a new wiki-entry as a kind of training-unit for the purpose of "ad-hoc training" the interviewee distributes the final, consolidated and pedagogically more sound version among the customers and members of the company by classifying the article into the wiki-directory. The drafts' authors determine the category to which the document has to be assigned. Thus, the Filebrowser is the main software-type supporting the release and dissemination of new contents.

7.2.3.6   Topic 5: What plans are there or what could generally be done to further enhance KM?

As mentioned above (topic 2), media disruptions in the course of one task are seen as detrimental to individual as well as collaborative learning processes at the workplace. The implementation of *one* software-product supporting different aspects of a single task is a highly prioritized and software-based goal to be achieved within the next three to five years.

The company is becoming larger and CoPs are more and more distributed across geographically different parts of the company. As informal communication is regarded essential for information flow, the future ensemble of knowledge services should also be extended by CSCL-tools providing ease of communication. Besides passing physical artefacts and factual contents, more appropriate communication means have to convey also implicit aspects of communication, such as the situational/emotional state of the communication partner and her or his implicitly expressed appeals. In short, the adoption of services increasing communication bandwidth should help – at least to some extent – to imitate face-to-face communication that imparts more information than traditional computer-based communication means.

In the near future the company will implement a software-application that should help to overcome the barriers identified in phases II and III, which hinder the formalization and distribution of problem-solutions. This application is an aggregation and collaboration service that helps to create collections of information sources (PDFs, pictures, web-resources,...) by using drag and drop that can be accessed and also changed by other employees.

To enhance employees' and customers' commitment to the use of the wiki it will be extended by quality indicators making sure the data are accurate, up-to-date and relevant. Therefore the company participates in a study that gathers information about the importance of several quality indicators (e.g. automatically computed readability scores or relevance-ratings given by the employees) and how this importance depends on different tasks (e.g. searching for new resources, integrating or reviewing wiki-articles). Results will be used to integrate relevant quality indicators into the wiki and consequently, to support the action steps of evaluation and review of documented knowledge.

7.2.3.7 Summary

This case-report describes a small company in the sector of computer programming and consultancy that makes much effort to overcome barriers in KM in the interacting areas of software-development and customer-support.

Company's managers regard the MATURE-model as a helpful concept to picture learning sequences in their company and to address crucial problems, such as barriers in distributing and documenting ideas as well as already mature problem solutions.

In the company the focus is both on informal (e.g. atmosphere of collegiality) and formal measures (e.g. SCRUM-meetings) to support knowledge actions within phases I to II. Extensions and a further advancement of an internal wiki should be conducive to phases III to V.

Lack of time, *geographical distribution* and *media disruptions* are the main barriers for KM, while for each of them software-based solutions have been considered and to some extend implemented, including an aggregation service, tools suggested for CSCL-situations and a wiki extended by quality/maturing indicators.

7.2.4 UPB – Case Study Report

7.2.4.1 Introduction

For the UPB-case a large, worldwide operating company in the area of management consultancy (NACE-Code 71) with more than 90.000 employees and subsidiaries in over 30 countries was selected. Besides consulting services the company is providing technology services, outsourcing services and local professional services. Seven interviews were conducted in July 2010 in a Polish subsidiary of the company. This unit of our analysis is mostly engaged in the area of business outsourcing services. Henceforth, we will refer to this company as BPOC (Business Process Outsourcing Company).

The main reasons for considering BPOC as a candidate for our in-depth case study were: (1) the company itself is focusing on knowledge maturing in order to restructure and outsource business processes of their clients with regard to quality, time and cost. They simultaneously want to restructure and improve their own consulting processes. (2) This service for lean business process management is highly formalized according to the company's global business process model. Based on this formal model BPOC transition teams are interacting with two different groups: The employees of their client's company, which were affected of the outsourcing processes and the employees of the company who take over the restructured lean processes (lean team). It was interesting to identify differences and similarities between the strategy of knowledge maturing of BPOC's transition teams, who are working with their clients, and the knowledge maturing model of MATURE. (3) Based on the specific relationship between BPOC's transition teams and their client's employees we wanted to analyze the impact of social interaction and social networks on knowledge maturing (a) within BPOC (b) in teams of the clients / lean teams and (c) between BPO-transition teams and client / lean teams. (4) Finally, the supportive role of software tools for those knowledge maturing processes could be analyzed with specific regard of the evolution and the mat-

uration of sociofacts. Thus, the case study addresses the general research topics of our in-depth study and allows us a specific view on our research area.

Since the UPB case study was conducted at an outsourcing company who focuses itself on the relationship between knowledge achievement and process improvement, we want in our analysis enable a specific, more system-oriented view on the mutual dependencies between artefacts and sociofacts. This means not only to analyse the use of software tools for knowledge maturing in the company, but also to gather a more systemic view on the relation between artefacts and sociofacts. Thus, the analysis of the UPB case study was guided by the lead question: How can Sociofacts contribute to and improve knowledge maturing? In this context we understand sociofacts as capacities to perform specific actions, which are related to a topic and a target group. In addition to the social dimension of their intended action sociofacts mostly are goal-oriented. Besides their internal individual aspects, sociofacts have an external representation, observable as social interaction and as activities of individuals within groups. The topic related actions in groups include a different degree of shared topics and a common understanding of those topics between the interacting group members. This social interaction, often supported by digital media, also effects the creation of associated artifacts. Therefore, as a result of that kind of social activity (e.g., delivering emails in a working group, using a Wiki cooperatively), we also generate artifacts. This topic-related communication and the resulting social interaction establish a specific workflow in a company. Thus, so-called Artefact-Actor-Networks (AANs) (Reinhardt, Moi, Varlemann 2009) may indicate the existence of related sociofacts and can be used to describe and analyse them. The concept of sociofacts supports the analysis of existing social networks and associated topics the network is dealing with. Regarding sociofacts and AANs shifts the focus of analysis from the use of a specific software tool to a more broadened view of media-supported topic-related communication in a social network within a group, a company or an organization. A more detailed discussion is provided in section 5.4.5 and (Riss et al., 2011).

Besides semi-structured interviews with seven representatives of BPOC (L&D Management, HR Business Partner, Compensation & Benefits Lead, IT Department Lead, Delivery Excellence representative) discussions in small focus groups on different topics of KM were conducted. After the transcription of the recorded interviews and discussions and the evaluation of the field notes, these inputs were evaluated with methods of qualitative content analysis. Additionally, the company provided us with supplementary documents, that were subject of a document analysis and helps us to clarify upcoming questions regarding the activities and the organizational structure of BPOC. J. Magenheim conducted the interviews at BPOC.

7.2.4.2 Topic 1: Why do people think that they perform KM better than others they compare themselves to?

Since the improvement of business processes is the main field of action of this world-wide operating company, its organizational activities are driven by a spirit of continuous improvement and its objectives and practices of business process management are supposed to achieve world class level. Therefore, they e.g. developed a global database with best-practice processes (GPM, global process model) that represent patterns for a best-practice alignment of their client's business processes. Transparency of decisions and processes within BPOC and a hierarchical structured system of roles and approved documents enable good performance with regard to knowledge maturing:

The members of a transition team of BPOC who are responsible for the restructuring of business processes at their clients are endued with a quick access to a classified system of knowledge bases that contain artefacts of different levels of maturity. The global process model database provides a collection of best practice process-descriptions that were approved according to quality assurance procedures. The company's global Wiki is available for all employees and contains not restricted information about all business activities of the company. Employees are encouraged to contribute. The articles will be reviewed and edited similar to processes in Wikipedia. For the needs of expressing and finding new ideas an idea database is used. Employees can entry their improvement-proposals and annotate and discuss those of others. For project-related work in the transition teams a project-database with a web-interface (team-room) is as well available as a shared file system with restricted access rights.

Since the company uses a hierarchical classification system for the approval and the maturity of documents, employees of BPOC are well aware of knowledge maturing on the artefact level. During the transition phases in their daily work they also improve their client's business processes according to a best

practice process model that as well is continuously subject of improvement. This provides them awareness with regard to sociofact maturing. Finally, each employee has his/her own PDP (Personal Development Plan), which define agreed personal learning objectives. Thus, formal an informal learning of the employees, whose outcomes are measured with balanced score-cards, contribute to the awareness of knowledge maturing on the cognifact level.

In BPOC there exists besides a hierarchical approval-system for documents, and complementary to a governance model that regulates communication structures within the company, a culture for open discussions. These discussions, which take place within the transition teams, between them, and on subsidiary-level as well as company-wide, are supported by appropriate IT-tools and by digital and f2f-forums. This mood of 'continuous improvement' is an essential part of the company's corporate identity and is well known and accepted by the employees.

A strategic action guideline of the company is given by the concept of continuous improvement. This concept not only encourages the employees e.g. to contribute their new ideas to a discussion forum in order to develop innovative strategies but also fosters a change in social interaction. Due to regularly enforced role-changes within the transition teams individual responsibilities were changed from time to time and thus a multi-perspective view on problems should be enabled. Furthermore, the teams are mixed with regard to the competences of their members, which are experts in diverse subject domains. This also could be a mechanism to overcome rigidity of thinking and from sticking in convenient but ineffective action patterns.

It is one of the major tasks of the employees of BPOC to describe the change of business processes in documents of different abstraction levels and of different states of approval. Afterwards the business processes will be changed according to these descriptions. So the employees are very well aware of the strong relationship between the advancement and the maturing of artifacts and sociofacts. Since they themselves are involved in formal and informal learning processes during this phase of organizational change management, they also should consider the impact of these activities on cognifact maturing.

The interviewees emphasize that for BOPC the sharing of knowledge in the transition teams, between them and also on the company-level is crucial for the company's successful activities. Fostering a climate of continuous improvement that implicates knowledge sharing as one relevant factor therefore can be regarded as a contribution to knowledge maturing on the sociofact level.

In the company (BPOC) there exist a variety of activities to improve the clients' business processes according to a BPM (Business Process Model) and a best practice model GPM (Global Process Model). After a process of consolidation (alignment with GPM), consolidated processes can be conducted by the client further on or may be outsourced to another company (lean management by transition and outsourcing). The maturing of processes is oriented on a highly standardized best practice model (GPM). It provides benchmarking indicators KPI (Key Performance Indicators), which enables also cross-client comparisons of similar business processes. Thus, these benchmarking indicators were used to identify differences in the performance of different projects (different clients) and compare them with regard to efficiency, effectiveness, value, control etc. Also the GPM will be revised after a concept of reflection, continuous improvement, training, and standardization of processes and benchmarking.

Since BPOC is a worldwide operating company with more than 90 000 employees they operate an internal system of expert finding. According to their topic-related expertise and their position in the company's hierarchy many business process mangers (subject matter experts, process owners of processes in the best-practice global process model (GPM)) offer training courses for local, regional and sometimes global trainings and events. Thus, the expertise of people is assigned and identified by their role within BPOC and the content domain they are dealing with in their daily work. If local transition teams looking for improvement of specific client's processes they use these concepts of expertise assignment either to gather recommendations for process improvements from those experts or for finding appropriate training courses in order to improve group members' competences in the long run. This concept of advanced training and expert finding concurrently establish an internal community of practice (CoP) that forms an internal social network, where only few external experts are included. The focus on internal experts is justified with the company's huge resources of internal expertise. Nevertheless, occasionally external presenters contribute to international workshops and meetings of the company.

7.2.4.3 Topic 2: How is KM supported?

There are several levers within BPOC to support knowledge maturing with regard to artefacts, cognifacts and sociofacts and concerning the different phases of knowledge maturing.

First of all a governance model of BPOC defines precisely the abstraction levels of business process related documents (6 levels of abstraction: e.g. desktop procedures, mapping clients specifics, process flow and narrative, abstract process flow, process group) and their hierarchical status of approval, which indicates also their knowledge maturity. This governance model also regulates the authorship and the workflow for the approval of a business process related document. Thus, the abstraction level and the approval-status of a given document can identify the knowledge maturing on artefact level. This process of approval and the 6 different abstraction layers also can be assigned to the different phases of knowledge maturing in the MATURE KM model. The governance model of BPOC thereby supports knowledge maturing on artefact level and defines workflows and social interaction. These dynamic social structures within the company, which are also subject of improvement, can be regarded as sociofacts and their improvement with regard to e.g. quality as an indicator of knowledge maturing on sociofact level.

Informal and formal training is also part of this governance model because during the transition of business processes at the clients we have to consider three different groups of learners. Members of the BPOC transition team become acquainted with the business processes of their clients and themselves provide the client's employees and the employees of the 'lean company' with training on the restructured processes. In the meetings between members of the transition team and the client-employees different types of documents are presented in order to indicate future developments of the organizational change. Most of the documents are embedded in PowerPoint presentations that also could contain interactive elements. Similar documents were produced for the needs of training for the lean processes at the company, which is responsible for those processes. Thus, interactive and animated digital media provide the basis for communication with client teams and lean companies and may be regarded as technology-enhanced boundary objects (TEBOs.)

The informal and formal training within BPOC is also closely related to the advancement of individuals, the success of the group they belong to and to the organizational objectives. According to a personal development plan (PDP), which is discussed with the personal supervisor of an employee, an individual should select from a subset of courses that are supposed to be useful for the advancement of all the three levels. For those purposes balanced scorecards were used. The scorecards are calculated with regard to the core goals of a project, the benchmark figures (KPI, see below) of the client's business processes, the customer satisfaction and the innovative contribution of the group member (e.g. contribution to the idea data-base). Thus, the training opportunities of BPOC's employees are closely linked to the business objectives of the company. Participation in formal training on regular intervals is mandatory for employees of BPOC and is considered as an important element of his/her PDP. Nevertheless, additionally optional courses may be selected if they are of special interest for the employee. All these learning activities contribute to knowledge maturing within BPOC on cognifacts level.

Transition teams are assed by benchmarking relevant aspects of the change management they initiated at their clients. For the needs of quality insurance the revised business processes of their clients are benchmarked with KPIs (Key Performance Indicators). These indicators are also used to foster competition between the different transition teams of BOPC and compare the outcomes of the lean and outsourced business processes. The results of the assessment is basis for further discussions with the clients as well as for discussion within BPOC about possible future improvements of the transition processes.

BPOC owns a sophisticated quality management system that is involved in the activities of the transition teams. The excellence deliver team members affect the personal development plans of the employees as well as the performance of the transition team or the main objective of the company. Based on assessment (KPIs, weekly dashboard on a teams performance) meetings with team leaders were organized in order to improve the results in compliance with the agreements with the client. Furthermore, monthly and annual competitions between the teams and individuals were organized in order to foster awareness for the quality of their work. Regular team meetings were held within the transition team in order to co-ordinate and improve their performance. For the needs of quality management monthly meetings of the team leaders with members of the quality assurance are organized. Besides these intra-company meetings, f2f meetings

and subject related workshops are conducted with the clients and separately with the members of the lean company, which prospectively will be responsible for the outsourced processes.

The delivery excellence team is part of the quality management of BPOC. Delivery excellence teams (DET) are publishing targets every year, which needs to be achieved with every specific client. Members of the DET not only are visiting every transition team for discussion and reflection of their daily work with their clients. They also organize monthly meetings with the team leaders of the transmission groups for cross group discussions on the groups' performance and possible improvements.

BPOC forms transition teams of mixed expertise. The different competences in the team of experts from various domain areas are supposed to deliver better performance in terms of innovative social creativity, effective collaboration and stimulation of continuous improvement. Regularly held team-meetings provide an opportunity for open discussions between the members of the expert-team in order to facilitate the group's capabilities.

There exists a specified hierarchy of roles within BPOC, which includes supervisory and guidance functionality. Every transition team has a leader who is responsible for the performance of the team and also supports team members, if help is needed. They all together were measured with KPIs from the client they are in charge of. The transition team's performance is weekly published in a group-dashboard that indicates performance indicators of their project with regard to customer's KPIs, milestones, project-schedule and budget. The team- leaders themselves are guided and supervised by a member of the quality management team (delivery excellence service). The delivery excellence team and transition team leaders together are co-operating with process-owners (who are responsible for a process described in a best-practice model (GPM)) and subject domain experts. Thus, a social network of supervision and guidance is established within the company that goes beyond the boundaries of a single subsidiary.

In the company (BPOC) there exist knowledge sharing media, which are used by members of the transition teams, who work e.g., with a certain client (project). An 'idea database' is available and enables members of a working group to publish their topic related problem solving ideas. Based on these documents and the personal experiences of the group members, ideas will be improved and finally agreed and approved (f2f discussions, annotation on documents, contribution in Wikis, use of a versioning system, documents in a virtual team room). Company experts from outside the transition team will be included in these knowledge sharing and maturing activities. The final approval is made by the project related content manager. Based on approved documents (consensus artifacts) transition processes at the client will be applied. Final version of solution will be published company-wide and may be integrated after well defined processes of quality assurance into the standardized global process model. Thus, the shared topic related understanding within a group or between groups in the company is fostered.

In the company an incentive system exists combined with a competition. Individuals and teams once in a year submit innovative ideas and projects which have been or will be applied at a client site. All the contribution will be presented during a one day exhibition (one room for every project). During an Oscar award ceremony ovations and financial rewards will be delivered. Thus, all members of a subsidiary of the company will learn about other projects and ideas and have to be innovative by themselves. By this way a culture of knowledge sharing and continuous improvement should be fostered. Furthermore, subject domain experts, who are involved in these discussions, also contribute to subject-related formal trainings. Hereby, dynamical changing communities of practice contribute on different levels to topic-related knowledge maturing. Furthermore, the discussion-forums, which occur in the 'idea-database', can also be regarded as communities of practice that promote a specific topic.

Within BPOC we have to state collaborative activities to increase a group's performance in the company. There is a strong reflection of ongoing group activities in the BPOC transition teams. This is done for instance by discussion in regularly conducted meetings between the group members and creates a high level of group awareness and corporate identity. Reflection, team building and knowledge sharing is also organized by temporary changes of roles and responsibilities within the group. A member of the team who is responsible for some processes of a client takes afterwards the role of an expert and teacher for the colleagues, sharing his/her problem-related experiences with the client in order to improve further transition processes.

Additionally, monthly cross-project meetings of the team-leaders with members of the quality management task force are conducted in order to exchange experiences across the different client-engagements and foster a higher level of responsibilities of the group managers and the group members. Thus, awareness on group activities is not only supported by software with awareness functionality (content change awareness, social awareness in a virtual team room) but also by further accompanying measures. Therefore, also PDPs (personal development plans) are not only oriented on individual needs and interests, but consider team-related requirements in order to strengthen the team's performance. Thus, participation of employees in formal and informal training of the company contributes to the concept of continuous improvement and is linked to group-related quality indicators provided by the quality management department of BPOC. Advanced training within the company is linked with a system of company-specific certificates and is partly included in a competition between teams (team-oriented ovational award scheme: e.g., best lean project, best GPM alignment project, best six sigma project…; financial gratification as part of an incentive system).

Finally. On the sociofact level written or unwritten rules, which contribute to efficiency and effectiveness of communication can be identified as relevant aspects of knowledge maturing on sociofact level. In order to organize communication and interaction between clients and the transition team of BPOC in an effective way SPoCs (single points of contacts) are defined. All relevant communication between both sides, especially those who are essential for changes of business processes, is proceeded between these two persons who are responsible on both sides for those changes (client: project manager; BPOC: transition team leader). Members of the transition team are supposed to provide the SPoC members with all relevant information. This could be done in f2f communication, via E-mail, entries and comments in a database or changes of documents in the team room. Before decision is taken, the final versions of the decisive documents have to be approved. The approval process is organized according to a governance model, which defines the workflow of a document until it achieves the status 'approved'. Thus, the two members of SPoC are working as boundary spanners and the approved documents and related materials like ppt-presentations on this specific issue can be regarded as boundary objects. Not only the alignment of existing processes of clients with the best practice processes of the GPM (global process model) is ruled after a governance model but also the improvement of processes within the GPM. Before a process is approved as part of GPM it is subject of a quality assurance analysis. The workflow of this approval process within BPOC is often supported by workflow-macros which are part of the process-related documents. The macros contain specific information about approval-phases, participating staff, automatic notification to the reviewers and the sequencing of the document in this evaluation process.

7.2.4.4   Topic 3: What barriers have been overcome?

There are barriers of communication not mainly within BPOC but between BPOC transition teams and the customer's employees. Since BPOC is a global player, its transition teams often are focusing on the transfer of workload from high cost location to low cost location, they are taking knowledge and experience from the customer's employees who are not interested in sharing. There is a fundamental role-conflict between members of both groups, which cannot be solved honestly. Nevertheless, the members of BPOC's transition teams try to be 'polite, appreciative, communicative and persuasive' and foster the employees' often unrealizable hopes to get a job in another department of their company.

In order to overcome possible existing difficulties within the transition team, group-meetings and changes of roles and tasks are conducted from time to time. There also exist language and cultural barriers between transition teams and members of the 'lean company' who will be responsible for the outsourced processes in the future. For instance, mostly technical qualified people from India, who are excellent computer scientists, show a lack of understanding of social processes and workflows in western style companies. That's a relevant sociofact for knowledge maturing. Therefore, BPOPC transition teams try to involve them from the beginning of the project into the change management and provide them in parallel with formal and informal training including role taking and simulation of business processes even on the level of navigating graphical user interfaces.

During these training courses the BPOC transition team tries to foster the topic related shared understanding between employees of the company and customers employees. Hereby they contribute to knowledge sharing and overcoming barriers between the groups: After the analysis of processes (with ethnographic

study methods) at the customer's site documents were created (process maps, process diagrams) that enable the communication and the shared understanding between the customers and the transition team of the company (BPOC). Based on these continuously changing documents, weekly discussions between customers and transition team take place (organized as f2f or via video-conferences including lots of ppt-presentation, charts and process maps etc.). These social events and the used TEBOs are crucial for a successful change management. The process manager from the client and the leader of the transition team are mainly responsible for the success of these communication processes and have to take their role as boundary spanners. The BPOC people have to convince the customers of the effectiveness and the benefit of the intended changes and transitions though some of them might lose their jobs after the transition. We have to state, that in this specific situation an emotional communication barrier exists between the transition team and the client people, which inflicts the willingness of knowledge sharing.

BPOC itself is eager to re-organize its customer services according to the criteria they are applying at their clients. Therefore, the employees of BPOC also are facing the possibility of loosing their jobs after having finished a project. This puts pressure on them and leads to a strategy for project enhancement (taking over processes from the client or restructure more processes in addition). The team tries to achieve an extended appointment from the client or to acquire a new project. This can be regarded as a relevant sociofact that influences the motivation and action of the members of the transition team.

Another barrier occurs between the best practice business models and the currently conducted business process of the clients. The BPOC concept of knowledge maturing is based on the alignment between the current practice of business process at the clients and a theoretical concept of best practices described in a best practice global process model (GPM). The GPM itself is subject of continuous improvements based on experiences with current transition processes. Therefore, identifying and classifying gaps between current customer procedures and the GPM is a main effort of the transition teams. Furthermore, they have to consider the specific regional and local contexts. The restructuring of business processes for BPOC means bridging the gap between an 'ideal model' and the existing practice of the client. Nevertheless, the BPO transition teams have to consider the specific regional and local contexts of their client, when restructuring their business processes. For instance, country specific legislation and regulations and regional or local specific procedures at the customers have to be taken into account, while modeling new processes. These specific solutions will not be included in best practice model (GPM). This alignment process needs to convince the client's employees and foster their acceptance.

7.2.4.5   Topic 4: How is software used for knowledge maturing?

BPOC applies a broad variety of software tools for the different phases of knowledge maturing. For finding and expressing ideas an idea-database is used. While E-Mails are mostly used for communication between individuals or in specific groups (lists) Wikis serve mainly as an open forum for the purposes of company-wide global dissemination of ideas. For the needs of exchange and discuss new ideas an idea database is accessible for the employees of BPOC. MS SharePoint, MS Outlook and MS Office are used to meet the demands of business intelligence (e.g. scheduling, reporting, benchmarking, document access and delivery, content management) and the generation of documents. Visio is used to draw and process concept maps, while Excel serves for calculating and simulating process-related figures. The approval and the status of documents are supported by document-related macros. Furthermore, there are available: i2i data base on approved processes (GPM), file repositories and shared file systems with a versioning system. A global user management provides restricted areas according to the demands of privacy and business interests. Since BPOC is a global company; meetings of local distributed teams customarily are supported by eligible IT-tools like video-conference-systems and global intranet, which provides access to digital resources to every subsidiary, team and employee according to the governance model and the access rights management system.

Animated and partly interactive media (mainly power point) are produced in order to organize informal and formal training with the employees of the client and of the outsourcing company

Most of the software tools can be assigned to different phases of the knowledge maturing phase model. The IT- department of the company is closely involved in the organisational processes and the change-management.

Employees are not allowed to install and use software tools of their own.

Though BPOC is providing a suitable set of software tools to the employees, the mixture of various tools for the same resp. different purposes and the upgrade to new versions sometimes proves as a barrier.

The software in BPOC is used to increase the degree of networkedness between the members of a topic related artefact-actor network: Employees who are working in the same client-project or co-operate with other staff members (e.g., domain experts) or process owners (only owners of processes are allowed to approve and change processes in the GPM) exchange and co-operatively generate documents. By doing this, they use different media (MS-Office tools, web-based virtual team room, shared idea data base, 12i data base on approved processes, Wikis, E-mail, share point, shared calendars, file repository, documents with workflow macros…). Thus, they become part of a topic related AAN (artifact-actor network) and the degree of networkedness (frequency of exchange or contribution, number of contact-persons, topic related profoundness, degree of social and topic-related awareness) is supported by the applied communicative software-tools. Though some of the software tools, which are used by BPOC staff, provide awareness functionality to the users, there exist no network-specific awareness tool like visualization of AANs and related network activities.

Additional to the software-based social network support BPOC organizes competitions and annually reward meetings where individuals and teams present their ideas and provide information about best practice processes and projects. Thus, additionally to the support by software the degree of networkedness and community building is supported within the company by face-to-face meetings.

7.2.4.6   Topic 5: What plans are there or what could generally be done to further enhance KM?

BPOC uses KPIs not only to measure the team's performance but also relates it to the PDP (personal development plan) by using balanced score cards to identify personal training needs in compliance with the requirements of the team and the company. This system of guided personal development will be enhanced in the future in order to motivate and encourage employees to improve and enhance their knowledge and their status in the company.

During the phase of restructuring processes at the clients the BPOC transition team takes over the role of the client's employees and later on simulates re-structured processes in their own offices before the new processes are allowed to be outsourced or be re-implemented at the client. For the requirements of that type of informal and formal training in the future more animated PowerPoint presentation and interactive media should be applied in order to improve training results of the employees of the lean company and to foster a shared understanding of the topics they are dealing with.

7.2.4.7   Summary

Some main findings of our case study can be summarized as follows. The transition of business processes of BPOC's clients is organized after a highly formalized procedure that is based on experiences of former engagements with other clients. Therefore, the transition of business processes can be regarded as a process of approximation to a global best practice concept. Nevertheless, contextual conditions of a specific client are considered. A GPM (global process model) database provides documents which support these efforts and is itself subject of continuous improvement in compliance with quality management regulations. Thus, the related knowledge maturing processes within BPOC can be identified on the artifact level as well as on the sociofacts level. On the artifact level there exist well defined document types which describe ongoing transition processes on six different levels of abstraction. These artifacts, which are co-operatively generated and edited, are bases for discussions between the BPOC transition team and the client's employees as well as for internal discussions of the BPOC staff. The maturation of these documents and their status of approval are processed after a pre-defined concept of quality assurance. For the needs of quality analysis of the revised business processes KPI's (Key Performance Indicators) are provided. The status of approval of documents and processes can also be regarded as a key indicator of knowledge maturation. Furthermore, the interviewees confirm, that the MATURE knowledge maturing phase model is similar to the phase model of business process management within BPOC. For the needs of finding and expressing ideas an 'idea data base' and a wiki are used as a media-based forum for open discussion in the company. Team members represent a broad variety of expertise in order to increase the

team's social creativity. Team-related competitions, ovational awards, an incentive system and annually arranged project-presentation and idea exhibitions contribute to reduce communication barriers between teams, support informal training, foster team building and the emergence of a cooperative identity. The subjects of formal training in BPOC are closely linked to the needs, which were identified during the implementation phase of approved standardized processes. The communication between clients and the BPOC-team is organized after a governance model and is mainly processed between two persons (single point of contact) who are responsible on both sides for those changes (client: project manager; BPOC: transition team leader). They can be regarded as boundary spanners using boundary objects to achieve a common shared understanding. Finally, we recognized, on sociofacts level of knowledge maturing, that social interaction within BPOC and with the clients occurs in accordance and in mutual dependency with co-operatively generated artifacts. This also provides evidence for existing artifact actor networks and their important impact on knowledge maturing.

7.2.5 UIBK1 – Case Study Report

7.2.5.1 Introduction

In the case study UIBK1 all common research topics are addressed (see section 3). Additionally, special attention is put on indicators of knowledge maturing (see section 5.2), their possible occurrence and potential usage in an organisation.

In order to investigate these research topics, a large company in the industry sector was selected as a potential candidate. In order to assure anonymity, this company is called UIBK1 in the following. The major reasons for considering UIBK1 as a promising candidate for researching (indicators of) knowledge maturing are: (1) UIBK1 is a large organisation (following criteria provided by (OECD and EUROSTAT, 2005)) and provides its employees performing knowledge work with access to an elaborate technical infrastructure and several different systems. (2) UIBK1 follows the approach of management by objectives (Drucker, 1993) implemented with the help of different measurements which could possibly be related to the area of knowledge maturing. (3) UIBK1's employees showed high interest in the area of knowledge management in prior studies that were partly conducted by researchers of UIBK. (4) As researchers of UIBK have already had contact to some employees of UIBK1, e.g., in prior studies, selecting UIBK1 was not only a highly suitable and promising but also convenient which is not uncommon in qualitative research (Bryman and Bell, 2007, Miles and Huberman, 1998).

Two series of interviews were conducted by two researchers of UIBK (Ronald Maier and Andreas Kaschig) for collecting data at UIBK1. In the first series three interviews were performed focusing on a more general perspective of knowledge maturing in a setting of two interviewers and one interviewee. The second series consists of four interviews that were conducted in a one to one setting. These interviews focus especially on questions of the interview guideline (see section 7.1) that were linked and aligned to the topic of knowledge maturing indicators, when deemed applicable.

The unit of analysis of this case study is a set of knowledge workers of UIBK1. All have been working or still work together towards a common goal. All of them changed their departments at least one times. During their time with UIBK1 all of them switched between different subsidiaries and also between different departments within one subsidiary.

Each interviewee fit the target group (see section 3.3.3) well. In consideration of the unit of analysis, special attention was put on a rich work experience of interviewees gained in different departments at UIBK1.

During Interviews field notes were taken. Together with recorded and transcribed interviews, field notes were used as inputs for qualitative content analysis (e.g., Mayring, 2007) that was performed by interviewers. In the following sections outcomes of data evaluation are presented with respect to each question of the interview guideline. Where it is feasible, special attention is put on knowledge maturing indicators.

7.2.5.2 Topic 1: Why do people think that they perform KM better than others they compare themselves to?

Answers to this question are manifold. For one interviewee the working environment in the subsidiary he worked before caused a good performance of knowledge maturing. Other interviewees directly compared different departments of UIBK1 they had been working or still work in. Also, the performance of knowledge work in project settings and in departmental settings was compared by interviewees.

With respect to the focus of this case study on knowledge maturing indicators, the analysis of data related to this topic also aims at eliciting factors or criteria the interviewees use for justifying their argument. In the following those criteria that could be seen as reasoning provided by interviewees for better performing KM than others are listed. After that, additionally provided information about aspects of measuring performance of KM feeding into the comparison and about decisions based on that are summarised.

Criteria used for justification

The *influences of guidance activities* of supervisors are seen as one influence on performance of knowledge maturing. If an executive fosters the performance of selected knowledge maturing activities, this could positively influence performance of knowledge maturing. In a comparison of one of his former and current department an interviewee explained that fostering documentation of knowledge in files leads to less interaction between knowledge workers and richer base of documented knowledge. Implementing deputies, in contrast, fosters communication as well as joint reflection on and challenging of practices of knowledge work. Attending regular meetings with employees of own and other departments is also seen as an important factor allowing for exchanging experiences and discussing ideas from different viewpoints.

Performance of knowledge maturing is deemed to highly depend on *people* involved in daily work activities and their *attitude* towards sharing and storing knowledge. Also the *top management's attitude* is seen as a strong influence on how people of UIBK1 act with respect to knowledge maturing. A former head of one subsidiary was mentioned by a few interviewees as someone having a very positive attitude toward knowledge management which resulted in a stronger support, e.g., of evolving projects related to this topic also on lower levels of the organisational hierarchy.

Furthermore, *organisational culture and employees' awareness* which could be influenced by top management is deemed as another factor influencing performance of knowledge maturing. One interviewee mentioned that support by senior management was a major reason affecting development of knowledge in a subsidiary of UIBK1 he worked a few years ago. Senior management had shown continuous interest in knowledge management and also supported knowledge management related projects. Another interviewee who worked at the same subsidiary stated that the interest of senior management raised employees' awareness of the topic throughout the subsidiary and resulted in, e.g., in confidence of stating and pursuing ideas regarding enhancements of support of knowledge work.

The ability of an organisation(al unit) to provide employees with a sophisticated IT infrastructure allowing for *transfer of knowledge via different channels* (e.g., e-mail, instant messaging, videoconferencing, file sharing) was on the one hand seen as a precondition enabling knowledge work and further development of knowledge. On the other hand, the existence of several different possibilities for storing knowledge and thereby making it accessible to others without defining clear rules of how should which kind of knowledge be distributed is deemed as a threat. A reason provided is that in a large organisation like UIBK1, it might happen that time is allocated to reinvent the same things twice just because of missing awareness caused by selecting the wrong/different channels for retrieving information on a specific topic.

An additional point raised by several interviewees which is also connected to the transfer of knowledge via different channels is the *quick accessibility and retrieval* of knowledge. This does not only support investigation of existing knowledge of a specific topic but also prevents the development of similar knowledge in parallel, e.g., caused by usage of different channels for transfer. With respect to digital artefacts, an applied rule that was mentioned as an example is that employees are forced to send links to documents instead of sending the documents themselves (e.g. via email or instant messenger). This offers for example the advantages that recipients (1) get information about the location of a document, (2) are not

tempted to save the document on a different place and (3) can jointly develop one and the same document further. With respect to accessing knowledge of colleagues, an interesting aspect is the open-minded communication culture which is ubiquitously recognisable.

Relation to KPI and decisions based on KPI

UIBK1 puts strong emphasis on management by objectives. Therefore, an elaborate process is performed to hand over and at the same time align goals from top management at the highest level of hierarchy over middle management down to lowest level of supervisors and employees having no managerial authority. Therefore, each employee negotiates and agrees upon goals in a one to one meeting with his or her direct supervisor.

Being a supervisor, one interviewee states that he has integrated knowledge management in the agreements of objectives between him and his supervisor. In order to pursue this goal, he sets up projects (e.g., development of software) and fosters ideas aiming at supporting knowledge work. On the other hand, one interviewee argued that being interested in further developing knowledge is rather a matter of course. Hence there is no need to implement any measurement agreements of objectives regarding knowledge maturing.

From a business-oriented perspective one interviewee reflects that the *amount of implemented ideas* would be an applicable indicator to assess performance of knowledge maturing at UIBK1.

Another indicator which is part of agreements of objectives between supervisors and their supervisors are *training measures*. This is used as an easily measureable indicator at UIBK1. One possibility is the agreement on a specific budget that has to be spent on different measures to further develop knowledge of employees. How the budget is allocated is controlled by the responsible supervisor whose task is to implement a goal directed strategy resulting in measures for selected employees.

7.2.5.3 Topic 2: How is KM supported?

One critical factor is seen in the *provision of time*. One employee reflected that most knowledge maturing takes place in project settings, because people from different departments or even subsidiaries with different backgrounds work together towards a common goal and, most importantly, are provided with time to meet in person, discuss and jointly mature ideas. Moreover, provision of time is seen as precondition to mature knowledge. On each level of hierarchy, it is legitimation by the supervisor that matters most.

In order to succeed in developing things further, e.g., changing established but maybe out-dated practices, several interviewees mentioned that a new idea needs someone who claims it. Interviewees called this role *claimant*. Ideally this person is in a relatively powerful position to stress his or her demand. If no one states the need for changing process, introducing new software or enhancing quality of a product it is deemed to be much more difficult to proceed further with an idea, proposal or intention.

Project setting are perceived as very fruitful not only because time is provided but also because these officially settings go along with a *legitimation of actions* which empower project members to pursue project goals and introduce changes at UIBK1. Furthermore, a goal guiding the direction of developing knowledge and introducing changes in UIBK1 are provided.

Besides dedicated projects, *workshops on specific topics* are used as another measure to foster knowledge maturing. Therefore, supervisors meet to reflect on competencies of their employees and initiate workshops where selected employees are brought together to drive a specific topic. A side effect of this guiding activity is that workshop attendees are fostered in performing activities to enlarge their network and establishing topic-related connections to colleagues in different departments or even different subsidiaries. Hence, this also fosters the emergence of communities of practice within UIBK1.

Encouraging selected employees to attend dedicated *trainings* is a widely used measure. The subjects of training courses are selected with respect to identified gaps between employees' competence profiles and needs of organisational units or projects he or she works for.

Furthermore, *organisational measures* support the transfer of knowledge between different levels of hierarchy and between different subsidiaries of UIBK1. Knowledge transfer between *different levels of hierarchy* is supported by an established procedure of regular team meetings. Each supervisor has recurring

team meetings with he or she directly leads. Acting this way ensures fast and target group oriented diffusion of knowledge in both directions along the hierarchy. An example for *transfer of knowledge between subsidiaries* provided by an interviewee is that some supervisors lead teams having similar tasks in different subsidiaries. This has the advantage that good practices of one team could be adopted by other teams more easily. Furthermore, it enhances transparency as measurement systems regarding, e.g., the performance of tasks, can be applied in a similar way ensuring comparable results.

Comparability of results is also seen as an important precondition for *performing benchmarks* between different departments, different subsidiaries or with similar organisations. A decision on a measure of making changes affecting practices in one department is often based in experiences gained in other departments that already deployed the measure. If no information is available in departments of one subsidiary, other subsidiaries are contacted. One interviewee stated that if there are no information or experience gained at UIBK1 at all, connections to other information sources are employed, e.g., connections to comparable large organisations also belonging to the industry sector. Such monitoring of other organisations that could also be competitors is deemed as very valuable.

Shared *sets of rules* regarding common ways of performing knowledge work are implemented and followed by employees. One example explained by a few interviewees is the compliance of each department to a shared and standardized way of organizing documents on the file share. The related rules comprise convention about, e.g., naming and structuring documents. As these rules are valid for the whole subsidiary, it is deemed as relatively easy to come up to speed after switching to another department as orientation in and search for documents is made easy.

For supporting knowledge maturing special attention is paid on *provision* of an adequate *IT infrastructure and software*. More information on this will be provided under Topic 4.

7.2.5.4 Topic 3: What barriers have been overcome?

As stated earlier the existence of someone in a more powerful position, i.e. someone on a higher level of hierarchy is an important factor mentioned by several interviewees. If an idea to enhance something even if it is very beneficial does not gain the attention and support of a so called role of a claimant, it is deemed very challenging to follow up on it.

A barrier reported by one interviewee is the *focus on product-related enhancements*. As UIBK1 is an organisation in the industry sector, organizational culture is oriented towards superior performance and quality of its products. With respect to product innovation, UIBK1 maintains and takes care of a "culture of dissent" which means that controversial discussions are invited and absolutely welcome, divergent opinions are carefully laid out and need to be dissolved into agreement. In addition to culture, substantial resources are allocated towards these controversial discussions and their settlement. In the opinion of one interviewee, the area of process enhancements could benefit from a heightened awareness. Nevertheless, opinions of interviewees vary in this respect. Several interviewees stated that they see no imbalance between awareness of process and product innovation and explained that process quality and product quality are strongly interwoven. Hence, enhancing processes also has strong effects on products and vice versa. It was also reported that quality of products is assessed through proving compliance of processes to specific standards. This barrier could be overcome by *relating process enhancements to products* that the company produces.

Another influencing factor mentioned by one employee is the organisational hierarchy. One can only act if he or she has the *legitimation of the supervisor* which can be seen as related to the role of a claimant which was mentioned by several interviewees. The supervisor acts as a barrier that one has to overcome before following up on an idea. One needs to convince and inspire the supervisor also in order to find someone who buys into the further development of e.g. a proposal. Allocation of budget goes also along with legitimation. This can be seen as a first filter applied on ideas. Another interviewee argued in his reflection on barriers of knowledge maturing that this could also be a healthy selection with the result that only knowledge deemed suitable to the organisational context and sustainable is allowed to mature. One way to overcome this barrier mentioned is being highly motivated to convince supervisors to buy-into and support new ideas. This could also be seen as generating a demand or motivating someone in a powerful position to act as a claimant.

With respect to the knowledge maturing phase model, the later phases are perceived to be more challenging. It is deemed as relatively easy to mature knowledge up to the phase of "formalization", The later phases are associated by one interviewee as "making a decision hard". In a company context with thousands of employees, this carries challenges and highly depends on *legitimation by superiors*.

7.2.5.5   Topic 4: How is software used for knowledge maturing?

UIBK1 provides a *broad spectrum* of IT tools and a sophisticated IT infrastructure that supports employees in performing knowledge work. Due to company guidelines, it is not allowed to install any software unauthorized.

Software is *used quite differently* in different organizational units. One interviewee perceived a tendency that software gets increasingly precise and complex and stated that there is a danger of "administrative overkill". Depending on the supervisor's style of management, the rules of how to use the software are interpreted more or less rigidly. While this is generally true for all levels of hierarchy, the most important influences are exercised from a rather senior management level, the level of a manager of an entire subsidiary for example.

UIBK1 offers a lot of standard software like tools for sharing and (jointly) further developing digital resources and can also be seen as being keen on trying new tools to see whether they are useful. Some employees at UIBK1 are also open to develop (smaller), mostly web-based technology, on their own if no adequate solution is available on the market. Also, smaller projects are set up on developing software or transferring self-developed solutions to other departments.

In phases *Ia and Ib,* the Intranet and Internet play an important role for investigation. Of high relevance for investigating the capability of an idea are digital resources that have a high reputation. Resources extensively used for such purposes are deemed trustworthy and already gained a high level of knowledge maturity and have mostly been standardized.

When discussing an idea in a community (*phase II*), interviewees stated that they mainly talk with colleagues or supervisors in a face to face setting. In order to support this, besides instant messaging or phone calls, UIBK1 provides the possibility of using video calls which can be performed on each workplace also allowing for video conference calls.

Microsoft Outlook is used to propose and confirm appointments and also for communication via email. In the formalizing phase (*III*), mostly Microsoft Office products such as Word or PowerPoint are used. UIBK1 also offers a Wiki which is used in different ways, e.g., one department sets up an instance of the wiki and only grants access to authorized people. Furthermore, a DMS (document management system) and different file shares are placed at the disposal.

For ad-hoc-training (IV_1) and formal training (V_1a) it was reported that software like Web browsers and Microsoft Office products are used. These tools are deemed to support especially the transfer of knowledge, e.g. by boundary spanners between different subsidiaries. In some areas related to production processes, the piloting phase (IV_2) is supported by simulation tools. During the phase of institutionalizing (V_2a), obtained results are compared with predicted simulation results. Besides that, no further software used especially for phases piloting and institutionalizing was named by interviewees.

The DMS is one tool used for storing and accessing digital resources containing knowledge is deemed to be highly trustworthy and went through or is currently in the phase of standardizing (*Vb*). For instance, an interviewee reported on a rule that affects several documents stored in the DMS saying that employees must not refer to print-outs but to the documents themselves. This ensures that the DMS is used as a single source of truth and employees refer to digital resources carrying current, standardized knowledge.

7.2.5.6   Topic 5: What plans are there or what could generally be done to further enhance KM?

One interviewee reported on discussions with colleagues that lead to a joint decision on the topic of *enhancing processes* as one major goal. This would involve an alignment of IT used for supporting knowledge work at UIBK1.

In one department, special attention is paid on further developing a *measurement system* containing indicators allowing for assessment of different aspects of quality. This also goes along with the evaluation of knowledge of employees and its development. Furthermore, performed processes and created or further developed documents and subject of interest.

Furthermore, another interviewee stated that also *new information technologies* are an important topic. As described before, UIBK1 is open to investigate new technologies that might enhance support of knowledge work. It is planned to continue this course of action. An important point in this respect is evaluating feedback of employees and evaluating usage of newly introduced or offered information and communication technology.

Additionally, it is planned to perform measures to *increase employees' awareness* of different services offered to support core business processes at UIBK1.

7.2.5.7   Summary

The case study UIBK1 at UIBK1 was successfully in investigating the five common research topics. Additionally, interviewees provided rich information about both knowledge maturing indicators and indicators with respect to performance of knowledge maturing. In sum, seven interviews were conducted by two researchers. The qualitative analysis of valuable data gained from interviews and field notes led to highly interesting results. Some of the major findings are shortly summarized in the following.

A major criterion employed for comparing departments or subsidiaries with respect to the performance of knowledge maturing is the awareness of employees of knowledge management in general. This awareness is seen as being strongly influenced by senior management. Another important factor is seen by the existence of a so called claimant. If someone in a relatively powerful position stresses a demand to change and enhance current knowledge related to artefact, sociofacts or cognifacts, it is deemed much easier to follow up on it. Another interesting aspect of supporting knowledge maturing is an organisational measure implemented at UIBK1: supervisors lead teams (possibly of other supervisors) in different subsidiaries. This is seen as having a positive influence on exchange and development of knowledge in general. A key barrier observed is legitimation by supervisors which is related to the role of a claimant. Besides the interpretation as a barrier hindering the further development of knowledge a second, positive aspect was provided by interviewees, as legitimation by supervisor is also be seen as a "valuable filter" allowing only powerful ideas to develop. Supervisors and their relation to ideas is also discussed by (Välikangas and Sevón, 2010) who highlight, e.g., risks that might go along with powerful ideas.

With respect to knowledge maturing in general, systems (or locations) where digital resources are stored are deemed to indicate different levels of maturity, e.g., standardized knowledge. Related to the strong influence of legitimation by supervisors, it was stated that if in phase III (formalizing) an official commitment is made by a supervisor and/or management panel, the idea will be standardized. Hence, the decision of standardizing or not is already made in a relatively early phase. Once, the standardizing phase is reached, new ideas might lead to further improvement though starting a new instance of the knowledge maturing phase model.

7.2.6 UIBK2 – Case Study Report

7.2.6.1   Introduction

This case study addresses the general research topics on the one hand and focuses on the appropriation of software for knowledge maturing on the other hand. The research for the case study was conducted at a large IT service provider in Germany in September 2010.

The organisation has about 460 employees, not including two subsidiary companies. Although the majority of employees are located at its headquarters, it has three smaller sites. It provides a variety of IT based services, ranging from consulting, application support and IT solutions to application hosting and outsourcing solutions in its own computing centre. The organisation is active in several sectors. Different business areas within the organisation seem to have individual working cultures which may be explained by different historical developments of these areas and different working requirements.

The organisation was chosen for different reasons: There was a pre-existing relationship between the studied organisation and the researcher, in particular a collaborative research project and prior studies which were conducted there. Furthermore, the organisation provides two distinct views on the use of IT tools: the view of a user and the view of a producer. The sector of the organisation is classified as highly knowledge-intensive (OECD and EUROSTAT, 2005).

As unit of analysis, two different communities acting within the organisation were chosen: the group of employees with a flexible office space (Maier et al., 2008) and "innovation group".

Interviewees were selected with respect to the general study guidelines (see section 3.3.4). Especially, work experience gained in different departments or gained in different environments (e.g., due to working in projects with different organisations and team compositions) was emphasized. All in all, five people were interviewed: a consultant, a team leader, the head of HR department, the head of the internal communication department and a project manager.

Data was collected using the following methods: semi-structured interviews, document analysis, participation in meetings and informal meetings with employees. Interviews and informal meetings were conducted in a neutral and open-ended way. All interviews, further data collection as well as further data analyses were conducted by Alexander Sandow (UIBK).

The interviews were conducted in two sequences: the first three interviews were conducted focusing on knowledge management and knowledge maturing in general. The second sequence of two interviews was conducted using the study guideline focussing on the topics below. Interviews were recorded and transcribed. Additionally, field notes were taken during interviews. The data was evaluated using qualitative content analysis (Mayring, 2007).

In the following, a summary of results by topic is presented.

7.2.6.2   Topic 1: Why do people think that they perform KM better than others they compare themselves to?

Interviewees typically compared themselves with other organisational units, or related comparisons back to old projects. In general, interviewees had some problems in comparing themselves with respect to knowledge maturing. For this analysis, mainly knowledge maturing with respect to the community or organisation is meant rather than the personal knowledge of individuals.

The reason for a better performance of knowledge maturing named most was the informal relationship between members of the respective community. As interviewees could choose at which office space they would sit for the week up to a certain extent, they preferred to sit close to colleagues they either had to communicate with often because of tasks or with colleagues they preferred on a personal basis. The created affable atmosphere would provide a positive environment for communication on a personal basis. To a lesser degree, the willingness to share knowledge in general was named. Communities (other teams) who would be more open to colleague's requests and communicate more were considered to be more successful in knowledge maturing.

In order to measure knowledge maturing, interviewees would name indirect measures: Most of them named the successful conduction of projects and the time to develop new products as the main indicators for successful knowledge maturing.

Although, there exist project-related KPIs for the success of projects and products (which were deemed to be an indicator by several interviewees), there are currently no direct KPIs for measuring knowledge maturing. There were plans to add a possibility for employees to document working time they spent to teach colleagues and transfer knowledge but this wasn't realized up to now.

7.2.6.3   Topic 2: How is KM supported?

Both communities studied in this case are situated in the same organisation and are supported by the same organisational measures. The organisation has several 'traditional' measures in place which also aim to facilitate the maturation of knowledge: On a formal basis, there is a quality management initiative which aims at documenting business processes. This is necessary for an ISO certification which is deemed nec-

essary in the sector. This quality management-based documentation typically revisits processes continuously but has a cycle length of about two to three years and concentrates only on the 'typical' process and therefore does not include a variety of exceptions in these processes.

Another organisational measure is to foster that each employee attends at least one training per year. The topic typically is chosen by the employee and his/her team leader. Additionally, each team takes part in one joint training event per year for which the team choses a topic. Recently, all employees of the organisation had to take part in an entry-level training for project management. Besides basic knowledge about projects, two interviewees specifically stated that the so created common language in that domain was a visible improvement for working together and therefore maturing knowledge in a project.

All interviewees mentioned that time for documenting lessons learned or project results or updating documentations is too scarce. Although there are organisational guidelines to steer documentation of results, it was stated repeatedly that this isn't always fully done. This is in line with answers that mention improvable results for knowledge transfer in transition phases between projects and the operation of resulting products.

For a part of the organisation, the office paradigm itself is directly aimed at supporting knowledge maturing. Employees are encouraged to sit close to colleagues they need to communicate often with. Besides the possibility of flexible seating, the organisation introduced a guideline for their employees to work at home. Up to an amount of 25 percent of their time, they may choose to do so. Although, interviewees stated to seldom use this, they valued the possibility, especially for doing work which required a quiet environment, e.g. writing a project proposal or concept.

Employees do not necessarily sit together with colleagues from their own team. This is either because of them working at a customer's site or because they temporarily work in an office dedicated to a larger project. In order to facilitate communication in teams, there are regular team meetings (typically every two weeks). These are specifically used to create an awareness of what colleagues are currently working on and also, to communicate decisions and information along the organisational hierarchy.

As the organisation is active within the IT sector which is characterized by a constant stream of new technologies, it created a so called "innovation group". Employees can take part in regularly meetings of this group on a voluntarily basis. This group is aimed at exchanging experiences with new technologies for both, internal use and use within projects.

There are also several community-based, more informal initiatives. The organisation is organised by business areas into a consulting, a datacentre and an application support centre. Due to this structure, there are several organisational units which would need similar know-how but in different business areas. Besides formal communication, some employees decided to have regularly topic-based meetings in which employees dealing with the specific technologies come together and exchange lessons learnt. But these communities of practice are mostly based on relationships between members of the organisation so that they are not existent for all topic areas of the organisation.

A deeper look on software support for knowledge maturing is given in section 4.

7.2.6.4 Topic 3: What barriers have been overcome?

As communication is seen as a key factor for knowledge maturing, most barriers overcome could be related to phase "distribution in communities".

Within the organisation, several knowledge management-oriented initiatives have been introduced, but not all of them have been successful. In the past, knowledge has been seen as a form of personal capital that wouldn't be handed out freely. Although, this attitude has changed over time, there are still some remnants as some interviewees stated that they would share knowledge with colleagues from their own team but would be more reserved to requests from colleagues of other parts of the organisation.

Poor communication in general was also stated as a barrier for knowledge maturing which has been overcome. This was done with the introduction of several guidelines and rules for official communication within the organisation on the one hand, and several topic-related measures on the other hand. One of

these measures would be the requirement to include members of different business areas in projects above a specified size.

One barrier seen specifically by one interviewee which is important for the later phases of the KMM and isn't fully overcome yet, is the existence of different contexts and backgrounds. Depending on background and, e.g. the specific tasks or project memberships, people would use distinct vocabularies or different meanings for words. This in turn would often lead to misunderstandings. The interviewee especially mentioned this as being problem in the process of eliciting requirements from a (prospective) customer. Internally, this issue was cushioned by introducing trainings all employees had to attend (e.g., project management trainings, see above) or by standardized processes according to ITIL (an industry standard for describing and aligning processes).

Across all phases of the KMM, usability software was named as a barrier. There exist a variety of tools which may be used for knowledge maturing or tools which have to be used for the daily work. On the one hand, typical requirements, e.g., stability or performance were named. Interviewees stated that they chose not to use a software tool connected to the yellow pages of the organisation and aimed at supporting finding people because of its slow response behaviour. On the other hand, the general user interface was focused. Although the interviewees had to work with software from a large software vendor which is viewed as not user-friendly, they still weighed easy access and usage as important for tools they optionally used. The third main reason for a low usage of knowledge management tools in the past was the lack of integration with other IT tools of the organisation. Following these problems, efforts were undertaken to re-design these tools in order to improve their graphical user interface and their performance. This was accomplished by introducing a company standard for self-developed and adaptable tools used in the organisation and by integrating these tools into the organisations portal.

7.2.6.5 Topic 4: How is software used for knowledge maturing?

Employees are not allowed to install their own software. There are only a few employees for which exceptions are being made. These are mainly employees of technical support and programming departments with special requirements. Although web-based services may circumvent locally installed software to a certain degree, it can't be fully replaced with regard to functionality or interoperability. Additionally, the organisation has a rather restrictive firewall and content filtering policy so that not all web-based services are available.

Ideas directly related to implementations were typically experienced in the respective testing system, rather than documenting them first.

For maintaining their knowledge base, interviewees named the standard office tools, the company provided. This would be MS Word and Excel. However, as standardized the tools and, therefore, technical formats would be, as different would be the organisation in the specific organisational units.

One thing that would be (implicitly) more common between organisational units is the tool usage for communication as MS Outlook provides a more solid frame for the communication and discussion. Besides Outlook, with Blackberries, a mobile solution was used by all users with a flexible working space which would allow them to access their received messages and to be available for colleagues at (nearly) anytime.

Specifically, portal developers started to integrate a wiki into the organisation's internal portal in order to document their shared knowledge on varying technology. It first got noticed by other colleagues when they used it to store non-work related information (e.g., private link collections) and distributed it. Two interviewees mentioned the challenge of creating a form of guidance for this wiki as they were struggling to steer the contents back to being mostly business-related.

Besides tools provided by the organisation, interviewees also stated that exchanging knowledge with colleagues outside of the organisation was very helpful, especially when dealing and experimenting with new technologies and very specialized problems. The use of bulletin boards aimed at related communities was often mentioned. However, most interviewees stated that they would rather search for answers than actively take part in discussions or provide answers themselves.

Two interviewees stated that MS OneNote was made available to the employees some months ago. But as this tool was still quite new to them, there weren't so many colleagues who would use it. Although they were aware of its general intend, they hadn't gotten around to familiarise themselves with the use and the features.

7.2.6.6   Topic 5: What plans are there or what could generally be done to further enhance KM?

There are two measures planned in order to improve knowledge maturing. As the organisation is conducting a variety of internal and customer-related projects throughout its departments, there is currently no transparency in what projects and therefore what topics are focused by whom. Therefore, it is planned to create a dynamic overview of present projects, their topics and employees which are working in it. Additionally, competency profiles of employees will again be focused. This topic was started several years ago but dropped in usage over the last several years.

Another measure currently developed is the introduction of a balanced scorecard aimed at personnel development. It is planned to include learning-related dimensions in order to guide the development of organisational knowledge.

Besides the planned measures, interviewees specifically stated the need for a better search through existing digital resources containing (project) documentation distributed over several network shares. This issue is considered to be a main improvement for re-using knowledge and therefore reducing the time needed for developing new knowledge.

7.2.6.7   Summary

The general view among the interviewees studied was that they considered themselves successful with respect to KM. Personal relationships were seen as a main factor for being better with respect to KM than others. This perception was based around key KPIs (i.e. duration of projects or a product development, being on budget) used in the respective organizational units of the interviewees.

Communities (of practice) were seen as a major means of supporting building of personal relationships. Besides this personal level, communities were also deemed to improve KM on several levels of the maturing model. Consequently, communities are supported by the organisation through different measures.

A main challenge which was seen in the organisation was the transition from community-based topics to organisation-based topics (e.g., when contents which were developed in the wiki would be formalized and therefore used in another application).

In later phases of the KMM, different backgrounds and contexts were seen as another main issue leading to errors in communication. Although measures were introduced to solve this issue, it is still one of the main areas of interest or the organization.

The organisation has several ideas how to better support KM in the future. In the nearer future, several projects relevant aim at providing better support for competency profiles and their visualization.

7.2.7 UWAR – Case Study Report

Case study: Careers Innovation Group (UK)

Organization(s): Careers Innovation Group (CIG): group is formed of individuals (in senior positions involved with career guidance management, training or research) interested in knowledge development, sharing and maturation in careers guidance

Unit of analysis: Interstices of individual and group action (across organisations, perspectives and disciplines)

Additional topic: inter-organisational learning

Involved researchers: Alan Brown, Sally-Anne Barnes,

Involved participant researchers: Jenny Bimrose, Deirdre Hughes

Methods for data collection: interviews; participant observation; document analysis; participation in linked meetings; and researchers talked about the phenomenon with participants in related practice contexts. Data collection was approached from a position of flexible and open-ended inquiry, and the researchers adopted a stance which was curious and facilitative (rather than, say, challenging and interrogative).

Methods for data analysis: Interpretative Phenomenological Analysis (IPA): this takes an idiographic focus, whereby insights into how the interviewees / participants, in the given context of the CIG, make sense of the phenomenon of knowledge maturation. In this case we are focusing on knowledge maturation which is a key driving rationale for the group as a whole, but is also seen as having personal significance for members of the group as well as for the future development of guidance in the country as a whole.

The IPA approach also meant there was an attempt at an open-ended dialogue between researchers and participants in order to generate a richer perspective on the issue of knowledge maturation. The central theme (knowledge maturation in career guidance) is something that not only mattered a great deal to the participants (as an object of pressing concern) it also had deeper significance and meaning for the participants as it was bound up with their emotions, feelings, sense of identity and imagined futures. The analysis has sought to balance phenomenological description with insightful interpretation, while keeping a close focus on meaning for participants. The final agreed interpretation was triangulated with group participants, which should act to increase confidence in the analysis.

7.2.7.1   Introduction: context of the case

Knowledge maturation processes can be examined from a number of perspectives, the individual, the social, the organisational and inter-organisational. The careers innovation group (CIG) was set up with the explicit intention of helping individuals in an inter-organisational setting advance their individual and collective knowledge and understanding of careers innovation processes. There is a degree of recursiveness built into our analysis of their knowledge maturation processes as that was the substantive focus of the group which was set up in 2007. The group, which has 14 members drawn from different organisations, was formed to facilitate knowledge maturation processes and group members thought that this was to some extent achieved. Membership of the group was seen to provide a platform for dialogue between academics and employers in identifying 'innovation' and 'ideas' for development activities. It also offered a 'space' for reflection, updates and supporting a community of interest in policy, research and practice.

The group continues to be active and this inter-organisational 'space' was used by participants as a reflective forum where they can return to different issues and themes as these evolve, in a broader socio-political context where the organisational and opportunity structures in which careers guidance is embedded are themselves in flux. For example, there are issues about changing boundaries of the field in relation to age of clients, relations with other services, extent of engagement with the economic focus featuring in policy and practitioner discourse and political promotion of particular pathways (Science, Technology, Engineering and Maths agenda; Apprenticeships and Diplomas). Careers work involves values – it is inextricably linked to who gets to do what in society. Furthermore, in a fast changing world it is difficult to see what sort of future young people and adults are preparing for. A 'space' where members can keep up to date, be self-critical, learn from experience, learn from new knowledge, technology, and reflect on how people are brought up and the kind of lifestyles they seek was seen by group members as very valuable in helping to mature their knowledge, individually and collectively, and for that knowledge to help members make sense of the field, contextualise their activities within and beyond their own organisations and inform how their own practice might evolve in future.

7.2.7.2   Topic 1: Why the group performs knowledge maturation better than others in the field

Key aspect: Members were reflexive about the nature of knowledge maturation itself

Membership of the group encouraged participants to examine and reflect upon their different individual perspectives on knowledge and learning development. This process gave insight into differences in what and how people learn and differences in how they interpret and use what they learn. Group members could also see the importance of the social construction of knowledge and the different contexts for learn-

ing, development and practice when considering innovation in careers guidance. The different institutions to which the members belonged displayed a wide range of cultural practices and differences in support for the development of knowledge resources to support individual and organisational learning. In relation to the understanding and use of labour market information (LMI) in different guidance contexts members' organisations drew upon a variety of resources. These resources included codified knowledge embedded in texts, records, databases and repositories related to labour market information (LMI) as well as in the cultural practices involved in developing, understanding and using such resources.

The group members were also aware, however, that there was a disjunction between how these resources were intended to be used and how they were actually used in practice. Cultural knowledge in guidance organisations plays a key role in practitioner practices and other workplace activities. Members of the CIG reflected upon the extent to which such knowledge could be made explicit and then utilised to improve knowledge maturation processes related to career guidance practice. Such cultural knowledge is often acquired informally through participation in social activities and so was amenable to being drawn upon through involvement in other social activities, such as group meetings. Indeed the CIG itself was set up in order to try to achieve this purpose. The group could perform knowledge maturation in this field more effectively than their own organisations because they were given time and space for reflection on these issues and were able to draw upon and compare how practice varied across contexts and settings.

However, the CIG members were also aware that there were other knowledge development currents running outside the formal organisations concerned with guidance delivery. These currents could comprise a mixture of the individual, the social and the organisational in that they could be represented by personal knowledge, personal networks and organisations with membership drawn from many other organisations such as professional bodies. Personal knowledge was thought to represent what individuals brought to work or work-related situations that enabled them to think, interact and perform. The personal knowledge stores of members of the CIG were very rich as all members had played a number of different roles concerned with guidance practice, supervision, management, training, research, development, evaluation and policy advice in different types of organisations. The personal networks of the group were also very rich and this was important in terms of gaining access to various types of resources and support in order to support collaborative learning and development. The group saw a more general challenge, however, in how practitioners could draw on their personal knowledge and personal networks in the construction of shared or at least shareable resources which could be accessed more widely. From this perspective, the CIG were interested in processes of people tagging and shared resource development and different members of the group reported back on this and the group experimented with different possibilities for developing these approaches further.

The personalised knowledge of the members of the group involved a mixture of adaptations of public codified knowledge (for example, in relation to guidance theories and theories-in-use); knowledge of people, situations, and contexts; know-how in the form of skills, practices and ways of working; memories of particular episodes, events and relationships; self-knowledge and reflexiveness; and awareness of the role of attitudes, emotions, empathy etc in knowledge maturation processes. Reflexiveness on their own personalised knowledge helped group members articulate the importance of taking account of personalised knowledge within the broader frame of innovative approaches to knowledge maturation within career guidance practice.

The CIG members were also aware that innovation, learning and development is strongly contextualised and that means what constitutes useful knowledge could itself vary quite widely depending upon the nature of social interactions and organisational culture. This also presented a particular challenge in that those wishing to support innovation in career guidance need to have an implicit or explicit theory of the management of change, particularly when other aspects of context were themselves changing, including how practice is delivered, the nature and reach of different guidance organisations as well as the labour market itself. The group did give considerable time and thought to issues associated with the management of change rather than assuming that innovation would be relatively unproblematic.

7.2.7.3 Topic 2: How knowledge maturation processes are supported

Key aspect: Members of the group had particularly strong overlapping personal and professional networks and the group acted as a form of 'bridging social capital' across the field as a whole (which sometimes operates within distinct 'silos')

Individuals in the CIG belong to many social groups with an interest in guidance within, across and outside formal institutions. The members also meet each other in many settings, which means it is difficult to isolate the influence of the CIG and the frequency of interactions outside the group and multiple group membership of members and this in turn leads to the patterns of knowledge maturation (acquisition, sharing, development etc.) associated with the CIG which are both idiosyncratic and social. The knowledge being developed within the CIG is interpreted within a personal context and history that has been shaped by these multiple social interactions inside and outside these formal groups and by other aspects of their career and learning biographies. However, the group as a whole also acted as a form of 'bridging social capital' in that it brought together people with diverse interests within the career guidance field.

There are currently a number of discourses about the future direction and shape of career guidance, so knowledge maturation and innovation are shaped by the connotations that these discourse have and how they are being played out in a number of different groups to which the CIG members belong. The group therefore has a political function too and could be seen as one of a number of sites for critical exchange.

The CIG members were aware, however, that the formal group meetings were time-bound and that the 'bridging social capital' of individual CIG members going across different groups and organisations had a variable reach when it came to supporting knowledge maturation. The group therefore believed that one of their key tasks was to see whether it would be possible to use the three years of the CIG as an opportunity to investigate and possibly establish other ways of supporting knowledge maturation processes. One particularly useful aspect of the CIG had been the way it was operating at the boundaries between different communities and they were keen to see whether artefacts (e.g. documents or software tools) could be used to extend and deepen the communication between communities, thus making possible productive communication and 'boundary crossing' of knowledge.

One line of investigation, drawing on earlier work of some CIG members on knowledge sharing in career guidance, which was reported on to the group, developed an approach to learning based on the design of symbolic boundary objects which were intended to act as facilitators of communication across community boundaries, between teams and specialists or experts. The argument was that effective learning about key aspects of guidance practice could follow from engagement in authentic activities that embedded models of support for practice which were made more visible and manipulable through interactive software tools, which could be considered as technology-enhanced boundary objects (TEBOs), software-based resources which supported knowledge sharing across organisational boundaries.

Members of the CIG were keen to investigate further whether TEBOs could be useful in supporting knowledge maturation processes in guidance. TEBOs were conceived as boundary-crossing tools which could support situated learning with a focus upon sharing ideas about practice in different contexts. One avenue explored (within and beyond the MATURE project itself) was to engage in a dialogue with guidance practitioners about the use of Labour Market Information (LMI) in the development of prototype TEBOs. Knowledge maturation processes were being supported in these developments through the use of co-design with users; developing conceptual tools to help people understand the models and ideas which are part of LMI; attempts to develop a pedagogy to engage users and boundary objects which are configurable by end-users (practitioners) and by guidance trainers so as being capable of being used in multiple ways. The knowledge maturation processes needed to extend to building an understanding of how TEBOs may be used in ways that are empowering for practitioners, and ultimately for clients too.

The knowledge maturation processes linked to the development work with TEBOs was seen as a potential way of getting individual practitioners to interact more readily with learning resources for understanding LMI and understanding the *conceptual* challenges in interpreting the output of TEBOs: graphs; labour market predictions; charts; employment data; financial models etc.; and supporting practitioners in how to visualise, analyse and utilise LMI in new ways in the guidance process they offer to their clients. This development work was seen as illustrative of a knowledge maturation process with the potential to sup-

port learning through the dynamic visualisation of data and relationships and the consolidation, representation and transformation of knowledge.

The Careers Innovation Group also has their own website and members experimented with a number of different technologies to support collaboration, including the sharing of ideas and resources (see section 4 for more on this).

7.2.7.4 *Topic 3: What barriers have been overcome*

Key aspect: Some knowledge maturation challenges have been surmounted but others remain before the goal of using software tools to support effective knowledge maturation in guidance can be practically realised

One CIG member drew attention to the implicit theories which influence practitioners' practice and how these might need to be addressed if innovation is to be embedded. If practitioners are able to recognise and reflect upon their own implicit theories about practice, this could be a possible basis for change. Implicit theories may develop for an individual from the partly unconscious aggregation of experiences of what are perceived to be a series of similar situations, but they could also be derived from the taken-for-granted perspective and the theories in use of a particular group.

The challenges associated with knowledge maturation in guidance are compounded by the distance which already exists between 'ideal' practice and what occurs in practice, because of constraints of time, resources, amount of effort required to improve practice, organisational hurdles and cultural inertia. 'Ideal' theories of practice can be almost impossible to implement given the constraints of particular contexts. Current practice can then be uncritically accepted as an inevitable reality, and any impetus towards improving the service is undermined.

Further members of the CIG were aware, not least from discussing these issues with a range of practitioners from a variety of contexts, that the knowledge developed around effective innovations in practice would have to take cognisance of the range of organisational contexts and cultures within which practice would have to operate; the conditions under which practice would be performed, e.g., access to resources, scope for collaboration, pressure of time, conflicting priorities, etc.; and the nature of guidance interactions, in terms of client types, demands and interactions, number of sessions, opportunities for feedback, deciding action plans, reporting procedures etc.; as well as the extent to which there are opportunities to continue learning in a context of constrained time and resources, conflicting priorities and complex personal and professional relationships associated with busy practitioners with high caseloads.

Participants' knowledge maturation processes had to encompass a dialogue about the changing nature of careers and what are the key messages that need to be conveyed to those unfamiliar with this issue. Group members considered this issue and how it linked to 'What are people going to need to feel equipped to deliver that which is required from their clients or prospective clients?' and 'Where do you go to find a safe space to build confidence and increase professionalism on this topic?' Members highlighted that 'in 10 years time we don't know what jobs will be available and ways in which career trajectories will unfold. Therefore, how does the careers sector harness knowledge of labour markets and embed this at a grass roots level?' Further questions emerged such as 'what changes in practitioner knowledge, skills, behaviour and attitudes are required to achieve innovation in the workplace?' The group felt that face-to-face meetings had helped them recognise that there was a need to develop an interactive and developmental approach to engaging practitioners with such debates. Overall then, the knowledge maturation processes of the group were useful in scoping the nature of the challenges the profession faced and exploring some possible technologically-enhanced ways of tackling these issues, but for the moment these were seen as some way away from practical realisation.

7.2.7.5 *Topic 4: How software is used for knowledge maturation*

Key aspect: the freely accessible careers innovation site utilises two main elements cloudworks and write to reply.

The careers work innovation site is available at: http://www.careersinnovation.net/

The site uses Cloudworks as the major tool for social networking and discussion. The site is a social networking site for sharing information, ideas and opinions about Careers Work Innovation. Cloudworks itself is a site which defines itself as a place to share, find and discuss learning and teaching ideas and experiences (see: http://cloudworks.ac.uk/). On the careers work innovation site 'write to reply' is highlighted as a site for commenting on public reports in considerable detail (see: http://writetoreply.org/). Rather than commenting on the text as a whole, respondents are encouraged to direct comments to specific paragraphs. The careers work innovation site has acted as a 'proof of concept' about how it would be possible to generate debate and collective action in support of knowledge sharing and development in order to extend the repertoire of possible actions of the careers guidance profession in England.

The technology-enhanced boundary objects (TEBOs), mentioned in Section 2, were software-based resources which supported knowledge sharing across organisational boundaries. The TEBOs were conceived as boundary-crossing tools which could support situated learning with a focus upon sharing ideas about practice in different contexts. The development of these tools was undertaken within and beyond the MATURE project. The prototype TEBOs were co-designed with users and were intended to engage users in the sharing and development of knowledge (of Labour Market Information and other aspects of guidance practice) within and across organisational boundaries.

Because four CIG members (two researchers and two managers) were linked to the MATURE project, and other training centres and research centres were interested in project developments, there were also links to approaches which involved, for example, tagging of resources and people with particular types of expertise. Such software tools were seen as useful for Continuing Professional Development, supporting people in development of their skills profile and what they might be able to share with others, and, more generally, in encouraging reflective practice, which, in turn, could lead to a sharing of skills and knowledge. People tagging was also seen as having a possible role in leveraging specific types of staff development related to guidance practice, where people might be able to discuss the effects on practice in different contexts. It was felt that once a certain threshold of engagement of practitioners was reached then people might be able to see the value of sharing their knowledge resources and making these accessible through people tagging, and this could then lead to greater use of competency frameworks and links to more systematic forms of appraisal, review and training needs analysis. Overall, these types of software tools were not as yet ready for widespread use in professional practice, but engagement with these ideas and practices were helping CIG members to envision how practice might start to be transformed in future. Such insights, or glimpses into 'what might be', shared within the group were often valuable to individual members when they returned to their own organisations: a dialogue was being established between current practice and future possibilities which ranged across and within the different organisations and groups to which members of the CIG belonged.

7.2.7.6 Topic 5: Plans in place to enhance further knowledge maturation processes

Key aspect: will need to be a shift of focus to support knowledge maturation in particular organisational settings as well as supporting learning and development across the field as a whole

Innovation and learning within and across organisations are essentially social processes and membership of CIG enabled participants to develop both their personal networks and inter-organisational networks. These networks were developed principally through the face to face meetings, which paid attention to the importance of members building relationships to support their own knowledge and understanding of innovation and learning development, as well as focusing upon substantive issues and experimenting with software tools. Such relationship building and deepening meant members were 'positioned' to take advantage of possible organisational developments in the area of technologically-enhanced support for collaborative practice, because they had experienced experimenting in a 'safe' external environment and they had developed their own personal and professional networks of people on which they could draw in the event of their organisations developing support for practice in some of the ways experienced by group members.

This interaction between formal and informal approaches to learning, skill development and knowledge creation emerged as a particularly effective way forward for enhancing members' personal professional development and positioned them to be able to contribute to discussions as to how such tools might im-

prove organisational effectiveness in future. Membership of the CIG had operated as support for knowledge maturation processes to improve their 'readiness' to handle innovation. One avenue for the further enhancement of knowledge maturation processes would involve a switch in the site of development: from an inter-organisational group which exchanged ideas to one where some members were engaged in the management of change within their own organisations. Overcoming motivational barriers to introducing information systems for collaborative learning in the workplace was thought likely to be a pressing concern in many contexts.

However, as well as a shift in focus for some members to situational innovation in particular contexts, for others there was still the more general issue of how to support more effective use of LMI for strategic planning, for policy formulation and for information, advice and guidance (IAG). Here there was a 'continuing struggle' to affect a shift in focus from labour market *information* to labour market *intelligence*. In essence, labour market information refers to quantitative or qualitative data found in original information sources (typically available from surveys and reported in tables, spreadsheets, charts, etc.), while labour market intelligence relates to the interpretation of labour market information, referring to subsets of information that have been subjected to further analysis. This strand of knowledge maturation would continue to be supported by efforts within MATURE and related projects. The dynamic integration of different sources of LMI and further development of TEBOs were avenues which were likely to be explored further.

The CIG has been successful in creating a space for dialogue (about innovation, learning and development of practice) and the face to face format created multiple opportunities for development of professional and professional networks. For the future the question is whether technology could play a more indirect, but still important, role in opening and resourcing dialogic spaces. The group's experience of experimenting with (Web 2.0) tools to support developing collaborative understanding was that this has helped them 'get ready' for such developments but their practical implementation still faced barriers, but that this was a line of development worth pursuing.

In terms of the MATURE model membership of the CIG was felt to have been a vehicle for:

Expressing and appropriating ideas: developing a greater awareness of the issue of innovation, learning, development and knowledge maturation in careers guidance through dialogical exchange.

Distributing in communities: the group members had developed a shared understanding and had become actively aware of new possibilities and 'imagined futures' and these ideas were subsequently discussed with other individuals and organisations within the broader community of interest of careers guidance.

Formalising was at least embarked upon through a deepening of the collective understanding about the possibilities of knowledge sharing and further development, which were then translated into structured documents available through the group's website

Ad-hoc learning was realised as group members engaged with innovative practices using experimental semi-formalised structures and resources to gain experience and help develop potential boundary objects that could help facilitate knowledge maturation processes across a wider community of interest. These boundary objects had the potential of being carriers of more explicit training and development of practitioners.

Knowledge maturation processes of the group had resulted in members developing a 'readiness to learn or 'readiness to mature knowledge' of how technology might support innovation, learning and development in guidance practice. This learning and knowledge development had been achieved through scaffolding (support) and reflection in face to face settings where peers had been experimenting with technology to collectively develop their understanding, thereby co-enculturating and developing one another. The challenge for the future is whether social software tools can produce similar support to takes participants to higher levels of understanding, which in turn makes the artefacts created increasingly useful for practitioners. The use of social software to support knowledge sharing for guidance practitioners is already being used in embryonic ways, but maybe to start to transform understanding of what is possible requires a more 'open pedagogy' in the production of digital boundary objects. This line of development will continue within and beyond the MATURE project.

In this case we were dealing with individuals and a group who share the MATURE vision, whereby they accord a high priority to a collaborative and open approach to the improvement of knowledge maturing processes. The group members also thought that their organisations were likely to become more interested in improvement of their knowledge maturing processes and group membership was 'one way to get ahead of the game.' Participation in the group was viewed not only as a possible mechanism for technology and process transfer but also as a means of generating an exchange of ideas about practice, development and innovation. It gave people not only access to innovative ideas, but also opportunities to shape these ideas in ways that were directly useful to them in their practice.

7.2.7.7 Summary

The in-depth study of the Careers Innovation Group (CIG) was successful in highlighting how collaborative knowledge maturation processes could be useful in preparation for support for inter-organisational learning and knowledge development. The group members drawn from 14 different organisations were given time and space to reflect upon how to support innovation, learning and development in careers guidance. They were able to draw upon and compare a wealth of understanding of how practice varied across contexts and settings. The most valuable aspect of support for knowledge maturation in the CIG was that it provided a 'space' where members could keep up to date, be self-critical, learn from experience, learn from new knowledge, technology, and be reflexive. These processes helped members to mature their knowledge, individually and collectively, and for that knowledge to help members make sense of the field, contextualise their activities within and beyond their own organisations and inform how their own practice might evolve in future. Members of the group had particularly strong overlapping personal and professional networks and the group acted as a form of 'bridging social capital' across the field as a whole (which sometimes operates within distinct 'silos'). For the future members felt there was a need to shift the focus to supporting knowledge maturation in particular organisational settings.

7.3 Cross-case analysis

7.3.1 Topic 1 – Reasons for better knowledge maturing

After collecting the different reasons that are deemed to influence the performance of knowledge maturing, we asked each partner to classify each reason found in his/her case according to:

- Scope: Individual (I), community (C), organisational (O)
- Knowledge Dimensions: Artefacts (A), cognifacts (C), sociofacts (S)

For both scope (table 15) and knowledge dimensions (table 16), each reason (in lines) is classified for each case (in columns). For example, a "CO" means, that the reason is relevant on a community and on an organisational level.

Reason	FZI1	FZI2	TUG	UIBK1	UIBK2	UPB	UWAR
Accessibility of knowledge		CO		ICO		ICO	I
Availability of different channels for sharing knowledge		CO	O	CO			C
Best practice model to improve workflows, tasks or processes						O	
Community of practice offering advanced training and expert finding						IC	
Employees' attitude towards and awareness of KM activities	IC	CO			IO	IO	
Employees' reflexiveness about the nature of KM itself						ICO	I

	FZI1	FZI2	TUG	UIBK1	UIBK2	UPB	UWAR
Informal Relationships		C	C		I	C	C
Mechanisms de-freezing thought patterns			O			O	
Willingness to share knowledge	I	IC		I	I	ICO	C

Table 15: Reasons affecting performance of knowledge maturing: individual (I), community (C), organisational (O)

Reason	FZI1	FZI2	TUG	UIBK1	UIBK2	UPB	UWAR
Accessibility of knowledge		AS		AC		ACS	AC
Availability of different channels for sharing knowledge		AS	AS	AS			S
Best practice model to improve workflows, tasks or processes						AS	
Community of practice offering advanced training and expert finding						CS	
Employees' attitude towards and awareness of KM activities	ACS	ACS		S		ACS	
Employees' reflexiveness about the nature of KM itself						ACS	C
Informal Relationships		ACS	S		S	ACS	S
Mechanisms de-freezing thought patterns			CS			ACS	
Willingness to share knowledge	AS	ACS		S	S	ACS	S

Table 16: Reasons affecting performance of knowledge maturing: artefacts (A), cognifacts (C), sociofacts (S)

7.3.2 Topic 2 – Measures for knowledge maturing

After collecting the different measures that the studied organisations employed to foster the performance of knowledge maturing, we asked each partner to map each measure highlighted in his/her case according to:

- Scope: Individual (I), community (C), organisational (O)
- Knowledge Dimensions: Artefacts (A), cognifacts (C), sociofacts (S)

For both scope (table 17) and knowledge dimensions (table 18), each reason (in lines) is classified for each case (in columns). For example, a "CO" means, that the reason is relevant on a community and on an organisational level.

Measure	FZI1	FZI2	TUG	UIBK1	UIBK2	UPB	UWAR
Acting as "claimant"				I			
Appropriate competency allocation in projects			O	OC		CO	
Formal trainings at regular intervals				OI	OI	ICO	
Fostering reflection on innovation by enabling purpose-oriented task groups		IC			OC	ICO	C
Fostering topics by conducting community of practice meetings		CO	C		C	CO	C
Guidance by supervisors and management in general					IO	CO	
Initiatives enabling awareness and orientation for quality management					O	O	

Measure	FZI1	FZI2	TUG	UIBK1	UIBK2	UPB	UWAR
One supervisor for teams in different subsidiaries				OC			
Organisational guidelines for documenting knowledge				OI	O	O	
Performing benchmarks	O			O		ICO	
Providing office spaces for flexible use and enabling home office					OC		
Provision of IT	ICO	ICO	OC	O		O	CO
Regular (team) meetings	CO			O	O	CO	
Technology-enhanced boundary objects						C	C
Workshops on specific topics				OCI	CO	CO	
Fostering of shared topic related understanding within a group or between groups in the company						ICO	
Competition-based idea management						CO	
Collaborative activities to increase a group's performance within a company						CO	
Written or unwritten rules which contribute to efficiency and effectiveness of communication						CO	

Table 17: Measures used in organisations for supporting KM (I/C/O)

Measure	FZI1	FZI2	TUG	UIBK1	UIBK2	UPB	UWAR
Acting as "claimant"				ACS			
Appropriate competency allocation in projects			S	CS		S	
Formal Trainings at regular intervals				C	C	CS	
Fostering reflection on innovation by enabling purpose-oriented task groups		CS			S	S	AS
Fostering topics by conducting community of practice meetings		AS	S		S	S	S
Guidance by supervisors and management in general				ACS		ACS	
Initiatives enabling awareness and orientation for quality management					AS	AS	
One supervisor for teams in different subsidiaries				S			
Organisational guidelines for documenting knowledge				AS	AS	AS	
Performing benchmarks	CS			CS		ACS	
Providing office spaces for flexible use and enabling home office					S		
Provision of IT	A	ACS	A	ACS		ACS	AS
Regular (team) meetings	A			S	S	S	
Technology-enhanced boundary objects						A	A
Workshops on specific topics				CS	CS	CS	
Fostering of shared topic related understanding within a group or between groups in the company						ACS	
Competition-based idea management						ACS	
Collaborative activities to increase a group's performance within a company						CS	
Written or unwritten rules which contribute to efficiency and effectiveness of communication						ACS	

Table 18 Measures used in organisations for supporting KM (S/C/A)

7.4 Additional input on Guidance

7.4.1 FZI1

Roles

- guided person in group: peer
- guiding person or collective: peer or support from group as a whole, also experts

Activities

- meetings to secure technical and other processes for the progress of projects
- high level of standardised software in use
- providing feedback to the employees
- embed information at individual or organisational level
- keep up-to-date with organisation-related knowledge
- restrict access and protect digital resources, e.g. very strict rules and guidelines about hardware and software usage

Artefacts

- access and update of information about similar projects on the intranet

7.4.2 FZI2

Roles

- guided person in group: peer
- guiding person or collective: peer or support from group as a whole, also experts

Activities

- meetings to secure technical and other processes for the progress of projects
- high level of standardised software in use
- providing feedback to the employees
- supporting discussion with regard to an open-minded organisational culture
- find relevant digital resources
- embed information at individual or organisational level
- keep up-to-date with organisation-related knowledge
- restrict access and protect digital resources, e.g. very strict rules and guidelines about hardware and software usage
- in-house exhibitions offer guidance to latest developments within the organisation

Artefacts

- access and update of information about similar projects on the intranet
- project related forums, blogs and shared network storage
- latest technology (3D technology for car manufacturing) guides the construction process

7.4.3 TUG

Roles

- experienced colleagues (guiding)
  - employees who have gained expertise in specific knowledge domains organize and lead internal workshops to discuss and distribute problem solutions

- they keep an overview of wiki articles related to their field of expertise
- project managers (guiding)
  - continually address the importance of reflecting upon own and organizational learning processes

Activities

- supporting discussions
  - e.g. by organizing workshops
- provide information
  - by consolidating wiki-articles
- encourage
  - to participate in the reflection of work processes (i.e., in writing wiki-articles about problems/solutions, as well as in reading articles of colleagues)
- irritate
  - by making aware of different perspectives within the same organization

Artefacts

- internal Wiki-articles
  - externalizing learning processes with respect to problems in the field of customer support and software development
- Information on intranet
  - faqs of customers and corresponding problem solutions
  - PowerPoint Presentations of workshops

7.4.4 UPB

Roles

- Boundary Spanner (guiding)
  - Boundary spanner is a member of the transition team (see 4.1.6 / 7.2.4) and coordinates the approved communication between his team and the clients employees as a 'single point of contact'
- Member of the Transition Team (guiding and being guided)
  - Members of the team organize transition processes at their clients and guide employees of the client as well as members of the team at the 'lean company' that provides new lean services
  - Transition team members are guided by their team leaders
- Owner of Changing Roles (guiding and being guided)
  - Members of the transition teams are changing roles with the employees of clients in order to clearly understand the process which is subject of modification. After this phase of informal learning they act as trainers to their colleagues in then transition team, reporting about their experiences and give advice with regard to improve the process.
- Transition Team Leader (guiding and being guided)
  - Guides members of his/her team and is guided by quality manager during transition process
- Process Owner (guiding)
  - Is a person who is responsible for a company-wide approved specific best practice process in a global process model (GPM). Changes in the process model, due to new practice-related experiences, must be approved by the global process owner.
- Content Manager (guiding)

- ◦ Is a global, company-wide known 'subject domain expert' who acts as a consultant to transmission teams in different regional contexts and is involved in negotiations concerning changes in the global process model (GPM)
- Quality Manager (guiding)
  - ◦ Acts as a member of the 'delivery excellence team' and is responsible for the alignment of restructured processes at the client with the global process model
  - ◦ Co-ordinates the work of different transition teams via measurement (Key Performance Indicators) and regularly held meetings between the transition team leaders
- Learning and Development Manager (guiding)
  - ◦ Person who is responsible for personal development plans of the employees and their alignment with the training-needs of the transition teams and the company
- Manager for Compensation & Benefits (guiding)
  - ◦ Person who contributes to the realization of company-internal competitions, ovational awards and other activities within the company's incentive system

Activities

- meetings with clients to improve technical processes and inter-group communication for the advancement of the project and getting feed-back on the change management (customer satisfaction)
- internal transition team meetings for individual and team-related self-assessment and reflection on the quality of the change management and the group's performance
- meetings between members of the transition team and employees of the company for outsourced processes in order to provide process related training and quality assurance
- acting according to a governance model in order to achieve a high level of standardization of documents and processes (quality assurance)
- defining global standards and sharing best practices and standards in global company-wide workshops
- using benchmarking indicators for feedback to the employees and the needs of quality assurance
- find relevant information in the company's data bases and intranet resources
- finding expertise for needs of problem solving and advanced training
- restructure processes in alignment with a global process model by regarding process, technology, policy and organizational issues
- contextualize processes-models under consideration of regional and local requirements
- changing roles and obligations within a transition team for better mutual understanding
- improving the best practice global process model after a well-defined approval procedure
- fostering creativity of groups by building teams with mixed expertise
- restrict access and protect digital resources
- organizing competition (ovational awards, gratification) between teams and individuals for continuous improvement of team performance
- organizing regional and global exhibitions and events of the company as market places for exchanging new concepts and ideas

Artefacts

- Regularly updated documents containing information about similar projects on the intranet (database, Wiki)
- project related 'virtual meeting rooms' forums, blogs, shared network storage and data base
  - ◦ the documents (mainly word, pdf, excel, visio) contain e.g. detailed process descriptions on six different levels of abstraction and aggregation:
    - ▪ (6) Desktop procedures [gained by observation, key and interface recording…]
    - ▪ (5) Mapping clients specifies [context-related annotation to the process]

- ▪ (4) Process flow and narratives on processes [procedure maps and stories]
- ▪ (2&3) Process flow [aggregation levels and de-contextualized description of process]
- ▪ (1) Process Group [more abstract description and aggregation of similar processes]
- company 'idea database' for the dissemination of innovative ideas supporting the company's objective of 'continous improvement'
- Company-wide accessible global data base that provides best practice processes (Global Process Model)
- data base on governance model that rules approval-procedures for documents with regard to their status of maturity and describe patterns of interaction with clients (rule book)
- Documents on Individual Service Quality Plans that align personal development plans with the needs of groups and the company according to quality indicators

7.4.5 UIBK1

Roles

- boundary spanner (guiding and being guided):
  - ◦ supervisors leading teams (possibly of other supervisors) in different subsidiaries or employees having regular meetings with representatives of other departments.
  - ◦ This role is seen as having a positive influence on the exchange and development of knowledge in general.
- internal consultant (guiding):
  - ◦ an employee acting as internal consultant observes situation(s) in other departments and guides employees and supervisor of respective department on possible enhancements.
- team leader (guided by employee):
  - ◦ employees with expert knowledge in certain areas recommend deciding on further development of certain knowledge.
- team leader (guiding employee(s)):
  - ◦ supervisors jointly agree on sending one or more of their employees to a workshop with specific topic to support networking of employees with similar background.
- claimant (guiding):
  - ◦ someone (ideally in a relatively powerful position) who stresses a demand to change and enhance current knowledge.
- supervisor (guidance through giving legitimation):
  - ◦ supervisor acting as valuable filter guiding employees only to further develop selected knowledge

Activities

- give legitimation (guide):
  - ◦ performed by supervisors or managers that decide on which knowledge should be further developed depending on goals (of organisation)
- claim (guide):
  - ◦ performed by supervisors, managers or employees that claim further development of certain knowledge deemed to have benefit
- interview (being guided):
  - ◦ performed, e.g., by internal consultants who aim at creating transparency, e.g., with respect to performed processes
- observe (being guided; prepare for guiding):
  - ◦ performed by internal consultants in order to evaluate knowledge that could be further developed

- evaluate (prepare for guiding):
  - performed by supervisors and employees in preparation of several guidance activities that are based on a (joint) reflection

Artefacts
- e-mail:
  - intensively used for creating common understanding and communication around guidance activities
- PDFs in content management system:
  - used as single source of truth in that is used to back, e.g., decisions or (standard) operations
- word files containing process descriptions:
  - created based on interviews and used for assessment and feedback for further enhancement of processes
- intranet web pages:
  - describing how to proceed in certain situation

7.4.6 UIBK2

Roles
- mentor (guiding)
  - employees being in the organisation for a longer time are assigned to new colleagues in order to guide them to the organisation's processes
- team leader (guiding)
  - team leader is guiding his employees a) with regard to soft skills, e.g. how to approach problems and b) what specific knowledge to focus for developing further

Activities
- provide information
  - on where to find experts on a topic
  - where to find documents / problem solutions
- discuss
  - help people on reflecting problems

Artefacts
- email
  - with helpful advice from a colleague
- Information on the intranet
  - some FAQs and How-Tos on products and tools that were added in parallel to the official process for contents on the intranet

7.4.7 UWAR

Roles
- Guided person in group: peer
- Guiding person or collective: peer or support from group as a whole
- The members of the group are also themselves guidance practitioners and engage in the following activities (e.g., activities that are performed in order to guide or to support guiding)

Activities
- scaffolding to help people learn

- responding to requests for information.
- Provision of information on learning and work
- Information about access to opportunities.
- Signposting where to find information
- Signposting where to get further support.
- Providing the most up-to-date and accurate information
- Providing information on trends
- Enabling information on how to
- Facilitating use of learning and career planning or career management tools.
- Signposting information on what is and what is not available
- availability of specialist support for the provision of advice requiring more interaction with the service user
- giving some explanation of some of the information provided, how to access and use information, and a recognition of when more in-depth services may be required by the user.
- Support for interpreting any information and taking into account personal circumstances;
- support for an individualised service tailored to users' needs;
- support for personalised information including possible referral to in-depth services;
- support for helping users to use decision making tools;
- support for helping service users to link their personal interests and/or skills to their desired job/career requirements;
- support for identifying skills needs and referring those clients to sources of help
- support for meaningful interpretation of (Labour Market) Information and Intelligence;
- advice around services available including how to access them, whom to contact etc.
- advice on job search methods (CV, interview skills, applications for support or referral to enhanced services)
- support for considering possible progression paths, personalising options;
- support for knowing what is and is not available and/or possible and discussing alternatives

Artefacts
- information on learning and work
- Information about access to opportunities.
- Signposts of where to find information; where to get further support; information on what is and what is not available
- Content (the most up-to-date and accurate information; information on trends; information on how to
- Learning and career planning or career management tools.
- Specialist support services - advice requiring more interaction with the service user (including explanation of some of the information provided, how to access and use information, and a recognition of when more in-depth services may be required by the user).

7.5 KM Indicators

ID	Level 1	Level 2	Level 3	Indicator	Topic-Dependent	Level of Justification
I.	Artefacts					
I.1	Artefacts	Artefact characteristics				
I.1.1	Artefacts	Artefact characteristics				
I.1.1.1	Artefacts	Artefact characteristics	Artefact quality characteristics	An artefact has changed its degree (score) of readability		validated by Wikipedia study
I.1.1.2	Artefacts	Artefact characteristics	Artefact quality characteristics	An artefact has changed its degree (score) of structuredness		validated by Wikipedia study
I.1.1.3	Artefacts	Artefact characteristics	Artefact quality characteristics	An artefact has changed its degree (score) of formality		individual proposal (FZI)
I.1.2	Artefacts	Artefact characteristics	Artefact metadata characteristics	An artefact's meta-data has changed its quality characteristics		individual proposal (FZI)
I.2	Artefacts	Creation context and editing				
I.2.1	Artefacts	Creation context and editing	creator			
I.2.1.1	Artefacts	Creation context and editing	creator	An artefact has been changed after an individual had learned something		validated by RepStudy
I.2.1.2	Artefacts	Creation context and editing	creator	An artefact has been edited by a highly reputable individual		validated by RepStudy
I.2.1.3	Artefacts	Creation context and editing	creator	An artefact has been created/edited/co-developed by a diverse group		individual proposal (FZI)
I.2.2	Artefacts	Creation context and editing	purpose			
I.2.2.1	Artefacts	Creation context and editing	purpose	An artefact has been changed as the result of a process		validated by RepStudy
I.2.2.2	Artefacts	Creation context and editing	purpose	An artefact was prepared for a meeting		validated by RepStudy
I.2.2.3	Artefacts	Creation context and editing	purpose	An artefact describing a process has been changed		validated by RepStudy
I.2.3	Artefacts	Creation context and editing	creation process			
I.2.3.1	Artefacts	Creation context and editing	creation process	An artefact was created/refined in a meeting		validated by RepStudy
I.2.3.2	Artefacts	Creation context and editing	creation process	An artefact was created by integrating parts of other artefacts		validated by RepStudy
I.2.3.3	Artefacts	Creation context and editing	creation process	An artefact has been the subject of many discussions		validated by RepStudy
I.2.3.4	Artefacts	Creation context and editing	creation process	An artefact has not been changed for a long period after intensive editing		validated by RepStudy
I.2.3.5	Artefacts	Creation context and editing	creation process	An artefact is edited after a guidance activity		individual proposal (FZI), used in D3
I.2.3.6	Artefacts	Creation context and editing	creation process	An artefact is edited intensively within a short period of time		individual proposal (FZI), used in D3
I.2.3.7	Artefacts	Creation context and editing	creation process	An artefact has been changed to a lesser extent than previous version(s)		individual proposal (UIBK)
I.2.3.8	Artefacts	Creation context and editing	creation process	An artefact was changed in type		validated by APStudy
I.3	Artefacts	Usage				
I.3.1	Artefacts	Usage		An artefact has achieved a high degree of awareness among others		individual proposal (FZI)
I.3.2	Artefacts	Usage		An artefact is used widely		suggested in RepStudy
I.3.3	Artefacts	Usage		An artefact was selected from a range of artefacts		validated by RepStudy
I.3.4	Artefacts	Usage		An artefact became part of a collection of similar artefacts		validated by RepStudy
I.3.5	Artefacts	Usage		An artefact was made accessible to a different group of individuals		validated by RepStudy
I.3.6	Artefacts	Usage		An artefact is referred to by another artefact		validated by RepStudy
I.3.7	Artefacts	Usage		An artefact was presented to an influential group of individuals		validated by RepStudy
I.3.8	Artefacts	Usage		An artefact has been accessed by a different group of individuals		validated by RepStudy
I.3.9	Artefacts	Usage		An artefact has been used by an individual		validated by RepStudy
I.3.10	Artefacts	Usage		An artefact was changed		validated by APStudy
I.4	Artefacts	Rating & legitimation				
I.4.1	Artefacts	Rating & legitimation		An artefact has been accepted into a restricted domain		validated by RepStudy
I.4.2	Artefacts	Rating & legitimation		An artefact has been recommended or approved by management		individual proposal (FZI)
I.4.3	Artefacts	Rating & legitimation		An artefact has become part of a guideline or has become standard		validated by RepStudy
I.4.4	Artefacts	Rating & legitimation		An artefact has been rated high		individual proposal (FZI), used in D1
I.4.5	Artefacts	Rating & legitimation		An artefact has been certified according to an external standard		for "process": validated by RepStudy
I.4.6	Artefacts	Rating & legitimation		An artefact has been assessed by an individual		validated by RepStudy
II	Individual capabilities					
II.1	Individual capabilities	Individual activities				
II.1.1	Individual capabilities	Individual activities		An individual has acquired a qualification or attended a training course	x	validated by RepStudy
II.1.2	Individual capabilities	Individual activities		An individual has contributed to a project	x	validated by RepStudy
II.1.3	Individual capabilities	Individual activities		An individual has contributed to a discussion	x	validated by RepStudy
II.1.4	Individual capabilities	Individual activities		An individual is approached by others for help and advice	x?	validated by RepStudy
II.1.5	Individual capabilities	Individual activities		An individual has significant professional experience	x?	validated by RepStudy
II.1.6	Individual capabilities	Individual activities		An individual is an author of many documents	x?	validated by RepStudy
II.2	Individual capabilities	Individual - organization				
II.2.1	Individual capabilities	Individual - organization		An individual changed its role or responsibility		validated by RepStudy
II.2.2	Individual capabilities	Individual - organization		An individual has been a member of the organisation for a significant period of time		validated by RepStudy
II.2.3	Individual capabilities	Individual - organization		An individual has been involved in a process a number of times		validated by RepStudy
II.2.4	Individual capabilities	Individual - organization		An individual has been involved in a process for a significant period of time		validated by RepStudy
II.2.5	Individual capabilities	Individual - organization		An individual has been the owner of a process for a significant period of time		validated by RepStudy
II.3	Individual capabilities	Individual - group				
II.3.1	Individual capabilities	Individual - group		An individual has a central role within a social network	x	validated by RepStudy
II.3.2	Individual capabilities	Individual - group		An individual changed its degree of cross-topic participation		proposal at CMLondon (FZI; UBP; UIBK)
II.4	Individual capabilities	Rating, assessment				
II.4.1	Individual capabilities	Rating, assessment		An individual has been rated with respect to expertise		individual proposal (FZI), used in D3
III	Topic					
III.1	Topic	Activities				
III.1.1	Topic	Activities		Topic has been searched for	x	individual proposal (FZI), used in D3
III.1.2	Topic	Activities		Topic has been associated with an artefact	x	individual proposal (FZI)
III.1.3	Topic	Activities		Topic has been associated with an individual	x	individual proposal (FZI), used in D3
III.1.4	Topic	Activities		Topic has been described/documented (or the documentation has improved) in an artefact	x	individual proposal (FZI), used in D2,D3
IV	Sociofacts					
IV.1	Sociofacts	Process/task (knowledge)				
IV.1.2	Sociofacts	Process/task (knowledge)		A process has been successfully undertaken a number of times		validated by RepStudy
IV.1.3	Sociofacts	Process/task (knowledge)		A process was certified or standardised according to external standards		validated by RepStudy
IV.1.4	Sociofacts	Process/task (knowledge)		A process was internally agreed or standardised		validated by RepStudy
IV.1.5	Sociofacts	Process/task (knowledge)		A process was changed by adding or deleting steps		validated by RepStudy
IV.1.6	Sociofacts	Process/task (knowledge)		A process was documented		validated by RepStudy
IV.1.7	Sociofacts	Process/task (knowledge)		A process was changed according to the number of cycles (loops)		validated by RepStudy
IV.1.8	Sociofacts	Process/task (knowledge)		A process was changed according to the number of decisions		validated by APStudy
IV.1.9	Sociofacts	Process/task (knowledge)		A process was changed according to the number of participants		validated by APStudy
IV.2	Sociofacts	Quality of social network				
IV.2.1	Sociofacts	Quality of social network		An individual changed its degree of networkedness		individual proposal (FZI)
IV.2.2	Sociofacts	Quality of social network		An individual changed its degree of participation	x	proposal at CMLondon (FZI; UBP; UIBK)
IV.2.4	Sociofacts	Quality of social network		An individual changed its intensity of social action	x	proposal at CMLondon (FZI; UBP; UIBK)
IV.2.5	Sociofacts	Quality of social network		A group of individuals changed their degree of external involvement	x	proposal at CMLondon (FZI; UBP; UIBK)
IV.2.6	Sociofacts	Quality of social network		A group of individuals changed their degree of heterogeneity	x	proposal at CMLondon (FZI; UBP; UIBK)
IV.3	Sociofacts	Agreement				proposal at CMLondon (FZI; UBP; UIBK)
IV.3.1	Sociofacts	Agreement		A group of individuals created a consensus artefact	x	proposal at CMLondon (FZI; UBP; UIBK)
IV.4	Sociofacts	Collective capability				
IV.4.1	Sociofacts	Collective capability		A group of individuals has established a reflective practice		suggested in RepStudy
IV.4.2	Sociofacts	Collective capability		A group of individuals changed their (systematic) approach to organizational development		individual proposal (FZI)
IV.4.3	Sociofacts	Collective capability		A group of individuals meets certain quality criteria for collaboration		suggested in RepStudy
V	Impact/performance					
V.1	Impact/performance	Performance				
V.1.1	Impact/performance	Performance		The performance of a process has improved		suggested in RepStudy
V.1.2	Impact/performance	Performance		The performance of a group of individuals has improved		suggested in RepStudy
V.1.3	Impact/performance	Performance		A process was improved with respect to time, cost or quality		validated by RepStudy
V.2	Impact/performance	Quality				
V.2.1	Impact/performance	Quality		The output of a process (product/service) has improved with respect to quality		suggested in RepStudy
V.3	Impact/performance	Impact				
V.3.1	Impact/performance	Impact		The customer satisfaction has improved		suggested in RepStudy

Table 19: Classification of KM indicators

Table 20: Summary on KM indicator mappings – instantiation: Connexions Northumberland

ID and KM Indicator	transition (target phase)									inner-phase maturing									not m.	sum
	Ia	Ib	II	III	IV1	IV2	V1a	V2a	Vb	Ia	Ib	II	III	IV1	IV2	V1a	V2a	Vb		
I.																				
I.1																				
I.1.1																				
I.1.1.1 [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of readability																				
I.1.1.2 [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of structuredness			X	X																X
I.1.1.3 [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of formality												X								X
I.1.1.x [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of ...																				
I.1.2 [Artefacts] [Artefact as such] - An artefact's meta-data has changed its quality characteristics																				
I.2																				
I.2.1																				
I.2.1.1 [Artefacts] [Creation context and editing] - An artefact has been changed after an individual had learned something											X									X
I.2.1.2 [Artefacts] [Creation context and editing] - An artefact has been edited by a highly reputable individual																				
I.2.1.3 [Artefacts] [Creation context and editing] - An artefact has been created/edited/co-developed by a diverse group												X								X
I.2.2																				
I.2.2.1 [Artefacts] [Creation context and editing] - An artefact has been changed as the result of a process												X								X
I.2.2.2 [Artefacts] [Creation context and editing] - An artefact was prepared for a meeting																				
I.2.2.3 [Artefacts] [Creation context and editing] - An artefact describing a process has been changed																				
I.2.3																				
I.2.3.1 [Artefacts] [Creation context and editing] - An artefact was created/refined in a meeting	X																			X
I.2.3.2 [Artefacts] [Creation context and editing] - An artefact was created by integrating parts of other artefacts																				
I.2.3.3 [Artefacts] [Creation context and editing] - An artefact has been the subject of many discussions												X								X
I.2.3.4 [Artefacts] [Creation context and editing] - An artefact has not been changed for a long period after intensive editing																				
I.2.3.5 [Artefacts] [Creation context and editing] - An artefact is edited after a guidance activity																				
I.2.3.6 [Artefacts] [Creation context and editing] - An artefact is edited intensively within a short period of time																				
I.2.3.7 [Artefacts] [Creation context and editing] - An artefact has been changed to a lesser extent than previous version(s)																				
I.2.3.8 [Artefacts] [Creation context and editing] - An artefact was changed in type																				
I.3																				
I.3.1 [Artefacts] [Usage] - An artefact has achieved a high degree of awareness among others																				
I.3.2 [Artefacts] [Usage] - An artefact is used widely																				
I.3.3 [Artefacts] [Usage] - An artefact was selected from a range of artefacts											X									X
I.3.4 [Artefacts] [Usage] - An artefact became part of a collection of similar artefacts											X									X
I.3.5 [Artefacts] [Usage] - An artefact was made accessible to a different group of individuals	X										X									X
I.3.6 [Artefacts] [Usage] - An artefact is referred to by another artefact												X								X
I.3.7 [Artefacts] [Usage] - An artefact was presented to an influential group of individuals																				
I.3.8 [Artefacts] [Usage] - An artefact has been accessed by a different group of individuals			X																	X
I.3.9 [Artefacts] [Usage] - An artefact has been used by an individual	X		X								X									X
I.3.10 [Artefacts] [Usage] - An artefact was changed	X																			X
I.4																				
I.4.1 [Artefacts] [Rating & legitimation] - An artefact has been accepted into a restricted domain	X	X																		X
I.4.2 [Artefacts] [Rating & legitimation] - An artefact has been recommended or approved by management																				
I.4.3 [Artefacts] [Rating & legitimation] - An artefact has become part of a guideline or has become standard																				
I.4.4 [Artefacts] [Rating & legitimation] - An artefact has been rated high																			X	X
I.4.5 [Artefacts] [Rating & legitimation] - An artefact has been certified according to an external standard																				
I.4.6 [Artefacts] [Rating & legitimation] - An artefact has been assessed by an individual	X																			X
II																				
II.1																				
II.1.1 [Individual capabilities] [Individual activities] - An individual has acquired a qualification or attended a training course																				
II.1.2 [Individual capabilities] [Individual activities] - An individual has contributed to a project																				
II.1.3 [Individual capabilities] [Individual activities] - An individual has contributed to a discussion	X																		X	X
II.1.4 [Individual capabilities] [Individual activities] - An individual is approached by others for help and advice											X									X
II.1.5 [Individual capabilities] [Individual activities] - An individual has significant professional experience																				
II.1.6 [Individual capabilities] [Individual activities] - An individual is an author of many documents																				
II.2																				
II.2.1 [Individual capabilities] [Individual - organization] - An individual changed its role or responsibility																				
II.2.2 [Individual capabilities] [Individual - organization] - An individual has been a member of the organisation for a significant period of time																				
II.2.3 [Individual capabilities] [Individual - organization] - An individual has been involved in a process a number of times																				
II.2.4 [Individual capabilities] [Individual - organization] - An individual has been involved in a process for a significant period of time																				
II.2.5 [Individual capabilities] [Individual - organization] - An individual has been the owner of a process for a significant period of time																				
II.3																				
II.3.1 [Individual capabilities] [Individual - group] - An individual has a central role within a social network																				
II.3.2 [Individual capabilities] [Individual - group] - An individual changed its degree of cross-topic participation																				
II.4																				
II.4.1 [Individual capabilities] [Rating, assessment] - An individual has been rated with respect to expertise			X								X									X
III																				
III.1																				
III.1.1 [Knowledge/topic] [Activities] - Knowledge has been searched for																			X	X
III.1.2 [Knowledge/topic] [Activities] - Knowledge has been associated with an artefact																			X	X
III.1.3 [Knowledge/topic] [Activities] - Knowledge has been associated with an individual																			X	X
III.1.4 [Knowledge/topic] [Activities] - Knowledge has been described/documented (or the documentation has improved) in an artefact																				
IV																				
IV.1																				
IV.1.2 [Sociofacts] [Process/task (knowledge)] - A process has been successfully undertaken a number of times																				
IV.1.3 [Sociofacts] [Process/task (knowledge)] - A process was certified or standardised according to external standards																				
IV.1.4 [Sociofacts] [Process/task (knowledge)] - A process was internally agreed or standardised																				
IV.1.5 [Sociofacts] [Process/task (knowledge)] - A process was changed by adding or deleting steps																				
IV.1.6 [Sociofacts] [Process/task (knowledge)] - A process was documented																				
IV.1.7 [Sociofacts] [Process/task (knowledge)] - A process was changed according to the number of cycles (loops)																				
IV.1.8 [Sociofacts] [Process/task (knowledge)] - A process was changed according to the number of decisions																				
IV.1.9 [Sociofacts] [Process/task (knowledge)] - A process was changed according to the number of participants																				
IV.2																				
IV.2.1 [Sociofacts] [Quality of social network] - An individual changed its degree of networkedness																			X	X
IV.2.2 [Sociofacts] [Quality of social network] - An individual changed its degree of participation																			X	X
IV.2.4 [Sociofacts] [Quality of social network] - An individual changed its intensity of social action																				
IV.2.5 [Sociofacts] [Quality of social network] - A group of individuals changed their degree of external involvement																				
IV.2.6 [Sociofacts] [Quality of social network] - A group of individuals changed their degree of heterogeneity																				
IV.3																				
IV.3.1 [Sociofacts] [Agreement] - A group of individuals created a consensus artefact																				
IV.4																				
IV.4.1 [Sociofacts] [Collective capability] - A group of individuals has established a reflective practice																				
IV.4.2 [Sociofacts] [Collective capability] - A group of individuals changed their (systematic) approach to organizational development																				
IV.4.3 [Sociofacts] [Collective capability] - A group of individuals meets certain quality criteria for collaboration																				
not mapped				X															X	X
sum	X	X	X	X							X	X							X	X

167

ID and KM Indicator	transition (target phase)									inner-phase maturing									n/a	sum
	Ia	Ib	II	III	IV1	IV2	V1a	V2a	Vb	Ia	Ib	II	III	IV1	IV2	V1a	V2a	Vb		
I.																				
I.1																				
I.1.1																				
I.1.1.1 [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of readability												X								X
I.1.1.2 [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of structuredness												X								X
I.1.1.3 [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of formality												X								X
I.1.1.x [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of ...																				
I.1.2 [Artefacts] [Artefact as such] - An artefact's meta-data has changed its quality characteristics												X								X
I.2																				
I.2.1																				
I.2.1.1 [Artefacts] [Creation context and editing] - An artefact has been changed after an individual had learned something			X								X									X
I.2.1.2 [Artefacts] [Creation context and editing] - An artefact has been edited by a highly reputable individual			X																	X
I.2.1.3 [Artefacts] [Creation context and editing] - An artefact has been created/edited/co-developed by a diverse group			X																	X
I.2.2																				
I.2.2.1 [Artefacts] [Creation context and editing] - An artefact has been changed as the result of a process																				
I.2.2.2 [Artefacts] [Creation context and editing] - An artefact was prepared for a meeting																				
I.2.2.3 [Artefacts] [Creation context and editing] - An artefact describing a process has been changed																				
I.2.3																				
I.2.3.1 [Artefacts] [Creation context and editing] - An artefact was created/refined in a meeting																				
I.2.3.2 [Artefacts] [Creation context and editing] - An artefact was created by integrating parts of other artefacts																				
I.2.3.3 [Artefacts] [Creation context and editing] - An artefact has been the subject of many discussions											X	X								X
I.2.3.4 [Artefacts] [Creation context and editing] - An artefact has not been changed for a long period after intensive editing																				
I.2.3.5 [Artefacts] [Creation context and editing] - An artefact is edited after a guidance activity																				
I.2.3.6 [Artefacts] [Creation context and editing] - An artefact is edited intensively within a short period of time																				
I.2.3.7 [Artefacts] [Creation context and editing] - An artefact has been changed to a lesser extent than previous version(s)				X																X
I.2.3.8 [Artefacts] [Creation context and editing] - An artefact was changed in type				X																
I.3																				
I.3.1 [Artefacts] [Usage] - An artefact has achieved a high degree of awareness among others												X								X
I.3.2 [Artefacts] [Usage] - An artefact is used widely																				X
I.3.3 [Artefacts] [Usage] - An artefact was selected from a range of artefacts	X									X	X									X
I.3.4 [Artefacts] [Usage] - An artefact became part of a collection of similar artefacts										X	X	X								X
I.3.5 [Artefacts] [Usage] - An artefact was made accessible to a different group of individuals	X																			X
I.3.6 [Artefacts] [Usage] - An artefact is referred to by another artefact	X									X	X									X
I.3.7 [Artefacts] [Usage] - An artefact was presented to an influential group of individuals																				
I.3.8 [Artefacts] [Usage] - An artefact has been accessed by a different group of individuals																				
I.3.9 [Artefacts] [Usage] - An artefact has been used by an individual	X	X								X	X	X								X
I.3.10 [Artefacts] [Usage] - An artefact was changed	X	X								X	X	X								X
I.4																				
I.4.1 [Artefacts] [Rating & legitimation] - An artefact has been accepted into a restricted domain	X																			X
I.4.2 [Artefacts] [Rating & legitimation] - An artefact has been recommended or approved by management											X									X
I.4.3 [Artefacts] [Rating & legitimation] - An artefact has become part of a guideline or has become standard					X															X
I.4.4 [Artefacts] [Rating & legitimation] - An artefact has been rated high												X	X							X
I.4.5 [Artefacts] [Rating & legitimation] - An artefact has been certified according to an external standard																X				X
I.4.6 [Artefacts] [Rating & legitimation] - An artefact has been assessed by an individual	X									X										X
II																				
II.1																				
II.1.1 [Individual capabilities] [Individual activities] - An individual has acquired a qualification or attended a training course																				
II.1.2 [Individual capabilities] [Individual activities] - An individual has contributed to a project												X								X
II.1.3 [Individual capabilities] [Individual activities] - An individual has contributed to a discussion											X	X								X
II.1.4 [Individual capabilities] [Individual activities] - An individual is approached by others for help and advice											X	X								X
II.1.5 [Individual capabilities] [Individual activities] - An individual has significant professional experience			X																	X
II.1.6 [Individual capabilities] [Individual activities] - An individual is an author of many documents												X								X
II.2																				
II.2.1 [Individual capabilities] [Individual - organization] - An individual changed its role or responsibility																				
II.2.2 [Individual capabilities] [Individual - organization] - An individual has been a member of the organisation for a significant period of time																				
II.2.3 [Individual capabilities] [Individual - organization] - An individual has been involved in a process a number of times																				
II.2.4 [Individual capabilities] [Individual - organization] - An individual has been involved in a process for a significant period of time																				
II.2.5 [Individual capabilities] [Individual - organization] - An individual has been the owner of a process for a significant period of time																				
II.3																				
II.3.1 [Individual capabilities] [Individual - group] - An individual has a central role within a social network			X								X	X								X
II.3.2 [Individual capabilities] [Individual - group] - An individual changed its degree of cross-topic participation																				X
II.4																				
II.4.1 [Individual capabilities] [Rating, assessment] - An individual has been rated with respect to expertise													X							X
III																				
III.1																				
III.1.1 [Knowledge/topic] [Activities] - Knowledge has been searched for																				
III.1.2 [Knowledge/topic] [Activities] - Knowledge has been associated with an artefact																				
III.1.3 [Knowledge/topic] [Activities] - Knowledge has been associated with an individual											X									X
III.1.4 [Knowledge/topic] [Activities] - Knowledge has been described/documented (or the documentation has improved) in an artefact																				
IV																				
IV.1																				
IV.1.2 [Sociofacts] [Process/task (knowledge)] - A process has been successfully undertaken a number of times																				
IV.1.3 [Sociofacts] [Process/task (knowledge)] - A process was certified or standardised according to external standards																				
IV.1.4 [Sociofacts] [Process/task (knowledge)] - A process was internally agreed or standardised																				
IV.1.5 [Sociofacts] [Process/task (knowledge)] - A process was changed by adding or deleting steps																				
IV.1.6 [Sociofacts] [Process/task (knowledge)] - A process was documented																				
IV.1.7 [Sociofacts] [Process/task (knowledge)] - A process was changed according to the number of cycles (loops)																				
IV.1.8 [Sociofacts] [Process/task (knowledge)] - A process was changed according to the number of decisions																				
IV.1.9 [Sociofacts] [Process/task (knowledge)] - A process was changed according to the number of participants																				
IV.2																				
IV.2.1 [Sociofacts] [Quality of social network] - An individual changed its degree of networkedness																				
IV.2.2 [Sociofacts] [Quality of social network] - An individual changed its degree of participation			X									X								X
IV.2.4 [Sociofacts] [Quality of social network] - An individual changed its intensity of social action																				
IV.2.5 [Sociofacts] [Quality of social network] - A group of individuals changed their degree of external involvement			X																	X
IV.2.6 [Sociofacts] [Quality of social network] - A group of individuals changed their degree of heterogeneity			X									X								X
IV.3																				
IV.3.1 [Sociofacts] [Agreement] - A group of individuals created a consensus artefact																				
IV.4																				
IV.4.1 [Sociofacts] [Collective capability] - A group of individuals has established a reflective practice																				
IV.4.2 [Sociofacts] [Collective capability] - A group of individuals changed their (systematic) approach to organizational development																				
IV.4.3 [Sociofacts] [Collective capability] - A group of individuals meets certain quality criteria for collaboration																				
not mapped										X	X	X	X						X	
sum	X	X	X	X						X	X	X	X						X	

Table 21: Summary on KM indicator mappings – instantiations: Connexions Kent and Structuralia

Table structure — columns under two grouped headers "transition (target phase)" and "inner-phase maturing", each with sub-columns Ia, Ib, II, III, IV1, IV2, V1a, V2a, Vb; followed by "not m." and "sum". Filled (colored) cells marked with X.

| ID and KM Indicator	|transition (target phase)|									|inner-phase maturing|									not m.	sum
	Ia	Ib	II	III	IV1	IV2	V1a	V2a	Vb	Ia	Ib	II	III	IV1	IV2	V1a	V2a	Vb		
I.																				
I.1																				
I.1.1																				
I.1.1.1 [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of readability																				
I.1.1.2 [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of structuredness											X									X
I.1.1.3 [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of formality					X	X	X			X	X									X
I.1.1.x [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of ...				X	X															X
I.1.2 [Artefacts] [Artefact as such] - An artefact's meta-data has changed its quality characteristics																				
I.2																				
I.2.1																				
I.2.1.1 [Artefacts] [Creation context and editing] - An artefact has been changed after an individual had learned something																				
I.2.1.2 [Artefacts] [Creation context and editing] - An artefact has been edited by a highly reputable individual																				
I.2.1.3 [Artefacts] [Creation context and editing] - An artefact has been created/edited/co-developed by a diverse group																				
I.2.2																				
I.2.2.1 [Artefacts] [Creation context and editing] - An artefact has been changed as the result of a process												X								X
I.2.2.2 [Artefacts] [Creation context and editing] - An artefact was prepared for a meeting																				
I.2.2.3 [Artefacts] [Creation context and editing] - An artefact describing a process has been changed																				
I.2.3																				
I.2.3.1 [Artefacts] [Creation context and editing] - An artefact was created/refined in a meeting																				
I.2.3.2 [Artefacts] [Creation context and editing] - An artefact was created by integrating parts of other artefacts	X	X																		X
I.2.3.3 [Artefacts] [Creation context and editing] - An artefact has been the subject of many discussions																				
I.2.3.4 [Artefacts] [Creation context and editing] - An artefact has not been changed for a long period after intensive editing												X		X						X
I.2.3.5 [Artefacts] [Creation context and editing] - An artefact is edited after a guidance activity					X															X
I.2.3.6 [Artefacts] [Creation context and editing] - An artefact is edited intensively within a short period of time																				
I.2.3.7 [Artefacts] [Creation context and editing] - An artefact has been changed to a lesser extent than previous version(s)																				
I.2.3.8 [Artefacts] [Creation context and editing] - An artefact was changed in type																				
I.3																				
I.3.1 [Artefacts] [Usage] - An artefact has achieved a high degree of awareness among others													X							X
I.3.2 [Artefacts] [Usage] - An artefact is used widely			X									X								X
I.3.3 [Artefacts] [Usage] - An artefact was selected from a range of artefacts																				
I.3.4 [Artefacts] [Usage] - An artefact became part of a collection of similar artefacts			X																	X
I.3.5 [Artefacts] [Usage] - An artefact was made accessible to a different group of individuals			X																	X
I.3.6 [Artefacts] [Usage] - An artefact is referred to by another artefact	X		X																	X
I.3.7 [Artefacts] [Usage] - An artefact was presented to an influential group of individuals																				
I.3.8 [Artefacts] [Usage] - An artefact has been accessed by a different group of individuals																				
I.3.9 [Artefacts] [Usage] - An artefact has been used by an individual																				
I.3.10 [Artefacts] [Usage] - An artefact was changed																				
I.4																				
I.4.1 [Artefacts] [Rating & legitimation] - An artefact has been accepted into a restricted domain				X																X
I.4.2 [Artefacts] [Rating & legitimation] - An artefact has been recommended or approved by management					X	X	X	X												X
I.4.3 [Artefacts] [Rating & legitimation] - An artefact has become part of a guideline or has become standard					X	X	X	X	X											X
I.4.4 [Artefacts] [Rating & legitimation] - An artefact has been rated high															X					X
I.4.5 [Artefacts] [Rating & legitimation] - An artefact has been certified according to an external standard																				
I.4.6 [Artefacts] [Rating & legitimation] - An artefact has been assessed by an individual																				
II																				
II.1																				
II.1.1 [Individual capabilities] [Individual activities] - An individual has acquired a qualification or attended a training course																				
II.1.2 [Individual capabilities] [Individual activities] - An individual has contributed to a project																				
II.1.3 [Individual capabilities] [Individual activities] - An individual has contributed to a discussion																				
II.1.4 [Individual capabilities] [Individual activities] - An individual is approached by others for help and advice																				
II.1.5 [Individual capabilities] [Individual activities] - An individual has significant professional experience																				
II.1.6 [Individual capabilities] [Individual activities] - An individual is an author of many documents																				
II.2																				
II.2.1 [Individual capabilities] [Individual - organization] - An individual changed its role or responsibility																				
II.2.2 [Individual capabilities] [Individual - organization] - An individual has been a member of the organisation for a significant period of time																				
II.2.3 [Individual capabilities] [Individual - organization] - An individual has been involved in a process a number of times																				
II.2.4 [Individual capabilities] [Individual - organization] - An individual has been involved in a process for a significant period of time																				
II.2.5 [Individual capabilities] [Individual - organization] - An individual has been the owner of a process for a significant period of time																				
II.3																				
II.3.1 [Individual capabilities] [Individual - group] - An individual has a central role within a social network																				
II.3.2 [Individual capabilities] [Individual - group] - An individual changed its degree of cross-topic participation																				
II.4																				
II.4.1 [Individual capabilities] [Rating, assessment] - An individual has been rated with respect to expertise																				
III																				
III.1																				
III.1.1 [Knowledge/topic] [Activities] - Knowledge has been searched for	X																			X
III.1.2 [Knowledge/topic] [Activities] - Knowledge has been associated with an artefact			X																	X
III.1.3 [Knowledge/topic] [Activities] - Knowledge has been associated with an individual																				
III.1.4 [Knowledge/topic] [Activities] - Knowledge has been described/documented (or the documentation has improved) in an artefact	X	X												X						X
IV																				
IV.1																				
IV.1.2 [Sociofacts] [Process/task (knowledge)] - A process has been successfully undertaken a number of times										X	X									X
IV.1.3 [Sociofacts] [Process/task (knowledge)] - A process was certified or standardised according to external standards																				
IV.1.4 [Sociofacts] [Process/task (knowledge)] - A process was internally agreed or standardised					X	X	X													X
IV.1.5 [Sociofacts] [Process/task (knowledge)] - A process was changed by adding or deleting steps																				
IV.1.6 [Sociofacts] [Process/task (knowledge)] - A process was documented						X	X													X
IV.1.7 [Sociofacts] [Process/task (knowledge)] - A process was changed according to the number of cycles (loops)				X																X
IV.1.8 [Sociofacts] [Process/task (knowledge)] - A process was changed according to the number of decisions																				
IV.1.9 [Sociofacts] [Process/task (knowledge)] - A process was changed according to the number of participants																				
IV.2																				
IV.2.1 [Sociofacts] [Quality of social network] - An individual changed its degree of networkedness																				
IV.2.2 [Sociofacts] [Quality of social network] - An individual changed its degree of participation																				
IV.2.4 [Sociofacts] [Quality of social network] - An individual changed its intensity of social action																				
IV.2.5 [Sociofacts] [Quality of social network] - A group of individuals changed their degree of external involvement																				
IV.2.6 [Sociofacts] [Quality of social network] - A group of individuals changed their degree of heterogeneity																				
IV.3																				
IV.3.1 [Sociofacts] [Agreement] - A group of individuals created a consensus artefact																X	X			X
IV.4																				
IV.4.1 [Sociofacts] [Collective capability] - A group of individuals has established a reflective practice																				
IV.4.2 [Sociofacts] [Collective capability] - A group of individuals changed their (systematic) approach to organizational development																				
IV.4.3 [Sociofacts] [Collective capability] - A group of individuals meets certain quality criteria for collaboration																				
not mapped																				
sum	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X			X

Table 22: Summary on KM indicator mappings – instantiations: FHNW and SAP

Table: Summary on KM indicator mappings – all instantiations

| ID and KM Indicator	transition (target phase) Ia	Ib	II	III	IV1	IV2	V1a	V2a	Vb	inner-phase maturing Ia	Ib	II	III	IV1	IV2	V1a	V2a	Vb	not m.	sum
I.																				
I.1																				
I.1.1																				
I.1.1.1 [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of readability												■								■
I.1.1.2 [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of structuredness			■	■								■	■							■
I.1.1.3 [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of formality			■	■	■	■						■	■							■
I.1.1.x [Artefacts] [Artefact as such] - An artefact has changed its degree (score) of …			■	■								■								■
I.1.2 [Artefacts] [Artefact as such] - An artefact's meta-data has changed its quality characteristics												■	■							■
I.2																				
I.2.1																				
I.2.1.1 [Artefacts] [Creation context and editing] - An artefact has been changed after an individual had learned something			■	■								■								■
I.2.1.2 [Artefacts] [Creation context and editing] - An artefact has been edited by a highly reputable individual			■	■								■								■
I.2.1.3 [Artefacts] [Creation context and editing] - An artefact has been created/edited/co-developed by a diverse group			■									■								■
I.2.2																				
I.2.2.1 [Artefacts] [Creation context and editing] - An artefact has been changed as the result of a process												■								■
I.2.2.2 [Artefacts] [Creation context and editing] - An artefact was prepared for a meeting																				
I.2.2.3 [Artefacts] [Creation context and editing] - An artefact describing a process has been changed																				
I.2.3																				
I.2.3.1 [Artefacts] [Creation context and editing] - An artefact was created/refined in a meeting	■	■																		■
I.2.3.2 [Artefacts] [Creation context and editing] - An artefact was created by integrating parts of other artefacts	■	■																		■
I.2.3.3 [Artefacts] [Creation context and editing] - An artefact has been the subject of many discussions												■	■							■
I.2.3.4 [Artefacts] [Creation context and editing] - An artefact has not been changed for a long period after intensive editing												■	■							■
I.2.3.5 [Artefacts] [Creation context and editing] - An artefact is edited after a guidance activity				■																■
I.2.3.6 [Artefacts] [Creation context and editing] - An artefact is edited intensively within a short period of time				■																
I.2.3.7 [Artefacts] [Creation context and editing] - An artefact has been changed to a lesser extent than previous version(s)				■																■
I.2.3.8 [Artefacts] [Creation context and editing] - An artefact was changed in type				■																■
I.3																				
I.3.1 [Artefacts] [Usage] - An artefact has achieved a high degree of awareness among others												■								■
I.3.2 [Artefacts] [Usage] - An artefact is used widely																				
I.3.3 [Artefacts] [Usage] - An artefact was selected from a range of artefacts		■	■								■	■								■
I.3.4 [Artefacts] [Usage] - An artefact became part of a collection of similar artefacts		■	■								■	■								■
I.3.5 [Artefacts] [Usage] - An artefact was made accessible to a different group of individuals		■	■								■	■								■
I.3.6 [Artefacts] [Usage] - An artefact is referred to by another artefact	■	■									■	■								■
I.3.7 [Artefacts] [Usage] - An artefact was presented to an influential group of individuals																				
I.3.8 [Artefacts] [Usage] - An artefact has been accessed by a different group of individuals		■	■																	■
I.3.9 [Artefacts] [Usage] - An artefact has been used by an individual		■	■								■	■								■
I.3.10 [Artefacts] [Usage] - An artefact was changed		■	■								■	■								■
I.4																				
I.4.1 [Artefacts] [Rating & legitimation] - An artefact has been accepted into a restricted domain	■	■	■									■								■
I.4.2 [Artefacts] [Rating & legitimation] - An artefact has been recommended or approved by management					■	■	■	■	■			■								■
I.4.3 [Artefacts] [Rating & legitimation] - An artefact has become part of a guideline or has become standard					■	■	■	■	■			■	■							■
I.4.4 [Artefacts] [Rating & legitimation] - An artefact has been rated high												■	■		■					■
I.4.5 [Artefacts] [Rating & legitimation] - An artefact has been certified according to an external standard												■	■							■
I.4.6 [Artefacts] [Rating & legitimation] - An artefact has been assessed by an individual												■								■
II																				
II.1																				
II.1.1 [Individual capabilities] [Individual activities] - An individual has acquired a qualification or attended a training course																				
II.1.2 [Individual capabilities] [Individual activities] - An individual has contributed to a project												■								■
II.1.3 [Individual capabilities] [Individual activities] - An individual has contributed to a discussion		■	■								■	■								■
II.1.4 [Individual capabilities] [Individual activities] - An individual is approached by others for help and advice												■	■							■
II.1.5 [Individual capabilities] [Individual activities] - An individual has significant professional experience		■	■																	■
II.1.6 [Individual capabilities] [Individual activities] - An individual is an author of many documents												■								■
II.2																				
II.2.1 [Individual capabilities] [Individual - organization] - An individual changed its role or responsibility																				
II.2.2 [Individual capabilities] [Individual - organization] - An individual has been a member of the organisation for a significant period of time																				
II.2.3 [Individual capabilities] [Individual - organization] - An individual has been involved in a process a number of times																				
II.2.4 [Individual capabilities] [Individual - organization] - An individual has been involved in a process for a significant period of time																				
II.2.5 [Individual capabilities] [Individual - organization] - An individual has been the owner of a process for a significant period of time																				
II.3																				
II.3.1 [Individual capabilities] [Individual - group] - An individual has a central role within a social network			■									■	■							■
II.3.2 [Individual capabilities] [Individual - group] - An individual changed its degree of cross-topic participation			■									■								■
II.4																				
II.4.1 [Individual capabilities] [Rating, assessment] - An individual has been rated with respect to expertise			■									■	■							■
III																				
III.1																				
III.1.1 [Knowledge/topic] [Activities] - Knowledge has been searched for	■																		■	■
III.1.2 [Knowledge/topic] [Activities] - Knowledge has been associated with an artefact		■																	■	■
III.1.3 [Knowledge/topic] [Activities] - Knowledge has been associated with an individual												■							■	■
III.1.4 [Knowledge/topic] [Activities] - Knowledge has been described/documented (or the documentation has improved) in an artefact	■	■									■									■
IV																				
IV.1																				
IV.1.2 [Sociofacts] [Process/task (knowledge)] - A process has been successfully undertaken a number of times												■	■							■
IV.1.3 [Sociofacts] [Process/task (knowledge)] - A process was certified or standardised according to external standards																				
IV.1.4 [Sociofacts] [Process/task (knowledge)] - A process was internally agreed or standardised					■	■	■													■
IV.1.5 [Sociofacts] [Process/task (knowledge)] - A process was changed by adding or deleting steps						■	■													■
IV.1.6 [Sociofacts] [Process/task (knowledge)] - A process was documented						■	■													■
IV.1.7 [Sociofacts] [Process/task (knowledge)] - A process was changed according to the number of cycles (loops)				■																■
IV.1.8 [Sociofacts] [Process/task (knowledge)] - A process was changed according to the number of decisions				■																■
IV.1.9 [Sociofacts] [Process/task (knowledge)] - A process was changed according to the number of participants																				
IV.2																				
IV.2.1 [Sociofacts] [Quality of social network] - An individual changed its degree of networkedness																			■	■
IV.2.2 [Sociofacts] [Quality of social network] - An individual changed its degree of participation			■									■							■	■
IV.2.4 [Sociofacts] [Quality of social network] - An individual changed its intensity of social action			■																■	■
IV.2.5 [Sociofacts] [Quality of social network] - A group of individuals changed their degree of external involvement			■																	■
IV.2.6 [Sociofacts] [Quality of social network] - A group of individuals changed their degree of heterogeneity			■									■								■
IV.3																				
IV.3.1 [Sociofacts] [Agreement] - A group of individuals created a consensus artefact												■								■
IV.4																				
IV.4.1 [Sociofacts] [Collective capability] - A group of individuals has established a reflective practice																				
IV.4.2 [Sociofacts] [Collective capability] - A group of individuals changed their (systematic) approach to organizational development																				
IV.4.3 [Sociofacts] [Collective capability] - A group of individuals meets certain quality criteria for collaboration																				
not mapped			■								■	■	■						■	■
sum	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■		■	■

Table 23: Summary on KM indicator mappings – all instantiations

7.6 Hypotheses

In parallel to the in-depth study, the planning for the summative evaluation of MATURE was conducted. Within this process, all work packages were asked to provide hypotheses for aligning the summative evaluation on. For this collection of inputs in order to create a common foundation of the evaluation in the wiki, the following question has been raised:

What are the concrete hypotheses you would like to / expect to test in the summative evaluation? This includes your concrete planned outcome.

We felt that in hypotheses generation we should make clear the connections between the theoretical concepts we have covered so far, particularly the ones presented in D1.2 and D1.3 (e.g., boundary objects, sedimentation of knowledge, communities of practice) and demonstrator development. In our view, this called for a systematic approach that explicitly linked hypotheses to concepts established in literature or defined as part of our knowledge maturing landscape. In the following section, we provide several avenues towards hypothesis development and give several concrete examples which certainly need to be more clearly defined and contextualized in the application partners' usage settings, i.e. concepts like "effective" need to be operationalized, as well as the term "knowledge" can be understood as bound to a person, embedded in digital resources or processes.

Instantiation [1-5] refers to the respective instantiations of the demonstrator development (see D2.3/3.3).

KM activity [1-12] refers to the list of KM activities that resulted from the empirical studies conducted in the first two years of the MATURE project:

1. Find relevant digital resources
2. Embed information at individual or organisational level
3. Keep up-to-date with organisation-related knowledge
4. Familiarise oneself with new information
5. Reorganise information at individual or organisational level
6. Reflect on and refine work practices or processes
7. Create and co-develop digital resources
8. Share and release digital resources
9. Restrict access and protect digital resources
10. Find people with particular knowledge or expertise
11. Communicate with people
12. Assess, verify and rate information

Concepts well established in maturing landscape / academic literature:

This group of hypotheses integrates two views: the KM phase model and concepts related to specific phases that can be found in the academic literature:
- Support by instantiation --> performance of KM phases
  - Ia: Using instantiation [1-5] leads to a more effective generation of ideas.
  - Ia: Using instantiation [1-5] leads to a more effective generation of ideas.
  - Ib: Using instantiation [1-5] leads to increased individual commitment to an idea.
  - Ib: Using instantiation [1-5] leads to a more effective organisation of a personal work space.
  - Ib: Using instantiation [1-5] makes it easier for a person to identify emerging knowledge.
  - II: Using instantiation [1-5] leads to a more effective distribution of knowledge.
  - II: Using instantiation [1-5] leads to a more effective sharing of knowledge.

- ◦ II: Using instantiation [1-5] increases social presence.
- ◦ II: Using instantiation [1-5] makes it easier for a community to identify emerging knowledge.
- ◦ II: Using instantiation [1-5] increases awareness of activities/topics in other communities (of practice).
- ◦ III: Using instantiation [1-5] increases awareness of activities/topics in other formal organisational units, e.g., departments.
- ◦ III: Using instantiation [1-5] leads to a more effective formalization of knowledge.
- ◦ II-V: Using instantiation [1-5] leads to increased exchange/creation/use of boundary objects.
- ◦ V*: Using instantiation [1-5] increases awareness of standardized knowledge.
- ◦ V*: Using instantiation [1-5] makes it easier to identify solid/reliable/sedimented knowledge.

Concepts based on knowledge maturing landscape: guidance

In order to facilitate the concept of guidance (see section 5.3), several hypotheses were designed:
- • Support by instantiation --> performance of KM phases
    - ◦ Guidance: Using instantiation [1-5] enables goal-oriented development of knowledge.
    - ◦ Guidance: Using instantiation [1-5] supports alignment of knowledge development to goals of a formal organisational unit.
        - ▪ Guidance: Using instantiation [1-5] supports decisions on what knowledge to develop
        - ▪ Guidance: Using instantiation [1-5] supports monitoring the impacts of knowledge maturing.
        - ▪ Guidance: Using instantiation [1-5] increases motivation to engage in knowledge maturing activities.
        - ▪ Guidance: Using instantiation [1-5] supports balancing rigidity and flexibility in knowledge maturing.

Concepts based on knowledge maturing landscape: KM activities (see D1.2)

Similarly to the representative study in year 2, we created hypotheses that related to the successful performance and the support of knowledge maturing activities:

- • Supporting knowledge maturing activity [1-12] has a positive influence on the successful performance of knowledge maturing.
- • Support by prototype --> performance of KM activities:
    - ◦ Supporting knowledge maturing activity [1-12] has a positive influence on the successful performance of knowledge maturing.
    - ◦ Using prototype of the instantiation has a positive influence on awareness of knowledge maturing activity [1-12].
    - ◦ Using prototype of the instantiation has a positive influence on performance of knowledge maturing activity [1-12].

Concepts based on knowledge management in general

Besides concepts directly related to MATURE and the KM model landscape, we also created hypotheses with respect to a more general level of knowledge management.
- ◦ Support by instantiation --> generic knowledge management goals
    - ▪ Using instantiation [1-5] reduces time to proficiency.
    - ▪ Using instantiation [1-5] increases awareness of existing knowledge.

- Using instantiation [1-5] increases retaining of existing knowledge.
- Using instantiation [1-5] eases integration of acquired knowledge.
- Using instantiation [1-5] eases replacement of knowledge.

8 Bibliography

AHLERT, M., BLAICH, G. & SPELSIEK, J. 2006. *Vernetztes Wissen: Organisationale, motivationale, kognitive und technologische Aspekte des Wissensmanagements in Unternehmensnetzwerken,* Wiesbaden, DUV Deutscher Universitätsverlag.

ALLEN, J. F. 1983. Maintaining Knowledge about Temporal Intervals. *Commun. ACM,* 26**,** 832-843.

ANSOFF , H. I. 1966. *Corporate Strategy,* New York, McGraw–Hill.

ARGYRIS, C. & SCHÖN, D. A. 1974. *Theory in Practice: Increasing Professional Effectiveness,* San Francisco, Calif. [et al.], Jossey-Bass.

BALZERT, H. 2001. *Lehrbuch der Software-Technik - Band 1 Software-Entwicklung,* Heidelberg [et al.], Spektrum, Akad. Verl.

BRYMAN, A. & BELL, E. 2007. *Business research methods,* Oxford [et al.], Oxford Univ. Press.

CIALDINI, R. B. 2008. *Influence: Science and Practice*, Pearson.

CRESWELL, J. W. 2007. *Qualitative Inquiry and Research Design. Choosing Among Five Approaches,* Thousand Oaks [et al.], Sage.

DAVIS, F. D. 1989. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly,* 13**,** 319-340.

DESANCTIS, G. & POOLE, M. S. 1994. Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory. *Organization Science,* 5**,** 121-147.

DRUCKER, P. F. 1993. *The Practice of Management,* Oxford [et al.], Butterworth-Heinemann.

EUROSTAT. 2008. *NACE Rev. 2 structure and correspondences with NACE Rev. 1.1 and ISIC Rev. 4* [Online]. Available: http://epp.eurostat.ec.europa.eu/portal/page/portal/nace_rev2/documents/NACEREV2STRUCTURE.pdf [Accessed 10.05.2009].

EYSENCK, H. J. 1992. Four ways five factors are not basic. *Personality and Individual Differences,* 13**,** 667-673.

FINKELSTEIN, L. 2003. Widely, Strongly and Weakly defined Measurement. *Measurement,* 34**,** 39-48.

FRANCESCHINI, F., GALETTO, M. & MAISANO, D. 2007. *Management by Measurement. Designing Key Indicators and Performance Measurement Systems,* Berlin [et al.], Springer.

HÄDRICH, T. 2007. *Situation-oriented provision of knowledge services,* Halle (Saale), Universitäts- und Landesbibliothek Sachsen-Anhalt.

HERRIOTT, R. E. & FIRESTONE, W. A. 1983. Multisite Qualitative Policy Research: Optimizing Description and Generalizability. *Educational Researcher,* 12**,** 14-19.

KIRSCHNER, P. A. & KREIJNS, K. 2005. Enhancing Sociability of Computer-Supported Collaborative Learning Environments. *In:* BROMME, R., HESSE, F. W. & SPADA, H. (eds.) *Barriers and Biases in Computer-Mediated Knowledge Communication.* Springer US.

KUHLMANN, M. 2002. Beobachtungsinterview. *In:* KÜHL, S. & STRODTHOLZ, P. (eds.) *Methoden der Organisationsforschung. Ein Handbuch.* Hamburg: Rowohlt.

LEONTIADES, M. 1982. *Management policy, strategy, and plans,* Boston, Little, Brown.

LEWIN, K., LIIPPIT, R. & WHITE, R. K. 1939. Patterns of aggressive behavior in experimentally created social climates. *Journal of Social Psychology,* 10**,** 271-301.

LIEBOLD, R. & TRINCZEK, R. 2009. Experteninterview. *In:* KÜHL, S., STRODHOLZ, P. & TAFFERTSHOFER, A. (eds.) *Handbuch Methoden der Organisationsforschung. Qualitative und Quantitative Methoden.* Wiesbaden: VS, Verl. für Sozialwiss.

MAIER, R., THALMANN, S., BAYER, F., KRÜGER, M., NITZ, H. & SANDOW, A. 2008. Optimizing Assignment of Knowledge Workers to Office Space Using Knowledge Management Criteria - The Flexible Office Case. *Journal of Universal Computer Science,* 14**,** 508-525.

MALHOTRA, N. K. 2004. *Marketing Research. An Applied Orientation,* Delhi, Pearson Education.

MASOLO, C., BORGO, S., GANGEMI, A., GUARINO, N. & OLTRAMARI, A. 2003. WonderWeb Deliverable D18 - Ontology Library (final). Trento: Laboratory For Applied Ontology - ISTC-CNR.

MAYRING, P. 2007. *Qualitative Inhaltsanalyse. Grundlagen und Techniken,* Weinheim [u.a.], Beltz.

MCDERMOTT, R. & O'DELL, C. 2001. Overcoming cultural barriers to sharing knowledge. *Journal of Knowledge Management,* 5**,** 76-85.

MILES, M. B. & HUBERMAN, A. M. 1998. *Qualitative Data Analysis. An Expanded Sourcebook,* Thousand Oaks, Calif. [et al.], Sage.

MOURELATOS, A. P. D. 1978. Events, Processes, and States. *Linguistics and Philosophy,* 2**,** 415-434.

NEWELL, A. 1982. The knowledge level. *Artificial Intelligence,* 18**,** 87-127.

OECD & EUROSTAT 2005. *Oslo Manual - Guidelines for Collecting and Interpreting Innovation Data*, OECD Publishing.

PATTON, M. Q. 1990. *Qualitative evaluation and research methods,* Newbury Park, CA, Sage Publications.

PATTON, M. Q. 2002. *Qualitative Research & Evaluation Methods,* Thousand Oaks, Calif. et al., Sage.

REINHARDT, W., MOI, M. & VARLEMANN, T. Year. Artefact-Actor-Networks as tie between social networks and artefact networks. *In:* Collaborative Computing: Networking, Applications and Worksharing, 2009. CollaborateCom 2009. 5th International Conference on, 11-14 Nov. 2009 2009. 1-10.

RIEGE, A. 2005. Three-dozen knowledge-sharing barriers managers must consider. *Journal Of Knowledge Management,* 9**,** 18-35.

RISS, U. 2005. Knowledge, Action, and Context: Impact on Knowledge Management. *In:* ALTHOFF, K.-D., DENGEL, A., BERGMANN, R., NICK, M. & ROTH-BERGHOFER, T. (eds.) *Professional Knowledge Management.* Springer Berlin / Heidelberg.

RISS, U., MAGENHEIM, J., REINHARDT, W., NELKNER, T. & HINKELMANN, K. Year. Added Value of Sociofact Analysis for Business Agility. *In:* Association for the Advancement of Artificial Intelligence (AAAI) 2011 Spring Symposium, 2011 Menlo Park, CA.

RISS, U., WITSCHEL, H. F., BRUN, R. & THÖNSSEN, B. Year. What Is Organizational Knowledge Maturing and How Can It Be Assessed? *In:* 9th International Conference on Knowledge Management (I-KNOW '09), Graz, Austria, 2009. 28-38.

ROGERS, E. M. 1995. *Diffusion of Innovations,* New York, The Free Press.

SAKE, R., E. 2005. Qualitative Case Studies. *In:* DENZIN, N. K. & LINCOLN, Y. S. (eds.) *The Sage Handbook of Qualitative Research.* 3. ed. ed. Thousand Oaks [u.a.]: Sage.

SCHEIN, E. H. 2003. *Organisationskultur. The Ed Schein Corporate culture survival guide,* Bergisch Gladbach, EHP.

SCHMIDT, B. & RISS, U. 2009. Task Patterns as Means to Experience Sharing. *In:* SPANIOL, M., LI, Q., KLAMMA, R. & LAU, R. (eds.) *Advances in Web Based Learning – ICWL 2009.* Springer Berlin / Heidelberg.

SMITH, J. A., FLOWERS, P. & LARKIN, M. 2009. *Interpretative Phenomenological Analysis: Theory, Method and Research,* Los Angeles [u.a.], Sage.

TORNATZKY, L. G. & FLEISCHER, M. 1990. *The Processes of Technological Innovation,* Lexington, Massachusetts, Lexington Books.

VÄLIKANGAS, L. & SEVÓN, G. 2010. Of managers, ideas and jesters, and the role of information technology. *The Journal of Strategic Information Systems,* 19**,** 145-153.

VENDLER, Z. 1967. Verbs and times. *In:* VENDLER, Z. (ed.) *Linguistics in Philosophy.* Ithaca, NY: Cornell University Press.

VENKATESH, V., MORRIS, M. G., DAVIS, G. B. & DAVIS, F. D. 2003. User Acceptance Of Information Technology: Toward a Unified View. *MIS Quarterly,* 27**,** 425-478.

VYGOTSKY, L. 1978. *Mind in society. The development of higher psychological processes,* Cambridge, MA, Harvard University Press.

WALSHAM, G. 1995. Interpretive case studies in IS research: nature and method. *European Journal of Information Systems,* 4**,** 74-81.

WEILL, P. & ROSS, J. 2004. *IT Governance: How Top Performers Manage IT Decision Rights for Superior Results,* Boston.

WOOD, D., BRUNER, J. S. & ROSS, G. 1976. The role of tutoring in problem solving. *Journal of Psychology and Psychiatry,* 17**,** 89-100.

YIN, R. K. 2009. *Case Study Research - Design and Methods,* Thousand Oaks, Calif. [u.a.], Sage.