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Process Oriented Knowledge Management: A Service Based Approach

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Abstract: This paper introduces a new viewpoint in knowledge management by introducing KM-Services as a basic concept for Knowledge Management. This text discusses the vision of service oriented knowledge management (KM) as a realisation approach of process oriented knowledge management. In the following process oriented knowledge management as it was defined in the EU-project PROMOTE (IST-1999-11658) is presented and the KM-Service approach to realise process oriented knowledge management is explained. The last part is concerned with an implementation scenario that uses Web-technology to realise a service framework for a KM-system.

Keywords: Knowledge Management Service, Knowledge Management Process
Category: H.1

1 Introduction

Knowledge Management evolved to a serious management discipline that aims to integrate in the orchestra of existing management approaches. Current knowledge management approaches merge only partly with other management disciplines like strategic management (in the context of business intelligence), process management (in the context of process oriented knowledge management) or human resource management (in the context of skill and competence management). In contrast to rather weak integration on the management level the technological integration of knowledge - and information management is well advanced.

This can be explained by the historical development of this rather young (starting point around 1995) research discipline, as the root of knowledge management is seen in the artificial intelligence. Therefore the strong technical focus is still manifested in knowledge management.

Current status is therefore a tight coupling on the technical layer but a rather loose and weak integration at the management layer. The challenge of today's research is to integrate knowledge management not only at the technical but also on the management layer.

Integration on the management layer requires a homogenous concept; therefore a third layer – the conceptual layer – is defined that resides between the management and the technical layer. This conceptual layer has the task to connect the management view of knowledge management with the underlying technology. Process-oriented knowledge management belongs to the conceptual layer with the aim to integrate management issues and technological specifications.

The aim of this text is to introduce a new viewpoint on knowledge management – Knowledge Management Service – that is seen as an implementation approach for process-oriented knowledge management on the conceptual layer. The following text is an enhancement of the publication from I-Know 04, TAKMA 04, PAKM04 and the dissertation of the first author.

2 Process-Oriented KM: A Conceptual Approach

Process Oriented KM (POKM) is an entry point into KM independent on the used technology under the topic of organisational management. Process-oriented knowledge management is therefore required as [Karagiannis 01]:

- Knowledge has to be embedded in business processes,
- Knowledge processes are able to be modelled and
- A knowledge management system is a "Meta-tool".

PROMOTE® is a homogeneous process-oriented approach for knowledge management [Telesko 01] that developed a framework based on the above requirements for to establish KM within organisations.

Practical KM however is still not manifested as a consequent follow-up of Business Process Re-engineering projects. This conflict is also evident vice versa, as KM-projects are seldom based on Business Processes (BPs) but often individual solutions.

Three different evolutionary steps within POKM can be noticed:

1. **Processes as content**. The first meaning of POKM is to define processes as content. This means that a process models are seen as a document that provides knowledge. The management and the distribution of BP-Models are defined as KM. Therefore the acquisition, the analysis, the simulation and distribution of BPs are related to core KM activities (compare [Probst 97]). Today's research aims to distribute BP-Models in a more flexible way using Internet access for modelling tools, and dynamic model allocation depending on the knowledge role of the user. The storage of large BP-Models is executed using knowledge bases and the distribution is realised by knowledge dissemination strategies.
2. **Process as an Entry Point and Integration Platform**. The second step of POKM defines the BP as the starting point. The business process is used to define a process-oriented functional specification. This is realised by analysing each activity and identifying the so-called "Knowledge Intensive Tasks" (KIT). The BP is therefore the entry point for a more detailed specification of the knowledge platform. All requirements of an E-KMS are therefore directly or indirectly related to the needs of the BP. This leads to a BP-centred architecture that interprets the process as an integration platform.
3. **Process as a Management Approach**. The third interpretation of POKM is to define KM activities as processes. In today's literature these processes are differently named as either "Knowledge Processes" or "Knowledge

Management Processes" that define a sequence of KM activities. In this text the term "Knowledge Management Process" (KMP) is used, as the term "Knowledge Process" was used in the PROMOTE project has weak structured decision processes. This interpretation enables the usage of management concepts like steering, controlling, and evaluation of KM that are performed on processes. Research effort in this topic is e.g. to automate knowledge management processes like the distribution of a best practice article or the evaluation of knowledge usage based on evaluation criteria on the usage processes.

These three interpretations are seen as an evolutionary development of POKM; first, starting with defining, managing, and distributing the core processes; second, enriching these core processes with KM to make them more efficient; and finally third, manage the KM to make KM more efficient. This evolutionary approach implies that before process-oriented KM can be realised on the third level, level one and two need to be implemented sufficiently (compare [KPMG 03]).

In the following step one is unnoticed as this is seen within the responsibility of BP-Management. Step two and three are depicted in more detail, by introducing a modelling language. This section introduces a layer concept that defines the BP at the top layer and the actual Knowledge Resource (KR) at the bottom layer.

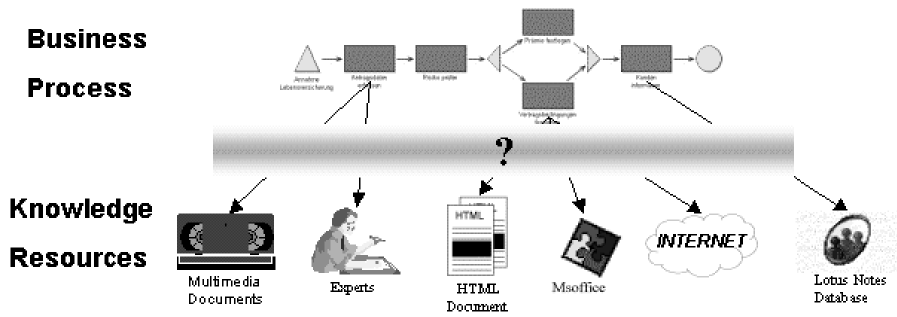

Figure 1: BP related to KR

Figure 1 depicts a BP as a starting point that enables the definition of knowledge resources (KR) that are directly linked to the process.

During the EU-project PROMOTE a concept has been developed to link KR to BPs using models. These models are seen as a container of all KR that can be accessed by input, output, and maintenance KMPs. In the following an introduction in knowledge models is discussed.

2.1 The PROMOTE® Model Language

Although there are many approaches to model knowledge where some approaches like frames, rules, semantic nets or predicates have been developed within the artificial intelligence and some approaches have been developed within the last years like K-Modeler, EULE2, Workware, Income or DÉCOR only the PROMOTE® approach will be discussed in this text. The PROMOTE® model language is the only modelling framework that integrates Knowledge Management Services within a Process-oriented framework that supports all three evolutionary steps of process-oriented KM. This model language describes knowledge management approaches in a method and tool independent way [Karagiannis 02a], [Karagiannis 02b], [Karagiannis 00], [Stefanidis 02], or [Woitsch 02].

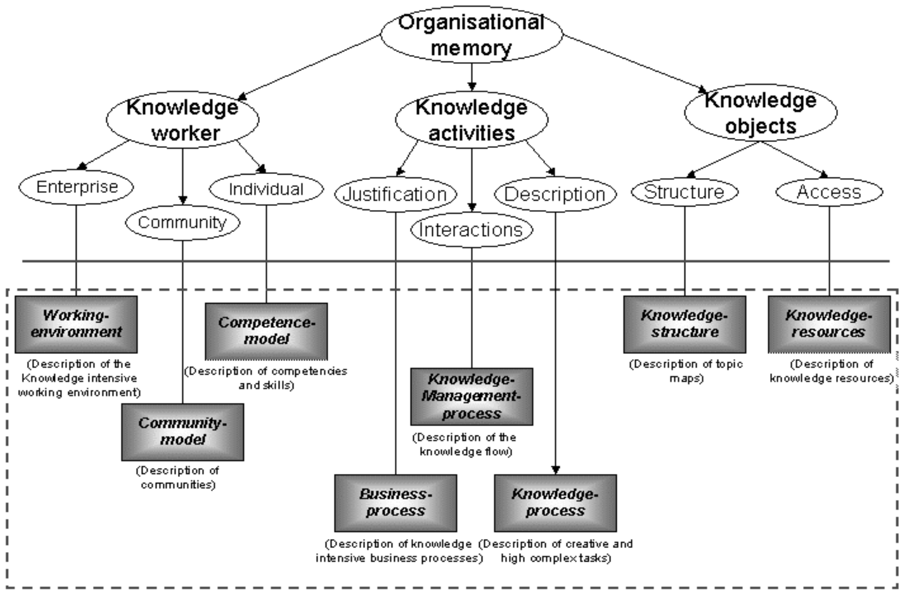

Figure 2: Overview of the PROMOTE® model language

Figure 2 depicts the framework of the PROMOTE® model language that is used to describe knowledge interactions between knowledge workers. This model language is based on the grammar of the natural language using "subject", "predicate", and "object" whereas the subjects are the knowledge workers, the predicates are the knowledge activities and the objects are the knowledge objects.

The "knowledge workers" are described on an individual level using skill profiles (skill model), on a community level to describe communities of practice (community model), and on an enterprise level to describe the competence profile of departments (working environment).

The already mentioned "knowledge activities" are justified by business processes, the interaction with the OM is defined by using the previously mentioned "Knowledge Management Processes" and knowledge intensive tasks (that have been defined as critical due to the analysis of the business process) are described in detail using a special type of process a so-called "Knowledge Process" that are weak structured decision processes.

The "knowledge objects" are categorised by using "Knowledge Structure Models" (where Ontologies can be defined) and accessed by using a modelled index, the "Knowledge Resource Model". These models are mapped via Knowledge Management Service models to executable applications and tools.

2.2 The PROMOTE® Framework

This section describes the PROMOTE® framework, as an overall framework for process-oriented KM. The focus of this approach is the third evolutionary step in POKM the modelling of KMPs, like modelling, identification, accessing, storing, distribution, and evaluation of knowledge in a process oriented manner.

2.2.1 The PROMOTE® Methodology

The PROMOTE® methodology is based on the Business Process Management System methodology (BPMS) [Karagiannis 02], [Junnginger 00], [Karagiannis 96]. This methodology is seen as a road map that guides organisations through developing KM strategy, designing, developing, and implementing a process based KM systems.

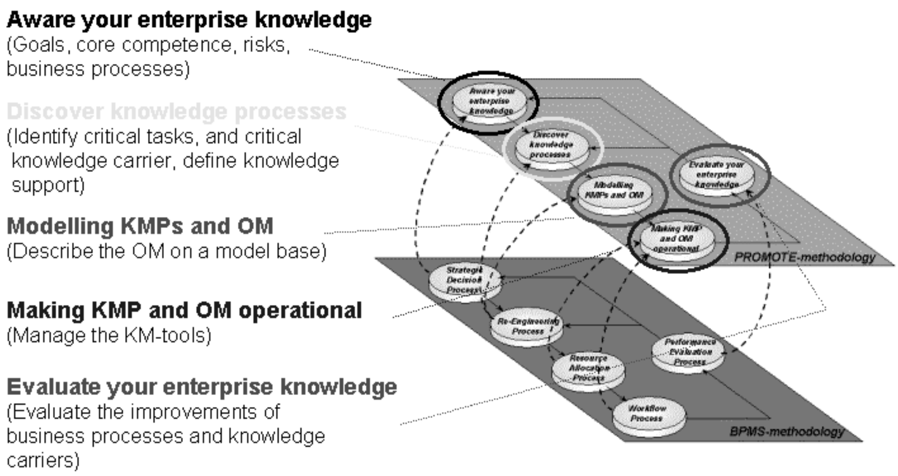

Figure 3: The PROMOTE® Methodology

Figure 3 shows the PROMOTE® methodology and the interaction with the BPMS-methodology. The PROMOTE® methodology has been instantiated by the PROMOTE® method. In the following each phase of the PROMOTE® method is briefly represented and interfaces between these phases are introduced based on [PROMOTE 00], [PROMOTE 01] and [Telesko 01].

2.2.1.1 Aware your Enterprise Knowledge

During the "awareness phase" knowledge goals (target), the knowledge criteria and the general strategy are defined. Within this phase the following steps have to be addressed:

- First of all the core competencies of the company have to be identified. These competencies imply a competitive advantage.

- Then risks and chances when dealing with these competencies have to be assessed. Some examples of possible outcomes are: the danger that the competence owners leave the company, the competitors are going to close the gap, the technological experts spend too much time in solving customer problems instead of product development and a new technology could lead to a new competitive advantage.
- Furthermore from this risk assessment the focus of knowledge management has to be derived, thus leading to the appropriate knowledge management strategy.
- And finally the business processes that should be improved by the knowledge management strategy are identified; and the business goals that are to be reached by the respective knowledge management strategy are defined.

2.2.1.2 Discover Knowledge Processes

During "Discover Knowledge Processes" KM-requirements are analysed within the limitations of the project definitions. The analysis considers the following tasks:

- Identifying the knowledge-intensive tasks in the business processes selected in step 1. The knowledge-intensive tasks are those tasks that either require or create critical knowledge.
- Categorising the types of knowledge these tasks deal with. The result is a kind of knowledge map showing for each task the knowledge that is needed and generated as well as the knowledge owners and knowledge flows.
- Identifying critical points. A critical point could be that important knowledge is concentrated in only one person that the same knowledge is generated in different tasks or processes, and that many people solve similar problems without co-operation etc.
- Define the knowledge support to avoid critical points. This results in the specification of KMPs specifying the knowledge flow.
- Set up evaluation criteria and units of measurement. The evaluation criteria must be mapped to the business goals defined in step 1, i.e. the management processes must support the business goals.

2.2.1.3 Modelling KMPs and OM

During the "Modelling KMPs and OM" phase the results of the analysis are defined using a human and machine interpretable modelling language. This phase defines the Knowledge Management Process (KMP) as the dynamic aspects and the Organisational Memory (OM) as the static aspects of the Knowledge Management System using a formal and well-structured definition language.

The model types that are used in PROMOTE® are classified in the following categories:

- Business process related model types (BPM)
    - Business process (describing the knowledge intensive process)
    - Working environment (reference to the working environment)
- Model types for knowledge processing (KMP)
    - Knowledge flows (knowledge management processes)
    - Knowledge resources (definition of the knowledge sources)

  - Knowledge structure (definition of the semantics of topics)
  - Skill documentations (description of skills, interests, and abilities)
  - Knowledge processes (describing knowledge intensive tasks)
- Overview model types (OVM)
  - Knowledge landscape (Overview of the OM)
  - Community pool (Overview of knowledge communities)
  - Process pool (Overview of processes)

2.2.1.4 Making KMPs and OM Operational

The next phase is concerned with the realisation of the E-KMS. This implies the development of software, the installation of tools as well as the implementation of organisational concepts.

A platform interprets the above models using a service based approach where KM models manage the KM platform orchestrating various tools.

2.2.1.5 Evaluate your Enterprise Knowledge

The last phase is to evaluate the KM-approach on several levels. The evaluation of knowledge management in PROMOTE® is therefore concerned with the following sub-tasks:

- Define the knowledge management strategy
- Define the business goals and the knowledge goals
- Define the knowledge management interventions
- Evaluation of the knowledge management criteria
- Aggregate the criteria to knowledge management metrics
- Compare the knowledge management metrics with the financial metrics

These proceedings lead to an evaluation of the different methodology phases. This phase can be supported with the well known balanced scorecard method developed by

Norton/Kaplan [Kaplan 96]. An alternative approach the Intangible Assets Monitor is introduced by Sveiby at [Sveiby 98], [Sveiby 99], [Sveiby 01a], [Sveiby 01b] and [Sveiby 01c].

2.2.2 The PROMOTE®-Method

The PROMOTE® method consists of four different levels:

- The **Strategic** level defines knowledge goals and business targets at the beginning of the realisation process and evaluates the result after a defined time period. Some concepts of knowledge strategies and knowledge evaluation frameworks have been briefly discussed in chapter 3 for more information on KM-strategies and KM-evaluation see [KnowledgeBoard 03], [Assessment SIG 03].
- The **Analytical** level focuses on the analysis and specification of functional requirements of the E-KMS. This includes the definition of the core tasks, the setting of functional priorities as well as technological and organisational limitations. The Service Based KM approach is an analytical method to analyse PO-KM.

- The **Formal** level describes the organisational memory in a specific format to generate well-formed knowledge models. A cooperatively design of the knowledge management system, raises the acceptance of final platform. Knowledge management tools for knowledge identification, knowledge accessing, knowledge storage, knowledge distribution, and similar tasks use these models.
- The **Operational** level provides functionality to identify, access, store and distribute knowledge. The mapping between formal models and executable tools are established via KM-Services.

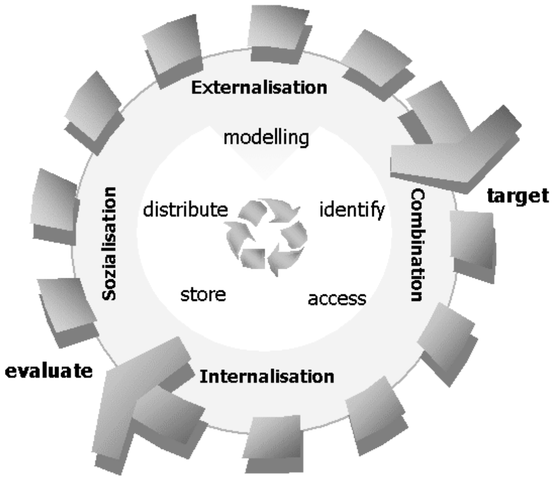

Figure 4: PROMOTE® Method

Figure 4 shows these four levels and assigns interfaces and tasks to each level. The strategic level is concerned with the definition of the KM-target and the definition of the evaluation criteria. This definition includes KM-strategies, organisation, economical, and technical requirements and is seen as the input into the analytical phase. In the analytical phase the KM-Dimensions are studied like for example the explicit and implicit knowledge dimension from Nonaka/Takeuchi [Nonaka 95] to define requirements as well as the should- and is-situation of the E-KMS. Please note that the analysis should be as detailed as "necessary" and not as "possible". The major concern of knowledge managers is that such analytical approaches need tremendous effort. Therefore, the focus of the analysis has to be defined during the strategic level and the analytical phase only studies well selected aspects. The analytical phase defines the requirements of the KM system on a conceptual level. This conceptual level is then translated into a readable language to humans and machines to enable continuous improvement of the models, to make relations between different aspects visible.

2.2.3 Process Oriented KM: The PROMOTE® Approach

The PROMOTE® approach uses BPs as a starting point of KM as the processes are not only seen as "a set of manual, semi-automatic or automatic activities that are executed under the restriction of certain rules to achieve an organisational goal", but also as the Know-How-Platform of an organisation that will be realised by value chains to achieve the strategic goals of an organisation (unpublished slogan from Karagiannis). Supporting the critical tasks of BPs automatically leads to KM that assists users in their daily work.

PROMOTE® interprets POKM as defining the core KM-activities as processes to enable a management framework for KM. This management framework defines so-called KMPs that define the modelling-, identification-, access-, storage-, distribution-, and evaluation-processes. These KMPs define the interaction between knowledge users and enables therefore a management framework to build, identify, and validate knowledge exchanges.

The KMP-categories used in PROMOTE® are described as following [PROMOTE 02]:

- **Knowledge model building processes:**
  This category of KMPs includes the analysis of BPs, the modelling and validation of knowledge models.
- **Knowledge identification processes:**
  This category of KMPs includes the identification of critical BPs, the analysis of skills and competence, and the analysis of the knowledge models.
- **Knowledge access processes:**
  This category of KMPs includes the interactions between human knowledge workers and the organisational memory as well as the interactions with the Internet.
- **Knowledge storage processes:**
  This category of KMPs includes the storage of micro articles, the categorisation of documents, and the description of knowledge resources with textual annotation.
- **Knowledge distribution processes:**
  This category of KMPs includes the co-ordinated generation, validation, and distribution of new entries in the organisational memory.
- **Knowledge evaluation processes:**
  This category of KMPs includes the definition of knowledge evaluation criteria, the modelling of such evaluation criteria, and the monitoring of KMPs according to the defined criteria.

This framework enables the definition of the KM-strategy, the realisation of an E-KMS platform or the development of an evaluation framework.

3 Service-Based KM: An Implementation Approach

The previously introduced process-oriented KM approach is a concept that enables the integration of KM with other management approaches. KM aspects are designed using a special modelling language that focuses on business processes.

KM tools are necessary for the realisation of KM activities (or knowledge management processes) within business processes. The challenge is that existing KM tools can hardly be classified, compared or selected regarding their requirements because as today's KM solutions suffer from:

- chaotic market situation, especially for decision makers it is very difficult to select the appropriate tool;
- several different KM-tools are required and have to work cooperatively;
- holistic KM needs both social and technical services, till date there is no concept that treats these services similar and
- global operating companies need KM solutions that are location independent.

The idea of KM-Services is to enable a clear definition of KM-tools on a conceptual level that is independent of the underlying technology. Such a service-based view would enable the classification of KM-tools, make decision easier, enable a better cooperation between KM tools and would treat social and IT-based services equally.

3.1 Literature on KM-Services

It is reasonable that KM-platforms follow the trend of service oriented programming (SOP) as realised in the KM-platform of CSC [AlBanna 98] mentioned in [Schwendenwein 99] and discussed within the concept of nine keys in [Sivan 03] introducing Knowledge Services.

These platforms define services on a technological level, as pointed out in [Kühn 03] and [Karagiannis 02] it is not sufficient to only emphasize the technological integration but it is also necessary to enhance the conceptual integration. In this case the conceptual integration would be a KM integration. Such a KM integration is rarely discussed. [Valenta 01] mentions a two dimensional framework for KM services whereas [Roehl 00] introduces a business-driven classification for KM-tools in [Keller Ginsky 00].

The KM-Service framework introduced in this section defines a multi-dimensional semantic service framework in the context of KM that provides interfaces to technological implementations and points out application scenarios. Parts of this approach have been published in [Woitsch 02], [Woitsch 03a], [Woitsch 03b]. The KM-Services separate technical implementation (KM-tools) and conceptual requirements (KM-Services) whereas the conceptual design is developed using KM-Services and the technical implementation is realised by mapping Web-Services.

A possible application scenario is introduced by [Fra03] that provides a questionnaire according to KM-dimensions, analyses the answers and suggests a set of KM-tools.

3.2 Web-Service: The Technological Basis

There are various different definitions of Web-Services that are either

Business-oriented like:

> "*Web-services are loosely coupled reusable software components that semantically encapsulate discrete functionality and are distributed and programmatically accessible over standard Internet protocols*" *[Brent 01].*

Technical oriented as:

> *"A Web service is a software system identified by a URI [RFC 2396], whose public interfaces and bindings are defined and described using XML. Its definition can be discovered by other software systems. These systems may then interact with the Web service in a manner prescribed by its definition, using XML based messages conveyed by Internet protocols." [W3C 03]*

The above-mentioned Web-Service only has a syntactical definition but not a semantic definition.

3.3 Semantic Web-Service: A Contextual Basis

When using Web-Services there are three major drawbacks by global UDDIs:

- Maintenance is expensive, when running global UDDIs professionally.
- The categorisation of services needs to be far more detailed including branches, topics and type of applications – current UDDIs are insufficiently classified.
- The offered services have to be consistent.

An expectation of the author is, that instead of global UDDIs organisational UDDIs will be appropriate for enterprise platforms. Companies own classification can be used for the UDDI and vendors have to sign a contract when uploading a service into the organisational UDDI.

For end user access of the service repository a User Interface management for the different services has to be provided by the portal.

The aim is to enable a semantic enriched UDDI like SNODDI mentioned by IBM in [Lee 03].

3.4 Knowledge Management Service: The Implementation Approach

The KM-Service is a semantic Web-Service that is defined in the context of KM. This means that semantic services are defined by a KM – framework consisting of KM-Dimensions and algorithms to classify and select services. The following dimensions have been published in [Woitsch 03a], [Woitsch 03b].

3.4.1 Semantic Framework for KM-Services

The semantic framework to classify KM-Services is defined by KM-Dimensions:

Representation of Knowledge: Set of knowledge representation is defined as *RepKM*, with *RepKM = {i,e}, vr* ∈ RepKM, where i is implicite and e is explicite.

Medium of Knowledge: Set of knowledge medium is defined as *MedKM* with *MedKM = {h,e}, vm* ∈ *MedKM*, where h is human and e is electronical

Knowledge User: Set of user types defined as *UseKM* with *UseKM = {i, ec, e, c},*

vu ∈ *UseKM*, where i is individual user, ec is enterprise community user, e is enterprise user and c is inter-organisational communities.

Time of Knowledge: This dimensions specifies the time of generation and usage. The set of time is defined as *TimeKM* with *TimeKM = {perf,past,pre,fut}*, where pref is the time before implementing this specific KMS, past is the past, pre is the present and fut the future.

The knowledge usage is defined as $vtu \in TimeKM$ depicting if the knowledge has been generated before using the knowledge, on time or will be generated in future.

The knowledge storage is defines as $vts \in TimeKM$ depicting if the knowledge is used on time or will be used in the future.

Origin of Knowledge: The set origin of knowledge is defined as *OriginKM* with $OriginKM = \{i,e,c\}$, $vo \in OriginKM$ where the origin of knowledge is either generated within the organisation, outside the organisation or within a community.

Sophistication: The set of sophistication of knowledge is defined as *SophKM* with $SophKM = \{t,nt,s,hs,c\}$, $vs \in SophKM$ where t is trivial knowledge that needs no special education, nt is non trivial knowledge, s is sophisticated, hs is highly sophisticated knowledge that needs special education and experience over a significant period of time and c is chaos where there is no available knowledge.

Life Cycle of knowledge: The set of knowledge life circle is defined as *LifeCKM* with $LifeCKM = \{ne,fs,e,s,o\}$, $vlc \in LifeCKM$ where ne is non existing knowledge, fs are the first steps into a new field of knowledge, e is the enthusiasm, s is to sober down and fundamentally use the knowledge whereas o is old knowledge.

Relevance of knowledge: The set of knowledge relevance is defined as *RelKM* with $RelKM = \{f,r,s,nr\}$, $vrel \in RelKM$ where f is fundamental knowledge, r is relevant knowledge in the specific field, s as side effects and nr is not relevant knowledge.

Applicability of knowledge: The set of knowledge applicability is defined as *AppKM* with $AppKM = \{o,i,a\}$, $vapp \in AppKM$, where o is operational knowledge, i is interpretative knowledge and a is analytical knowledge.

Level of knowledge: The set of knowledge level is defined as *LevKM* with $LevKM = \{n,s,t,o\}$, $vl \in LevKM$, where n is normative knowledge, s is strategic knowledge, t is tactic knowledge and o is operational knowledge.

Dynamic of knowledge: The set of dynamic is defined as *DynKM* with $DynKM = \{s,d\}$, $vd \in DynKM$, where s is static and d is dynamic knowledge.

Expression of knowledge: The set of knowledge expression is defined as *ExpKM* with $ExpKM = \{f,r\}$, $vex \in ExpKM$, where f is factual knowledge (Know-What) and r is a rule based knowledge (Know Why).

Service boundaries: The set of service boundaries is defined as *BouKM* with $BouKM = \{a,s,r\}$, $vb \in BouKM$, where a is an arbitrary definition of boundaries, s is a suggested definition of boundaries and r is a required definition of boundaries.

Knowledge abstraction: The set of knowledge abstraction is defined as *AbsKM* with $AbsKM = \{i,mi,m2i,\ldots mni\}$ with $n \in N$, $vabs \in AbsKM$, where i is the information layer, mi is the meta layer, m2i meta2 layer and mni metan layer.

Knowledge action: The set of knowledge action is defined as *ActKM* with $ActKM = \{m,i,a,s,d,e\}$, $vact \in ActKM$, where m is modelling knowledge, i identification, a access, s storage, d distribution and e the evaluation of knowledge.

Knowledge structure: The set of knowledge structure is defined as *StrucKM* with *StrucKM = {ns,ss,ws}*, *vstr* ∈ *StrucKM*, where ns is non structured, ss is semi structured and ws well structured of knowledge.

The whole KMS vector considers all of the above dimensions and is therefore defined as: *v = (vr,vm,vu,vtu,vts,vo,vs,vlc,vrel,vapp,vd,vex,vb,vabs,vact,vstr)*

This vector defines the required functionality of an E-KMS and the actual E-KMS. The difference between the desired vector and the actual vector represents the E-KMS-Gap. The requirement vector will be derived through qualitative or quantitative knowledge acquisition, whereas the service vector will be defined by the service vendor of KM-tools.

3.4.2 KM-Service Selection

This chapter briefly depicts a selection procedure to generate a KM-Service portfolio (E-KMS) on demand starting with the requirement vector without strategic influence. To simplify the explanation only three dimensions are depicted.

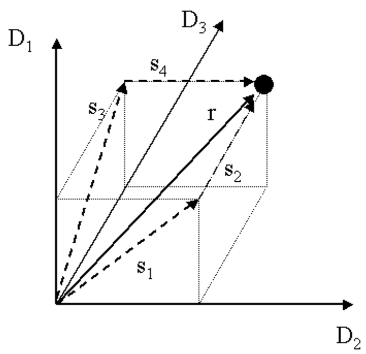

Figure 5: KM-Service Vectors

In this example a sufficient KM system can be generated by either adding s1 and s2 or by using the services s3 and s4. This selection procedure uses backwards chaining by starting from the requirement vector and subtracting one service by the other till the end condition either “no services left” or “all dimensions sufficiently covered” is matched.

The first step is to find s2 that is the first service to subtract from the requirement vector. To find the best service for the first subtraction, the service distance is calculated to find the most similar service vector to the requirement vector sd = √(r-s)2.

The service with the minimum distance is subtracted from the requirement vector, then the service distance is calculated again for the transformed requirement vector. This procedure is repeated till the transformed requirement vector is sufficiently close to 0, or no services are left to be subtracted.

To calculate the euklidic distance from service vectors to the requirement vector of the E-KMS requires transformed values of the KM-dimensions into decimal numbers. According to mapping functions for each dimension the service vector is transformed into a decimal representation of the vector. KM-strategies influence the requirement vector by pushing the vector towards preferred dimensions.

There are some challenges that have to be considered using such a service selection like Service dependencies, Strategic influence or the Service mapping.

Therefore the transformed requirement vector r' is introduced as r'=r'-sx, for x=1..n

In the above example the procedure is the following:

1:r' = r

2: repeat (r' = r'-sn)

3: No dimensions left or all dimensions sufficiently covered.

To optimise the results of the Service selection more sophisticated algorithms are used. Detailed calculations consider the input and output vector of a service, as well as the intensity of the dimensions. A KM-Service changes the intensity of KM-Dimensions.

Beside the algorithm, a cost function for each vector has to be defined to map each dimension into a decimal representation. These mapping functions are either equally spread (like at the "origin of knowledge"), or have to consider a conceptual difference (like the "users of knowledge"), where a distortion spread has to be used. The selection of cost function allows a fine-tuning of the service selection.

The requirement vector r can be used as an input for algorithms to find the most appropriate KM-Service bundle. The following algorithm depicts a simple method to build a collection of service vectors that add up to the requirement vector and therefore simulates or verifies an E-KMS.

3.5 KM Meta Service Framework: A Context Independent Implementation

The previously described KM-Service framework is based on selected KM-Dimensions. To enable a more flexible approach that allows for the definition of any KM-Dimensions by the organisation a Meta-Service-Framework has to be used.

Such a framework is semantically independent which means that dimensions can be easily adapted or exchanged therefore enabling the definition of individual KM-Frameworks and providing standard algorithms for analysing, simulating or verifying a KM-System.

The above-mentioned method is completely independent from the type and domain of KM-Dimensions. The Meta KM-Framework therefore defines an Enterprise KM-System (E-KMS) entirely on the basis of KM-Services. This approach has been published at [Woitsch 04] and will be described in the proceedings of the PAKM04.

The concrete value of the vector is represented by the object value. The value allows for storing semantic description and the mapping into a computable number. The following figure describes the Meta-Service-Framework by presenting the major UML classes.

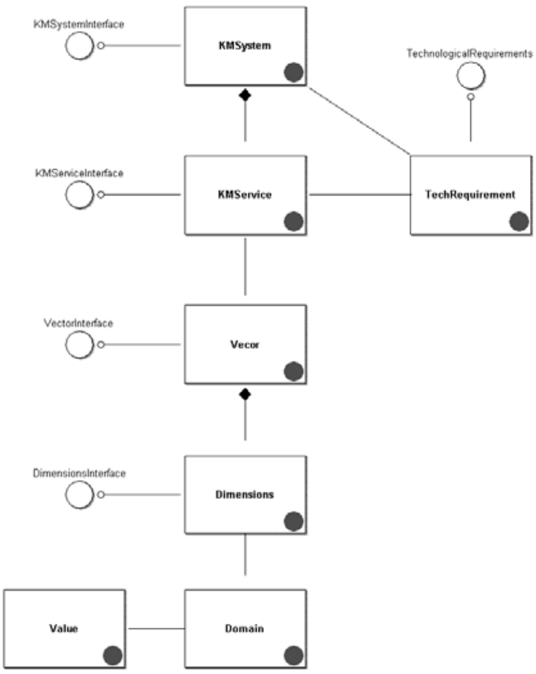

Figure 6: Meta-Service Framework

The value class is concerned with the mapping of the domains to computable numbers. The domain class defines the possible state per dimension, whereas a bundle of dimensions defines the service vector. The KM-Service is described by the service vector which is compared to the requirement vector. Technical requirements are listed in an own class.

4 PROMOTE® Platform: A Realisation Scenario

4.1 Overview of some KM-Approaches

KM initiatives are business driven projects with objectives like "Reducing cycle time" (e.g. Hoffmann-LaRoche),"Reducing cost", "More efficient user/reuse of knowledge assets" (e.g. Ernst & Young), "Enhanced functional effectiveness", "Increasing organizational adaptability" (e.g. Astra Merck) or "Creating new knowledge-intensive products, processes, and services" (e.g. Dow Chemicals) [Long 03]. As mentioned in [Wil98] consultancy is a knowledge intensive branch as expert knowledge is the basis for quality in consulting. Consultants therefore "sell" their expert knowledge, and their experiences. Once the customer uses the expert knowledge the knowledge has been partly transferred. This means that the resource of a consultancy – the experience and expert knowledge – is continuously transferred to the customer. This generates a pressure to regularly develop new knowledge and gain new experience. In this environment it is reasonable to understand that KM is a strategic objective of consultancies that has been analysed by [Schwendenwein 99].

In the following an example of the EU-research group of a consultancy is briefly mentioned to show some KM-models and the realisation via KM-Services.

4.2 The Design of the KM Approach at the EU-Project Group

The main business processes of the EU project group have been identified and the knowledge intensive processes have been designed.

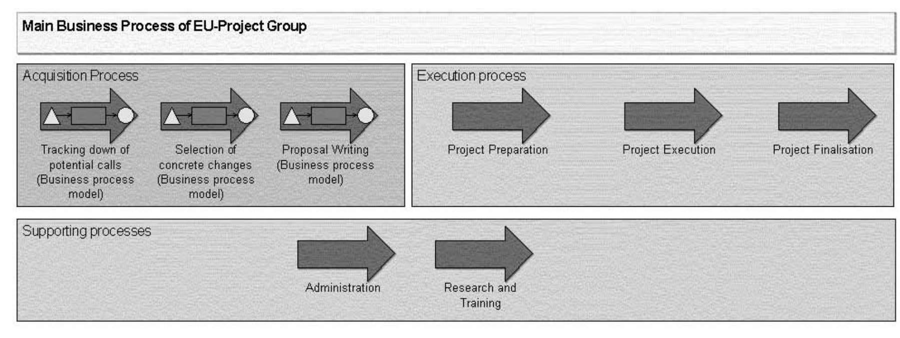

Figure 7: Process Pool of the EU-project group

Figure 7 depicts core processes of the EU-project group that are classified into acquisition processes, execution processes and supporting processes. The critical phase is the acquisition phase, therefore the three acquisition processes “Tracking down of potential calls”, “Selection of concrete changes” and “Proposal Writing” are modelled in more detail.

The remaining processes are not seen within the focus of the KM project. The process “Project preparation” is concerned with the setup of a project, when the negotiation with the European commission was successful. Project execution and project finalisation are not seen as critical, as there are not such time restriction than within the first processes.

There are two supporting processes that run in parallel. The administration process, is concerned with general organising activities like resource planning, reports and coordination meetings.

The second process “Research and Training” is concerned with continues training of the employees. This includes the regular publication of scientific articles, a close cooperation with the University and internal knowledge distribution like attending meetings, presentations or training sessions.

4.3 Knowledge Management Services

An overview of the KM-Service model that enables the access to the knowledge resources is depicted in Figure 8.

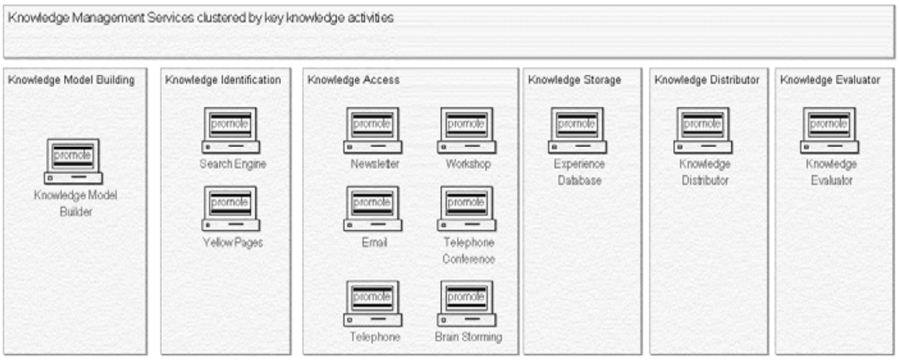

Figure 8: KM-Service Model

The "Knowledge Model Builder" is a service to define the knowledge management system. For the identification of knowledge there are two services the Search Engine (for collecting information, publications and statistics over the internet) and the Yellow Pages (for internal use of the EC-group only).

The knowledge access is realised by the service Newsletter that triggers the "Tracking process", the service "Workshop" for internal and external knowledge generation, "Email" for partner communication and distributed proposal writing, "telephone" for the access of human based knowledge, "telephone conference" for consolidating the proposal writing process and "brain storming" for the generation of innovative ideas.

For knowledge storage an experience database is installed to store past proposals and the evaluation report of the commission. The knowledge distribution is for internal reasons only; as the EC-group enlarges before a proposal call up to ten new members a portal with all relevant guidelines and descriptions is accessible. The knowledge evaluation using a balanced score card is installed but not used.

4.4 Knowledge Management Processes

Knowledge Management Processes define the knowledge flow at knowledge intensive tasks between knowledge workers in a process oriented way.

The first step is therefore to identify so-called "Knowledge intensive tasks". The identification of so-called "knowledge intensive tasks" is an individual process that needs specific adaptations for each application area. In the following the procedure that has been used within the above mentioned processes is introduced.

The type of knowledge intensity is described using two dimensions:

1. exact or vague knowledge;
2. complete or incomplete knowledge.

Those two dimensions generate a matrix that defines four types of knowledge intensity.

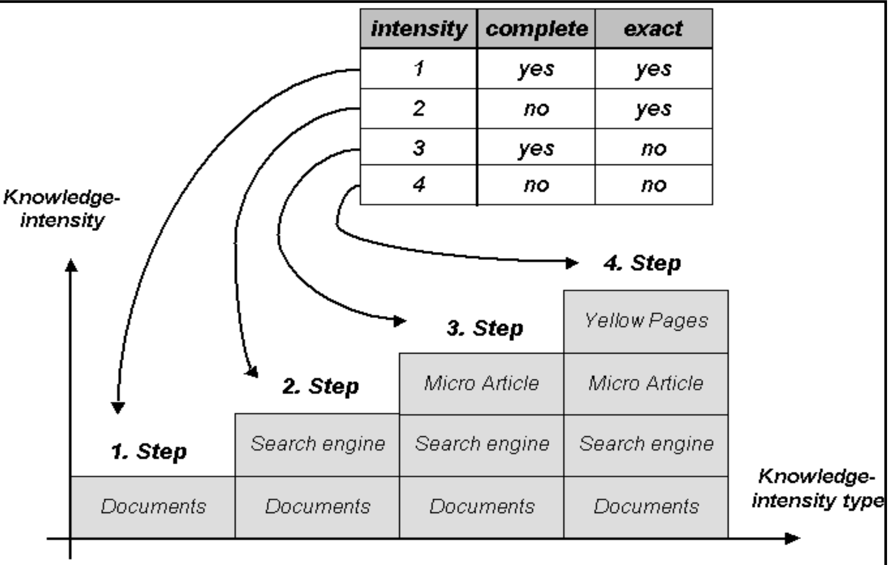

Figure 9: Knowledge-intensity of activities

Figure 9 shows a matrix with four different types of knowledge-intensities divided in complete and exact knowledge. Complete knowledge means that all relevant aspects to solve a task are known and defined. An example is to read the published call from the European Commission. Incomplete knowledge deals with aspects that are partly unknown. The positioning within the call strongly depends on positioning of the competition and the future market trends. These factors are unknown and the task therefore incomplete.

The second dimension describes exact or vague knowledge. Exact knowledge can be clearly identified whereas vague knowledge can only be estimated. In the above example the writing process of a proposal deals with exact knowledge as chapters, and the European Commission defines content. The definition of the proposal idea in contrary deals with vague knowledge, as the there are only estimations if the content is of a sufficient quality.

The first knowledge-intensity type deals with exact and complete knowledge. The second type deals with incomplete but exact knowledge, this means that the problem solving space needs enlargement, but an exact search can be performed. The third type deals with complete but vague knowledge. This means that a concrete search is impossible but a fuzzy search is required. In the above example the fuzzy search is realised in two steps, first the fuzzy transformation of expert knowledge into an article (concept of micro article) and the second step the exact search within micro articles. The fourth type of knowledge intensity deals with incomplete and vague knowledge. This type of knowledge activities requires new methods, as a transformation from implicit to explicit knowledge in an unknown search area is impossible. Therefore the search is applied on the implicit level (yellow pages).

The recommendation is not to model knowledge management processes in type 1, optionally model knowledge management processes in type 2 but mandatory model knowledge management processes in type 3 and 4.

4.5 KM-Services Meet Processes

The PROMOTE® platform contains special process models to manage KM-Services. Each user has access rights to certain knowledge management processes and knowledge services. When performing a knowledge intensive task, the user gets support by KM-services that are either related to the person, or related to the knowledge intensive task.

This leads to the definition of the business process that identifies the knowledge intensive tasks, the semantic framework that instantiates the semantic service framework and the knowledge management services that indicate Web-Services fulfilling the required operations.

Figure 10 shows the definition of the semantic context of a business process at the top, the semantic framework using knowledge dimensions in the middle and Knowledge Management Services at the bottom of the picture.

KM-Services therefore support the execution of knowledge management processes in a user centric and flexible way. This architecture enables a very dynamic KM-approach by separating the technical implementation from the semantic requirements.

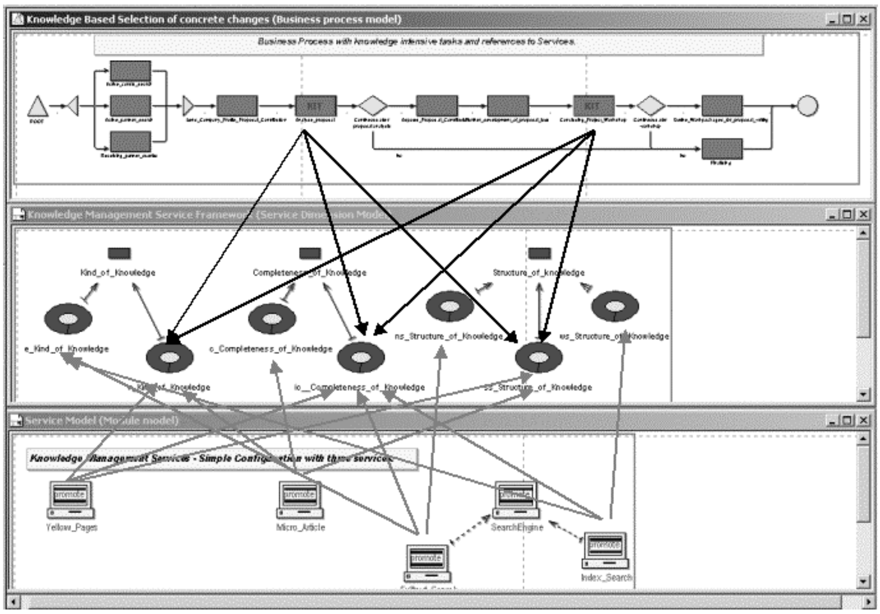

Figure 10: Integration of Processes and KM-Services

4.6 Architecture of an Enterprise Knowledge Management System

This section gives an overview on a service-based realisation of an IT-based KMS. The KM-Service framework is seen as the classification concept of the UDDI repositories. It is reasonable that the organisations will develop their own KM-Service framework and will therefore install an organisational UDDI. The necessary KM-Services will be uploaded on the organisational UDDI.

Figure 11 depicts an overview on Service Based E-KMS architecture. The blue line indicates the border between the Internet and the inner organisational system. The Web-Services implementing KM-services are deployed by vendors and categorised using UDDI Services (KM-framework). The KM-Dimensions are used to classify these KM-Services in the organisational service repository (UDDI). All user requests are coordinated by the KM-portal that uses the previously mentioned service selection algorithm to find the most appropriate KM-Service either in the organisational service repository or in external service repositories.

In this case the PROMOTE® platform is described that is coordinated by process models to manage KM-Services. Each user has access rights to certain knowledge management processes and knowledge services. By performing a knowledge intensive task, the user gets support by KM-services that are either related to the person, or related to the knowledge intensive task.

KM-Service support therefore the execution of knowledge management processes in a user centric and flexible way. This architecture enables a very dynamic KM-approach by separating the technical implementation from the semantic requirements.

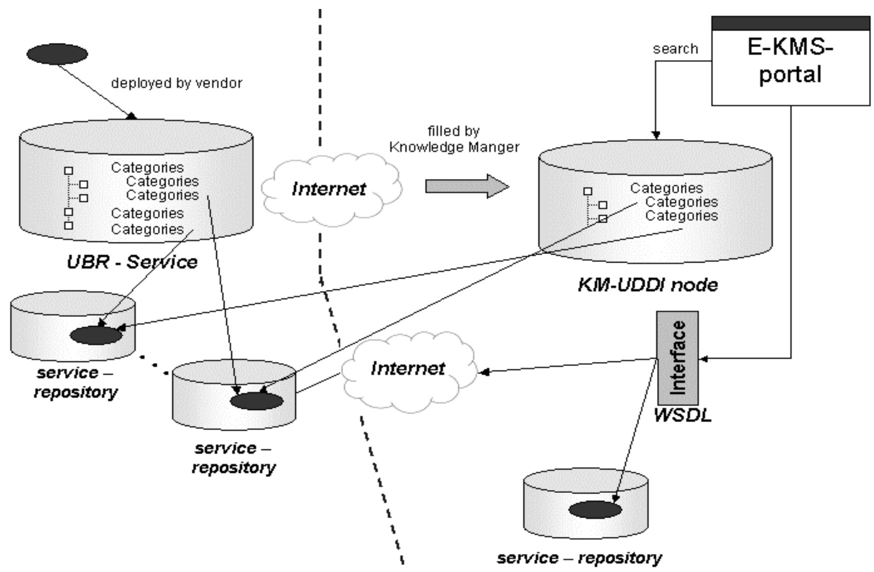

Figure 11: Basic Architecture of a Service Based PO E-KMS

5 Summary

This paper introduces a new viewpoint on knowledge management – the service based approach – to enable the integration of KM into existing management approaches.

The process-oriented knowledge management of PROMOTE® has been used as a concept to define knowledge management requirements on the basis of business needs. The KM-Services approach has been introduced to implement the KM-system on the basis of process oriented knowledge management.

The KM-Service framework has been introduced to enable analysis, simulation and evaluation of KM-requirements and KM-solutions.

A Meta-Service framework has been defined to make the KM-service framework adaptable.

Interesting questions for the future can be the identification of different knowledge management strategies in selecting KM-Services. Beside the introduced selection algorithm new KM-Service-selection algorithm like heuristics could enable a usable configuration process for very dynamic future KM-platforms.

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We thank our partners FIDUCIA and INTERAMERICAN for the fruitful cooperation during the PROMOTE project providing test beds in the field of software development and legal case management. Both partners influenced the development of the PROMOTE-approach by providing end user requirements and business objective for Knowledge Management.

The EC-Project run within the European Knowledge Management Forum (EKMF) exchanging experiences on the KnowledgeBoard that gave the author the possibility to share ideas during summer schools and online events with a large knowledge management community.

The service-base approach introduced in this text was topic of the dissertation of the first author.

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