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Utilization and Evaluation of Knowledge Management Tools in Information Technology Industry

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Abstract: *KM is based on the premise that, just as human beings are unable to draw on the full potential of their brains, organizations are generally not able to fully utilize the knowledge that they possess. Through KM, organizations seek to acquire or create potentially useful knowledge and to make it available to those who can use it at a time and place that is appropriate for them to achieve maximum effective usage in order to positively influence organizational performance. It is generally believed that if an organization can increase its effective knowledge utilization by only a small percentage, great benefits will result. An overview of the evaluation of the tools reveals that some of the requirements defined in chapter 2 are not well supported by the existing solutions. There are problems at different levels. The first problem is of technical nature. The systems used in knowledge management are distributed across different companies and use different formats and interfaces. Yet, it is necessary to access all of them. Thus, an integration infrastructure which enables data transfer between the different systems is required. The second problem, on the organizational level, is due to the fact that the organizational structures of the network have to be reflected by the knowledge management system, most notably by defining users' rights to view and manipulate contents.*

Keywords: *Knowledge management tools, Information technology industry,*

I. Introduction

Concept of Knowledge

Knowledge is increasingly being recognized as the new strategic imperative of organizations. The most established paradigm is that, knowledge is power. Therefore, one has to hoard it, keep it to oneself to maintain an advantage. The common attitude of most people is to hold on to one's knowledge, since that is what makes him or her asset to the organization. Today, knowledge is still considered power – an enormous power in fact – but the understanding has changed considerably, particularly from the perspective of organizations. The new paradigm is that within the organization knowledge must be shared in order for it to grow. It has been shown that the organization that shares knowledge among its management and staff grows stronger and becomes more competitive. This is the core of knowledge management – the sharing of knowledge[1].

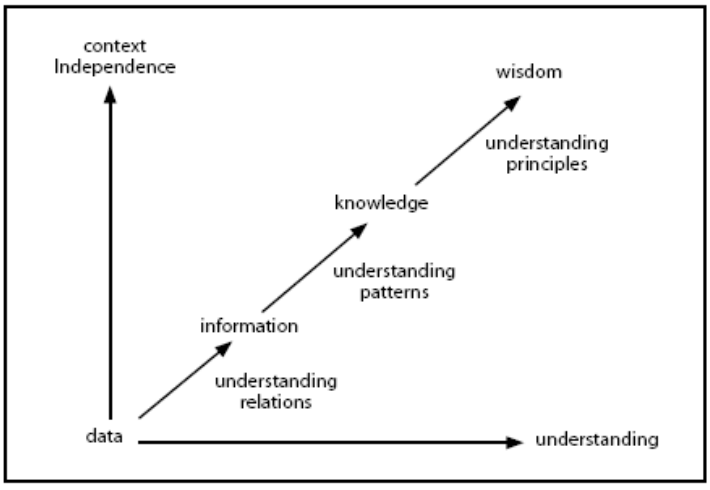

Figure 1: Conceptual Progression from Data to Knowledge.

Types of Knowledge

In the modern economy, the knowledge that it is able to harness is theorganization's competitive advantage. This competitive advantage is realizedthrough the full utilization of information and data coupled with the harnessingof people's skills and ideas as well as their commitments and motivations. In thecorporate context, knowledge is the product of organization and systematicreasoning applied to data and information. It is the outcome of learning thatprovides the organization's only sustainable competitive advantage. As such,knowledge is an essential asset that has become more important than land,labor or capital in today's economy[2].

In general, there are two types of knowledge: tacit knowledge and explicitknowledge. Tacit knowledge is that stored in the brain of a person. Explicitknowledge is that contained in documents or other forms of storage other thanthe human brain. Explicit knowledge may therefore be stored or imbedded infacilities, products, processes, services and systems. Both types of knowledge canbe produced as a result of interactions or innovations. They can be the outcome ofrelationships or alliances. They permeate the daily functioning of organizations andcontribute to the attainment of their objectives. Both tacit and explicit knowledgeenable organizations to respond to novel situations and emerging challenges.

Tacit knowledge

Tacit knowledge is personal. It is stored in the heads of people. Itis accumulated through study and experience. It is developed through theprocess of interaction with other people. Tacit knowledge grows through thepractice of trial and error and the experience of success and failure.Tacit knowledge, therefore, is context-specific. It is difficult toformalize, record, or articulate. It includes subjective insights, intuitionsand conjectures. As intuitive knowledge, it is difficult to communicate andarticulate. Since tacit knowledge is highly individualized, the degree andfacility by which it can be shared depends to a great extent on the ability andwillingness of the person possessing it to convey it to others[3].

The sharing of tacit knowledge is a great challenge to manyorganizations. Tacit knowledge can be shared and communicated throughvarious activities and mechanisms. Activities include conversations, workshops,on-the-job training and the like. Mechanisms include, among others, the useof information technology tools such as email, groupware, instant messagingand related technologies.

In managing tacit knowledge, the very first hurdle to mostorganizations is identifying the tacit knowledge that is useful to theorganization. Once relevant tacit knowledge is identified, it becomesextremely valuable to the organization possessing it because it is a uniqueasset that is difficult for other organizations to replicate. This very characteristicof being unique and hard to replicate is what makes tacit knowledge a basisof the organization's competitive advantage. Accordingly, it is essential foran organization to discover, propagate and utilize the tacit knowledge of itsemployees in order to optimize the use of its own intellectual capital.

In any organization, tacit knowledge is the essential prerequisite formaking good decisions. A new executive not yet familiar with the organizationwill find it difficult to make good decisions since he or she has yet to acquiretacit knowledge about the workings of the organization. Tacit knowledge istherefore crucial to getting things done and creating value for the organization.

Explicit knowledge

Explicit knowledge is codified. It is stored in documents, databases,websites, emails and the like. It is knowledge that can be readily made available toothers and transmitted or shared in the form of systematic and formal languages.Explicit knowledge comprises anything that can be codified,documented and archived. These include knowledge assets such asreports, memos, business plans, drawings, patents, trademarks, customerlists, methodologies, and the like. They represent an accumulation of theorganization's experience kept in a form that can readily be accessed byinterested parties and replicated if desired. In many organizations theseknowledge assets are stored with the help of computers and informationtechnology.

Explicit knowledge is not completely separate from tacit knowledge. Onthe other hand, the two are mutually complementary. Without tacit knowledgeit will be difficult, if not impossible, to understand explicit knowledge. Forexample, a person without technical, mathematical or scientific knowledge(tacit knowledge) will have great difficulty understanding a highly complexmathematical formulation or chemical process flow diagram, although it may bereadily available from the organization's library or databases (explicit knowledge)[4].

The core and enabling knowledge in organizations are more than a pure competitive advantage. This organizational knowledge makes possible focused and collective action. But as important as organizational knowledge is organizational memory. A great deal of the knowledge of the organization is created and stored at individual level. They are in the heads of people and groups of people who work in the organization – the employees, managers and top executives[5].

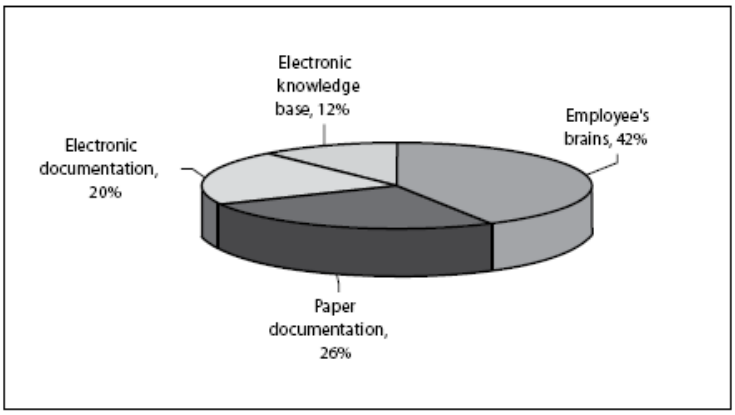

Figure 2: Primary repositories of an organization's knowledge

Defining Knowledge Management

There is no universally accepted definition of knowledge management. But there are numerous definitions proffered by experts. Put very simply, knowledge management is the conversion of tacit knowledge into explicit knowledge and sharing it within the organization. Putting it more technically and accurately, knowledge management is the process through which organizations generate value from their intellectual and knowledge based assets. Defined in this manner, it becomes apparent that knowledge management is concerned with the process of identifying, acquiring, distributing and maintaining knowledge that is essential to the organization[6].

Table 1: What is KM?

Results-oriented definition	"To have the right knowledge at the right place, at the right time in the right format."
Process-oriented definition	"The systematic management of process by which knowledge is identified, created, gathered, shared and applied."
Technology oriented	"Business intelligence + collaboration + search engines + intelligent agents."

Table 2: Technology Appropriate to Knowledge ManagementApproach

REPOSITORY MODEL	• Internet, HTML, XML • Full text search engines • Document management systems
COMMUNITIES OF PRACTICE	• Web conferencing • Threaded discussion groups • Automated workflow • Expert Directories
CONTINUOUS LEARNING	• Learning management systems • Electronic performance support systems (EPSS) • Performance management
BUSINESS INTELLIGENCE	• Databases • Data Mining Tools • Enterprise Databases • Decision Support Tools

Classification and evaluation of existing tools

In the following chapter, we will classify the existing tools for knowledge management and evaluate whether they are suitable for use in cooperative settings. It has to be noted that there is no such thing as "the knowledge management system" as a monolithic, integrated application. Instead, a knowledge management system is a more or less tightly integrated combination of various applications, some of which are used in other contexts as well[7].

Classification of knowledge management tools

There are numerous attempts at classifying software used in knowledge management in literature. In fact, almost every author uses his own classification, since the classification is usually closely linked to the subject treated and the insights desired. In the following, we will adapt the system proposed by Maier which classifies the IT tools based on the functions they serve in the knowledge management system. It is based on current research and covers all fields of technology used in practice. Besides, it is free from overlaps between categories. It offers a higher degree of clarity than categorizations which use only two categories based on dichotomies or strategies such as codification/ personalization. In this classification, the tools which are combined to form the knowledge management system are grouped into seven categories. These are the input-orientedfunctions of publication, structuring and linking as well as integration of knowledge fromexternal sources. The output-oriented functions include search and retrieval as well aspresentation of knowledge. These groups are supported by infrastructure functionscategorized as communication/cooperation and administration. The seventh group,imparting knowledge, which mainly consists of e-learning and related concepts, will notbe examined in detail in this paper, as it mainly belongs to personnel development andnot primarily to knowledge management[8].

We will introduce the results in the form of tables and discuss the main results, including tools which are particularly well- or ill-suited for use in cooperations. Blank fields in the tables indicate that the criterion in question is not applicable to the respective tool. The + sign denotes that the tool in question complies with the requirement in question, the 'O' means neutrality or limited support and '_' means that the tool conflicts with the requirement. Since we will not be able to treat all tools in depth, we will focus on the aspects which are particularly positive or negative.

II. Methodology

Content management systems

Content management systems include information assets bothinternal and external and systems that support the creation and administrationof digital information. To ensure proper functioning of the knowledgemanagement system, programs for managing the content of web sitesshould be developed and implemented. At the same time, the roles andresponsibilities for maintaining and updating content should be clearlydelineated. There should also be a way to allow 'authors' or 'contributors' toprovide new content in the form of articles. Content management systemsalso include some concepts of workflow for target users which define howcontent is to be routed around the system[9].

Measuring Knowledge Management

By way of a final note to fully understand what knowledgemanagement really is, it is useful to briefly consider and discuss themeasurement of the results of a knowledge management system. Anysuch system of measurement must take into consideration the value ofknowledge assets and the magnitude of knowledge sharing. Admittedly,such measurement is a difficult task since knowledge is generated by humanbeings and is both tacit and dynamic. Since the management of knowledgeinvolves the coordination of individuals who create, share, organize andapply knowledge, measuring this management involves the tracing anddocumentation of the causal relationships between the application ofknowledge and its creation and sharing[10].

Elements of Knowledge Management

A complete knowledge management system must contain fourelements. These are: (a) knowledge creation and capture, (b) knowledgesharing and enrichment, (c) information storage and retrieval, and (d)knowledge dissemination.

Knowledge Creation and Capture

The first element of knowledge management is knowledge creationand capture. Knowledge is continually being created in any group, corporationor organization since the very interaction among people generates knowledge.One of the primary aims of knowledge management is to capture theknowledge that is produced during such interactions. As a consequence of thehighly competitive nature of today's markets, there is increasing need withincorporations and organizations to create new knowledge, generate novelideas and

concepts, and to capture these ideas, concepts and knowledge.The very survival of a corporation sometimes depends largely onhow much new and advanced knowledge it can generate, capture and utilizein order to produce a more competitive or attractive product or service. Forthis reason, two factors have become of utmost importance in determiningcompetitiveness – creativity and innovation. These two factors have becomenot only important, but essential, to the long-term viability of the corporationor organization. Unless an organization is able to create new products, developmore efficient manufacturing processes, or introduce improvements in designor function, it will have great difficulty in competing in fast changing markets[11].

Knowledge Sharing and Enrichment

The second element of knowledge management is knowledgesharing and enrichment. This element is probably the most crucial among thefour. It is during the process of sharing that knowledge is usually refined andenriched. Knowledge can be shared by the organization with its employees(e.g., through memos and instructions) and sharing of knowledge can occurbetween employees of the organization (e.g., through group discussions andinternal meetings) as well as with people outside of the organization (e.g.,through attending seminars and workshops)[12].

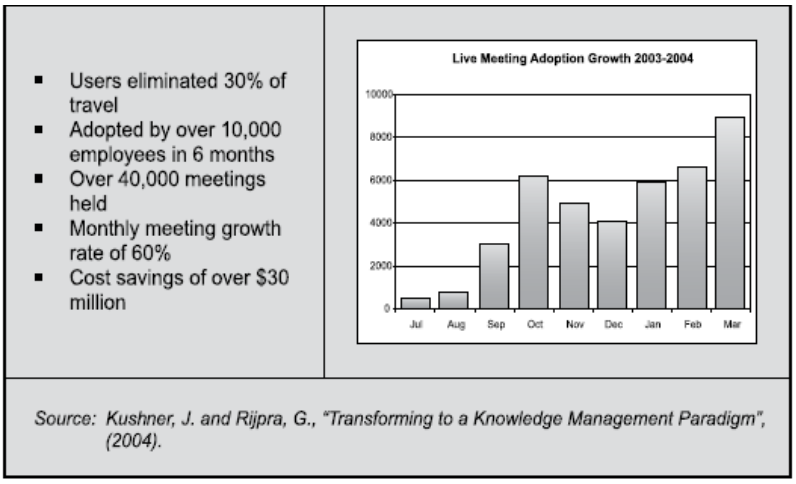

Figure 3: Live meetings at Microsoft.

Communities of practice

Communities of practice have been proven to be excellent means toshare knowledge among people who have a common interest. These comprisegroups of people who share knowledge, concerns or interest in a given area.As a result of their continuing interaction with one another, generally throughthe use and application of information and communication technologies,the members of the community enrich their knowledge and expertise in thatparticular area. Communities of practice provide their members with verypowerful cooperative tools for further developing their expertise and abilities.These groups are an effective and flexible means to examine some knowledgeissues and gain further insights into specific knowledge domains[13].

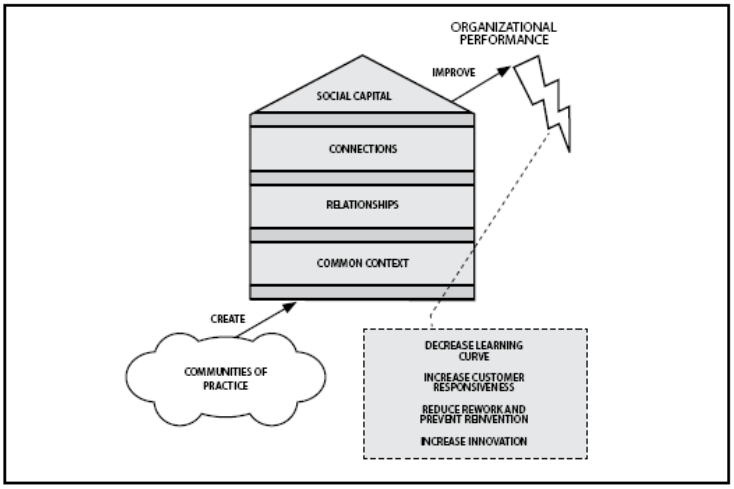

Figure 4: Communities of practice are linked to organizational performance through the dimensions of social capital

KNOWLEDGE MANAGEMENT TOOLS

All organizations deal with knowledge in their daily operations. However,only a few have a systematic and formal way of dealing with knowledge. Majorityof organizations rely on individuals and ad hoc processes. The consequence of thisis that when people leave the organization, they take their knowledge with themresulting in the loss of valuable organizational assets and resources[14].

There are a number of factors that can motivate an organization toestablish a formal and systematic management of knowledge. These includethe desire or need to:

(a) Get a better insight on how the organization works;
(b) Reduce the time and effort in searching for information and documents;
(c) Avoid repetition of errors and unnecessary duplication of work;
(d) Reducethe response time to questions that are asked frequently; and
(e) Improve thequality and speed of making important decisions.

Document Management

Documents are the most common repository of informationand knowledge in any organization. Documents are produced for almosteverything: a project proposal, a contract or agreement, a technical report,a scientific paper, and others. Because of the great variety of the types andlengths of documents that an organization can produce, the systematicand organized management of these documents can save the organizationconsiderable effort and money. And for many organizations such an effortto systematize and organize document management is the starting pointof knowledge management. However, knowledge management actuallyinvolves much more.

Enterprise Portal

Portals can be defined as single points of access that provideeasy and timely access to knowledge. Portals are important tools forknowledge management since they make it easier to share knowledge inan organization. In essence, knowledge portals serve as the central point forsharing knowledge. Through this portal, users can contribute informationto the corporate pool of knowledge, access information, and collaboratewith other experts and their peers. Since one of the goals of portals is toenhance corporate performance, it is essential to populate the portal withinformation of the highest quality in order to ensure its successful use in aknowledge management system[15].

Knowledge Map and Skills Management

Knowledge management tools deal not only with documents but,also, with information about living experts who provide advice and sharetheir expertise with colleagues. The system is an efficient way of making the‘localization of experts’ easy and quick.In an organization where people are the most important asset,managing their skills, capabilities, interests and experience is critical. A skillsmanagement system is a web-based tool that supports this in a distributedway, spreading the workload over the whole organization. All employeescan update their own skills (adding new skills or changing skill levels) andinterests, and use the tool to locate people with particular skills. Such toolsinclude a back office tool where the HRM department (or equivalent) candefine skills and their levels, i.e., what does it mean to have level 4 (or 5) onskill ‘web servers’, as well as profiles, e.g., what are the skills required for asenior programmer or a junior business consultant. Available software suchas Skillman includes a matching function, which enables people (or HRM,depending on permissions) to see how close they are to a particular profile,e.g., person needs one more year of experience to be a senior consultant.

Information Database and Lessons Learned

In every organization people learn everyday and improve their workconstantly based on the experiences gained. Apart from the fact that this ispositive for the employee (who is incrementing his knowledge and skills) it isalso beneficial for the company as a whole in the sense that individuals performbetter, and thus the organization as a whole. However, the organization canalso learn on itself by capturing relevant experiences and distributing themthrough the organization. This ensures that the appropriate persons consultthe right knowledge at the right time.

The Lessons Learned knowledge base forms the memory of thecompany. At the same time the Lessons Learned system supports theprocess of capturing and diffusing knowledge. Lessons Learned systemsare very important in organizations where mistakes can be very costly andavoiding them in the future provides significant savings. These systemsare also extremely useful in organizations where best practices need to berepeated and disseminated as much as possible.

Collaboration Tool

Along with document management, collaboration is one of themost important aspects of knowledge management tools. Collaborationresembles a large meeting room in which colleagues work together, evenover long distances or at different times of day. They share opinions, calendarsand projects. A collaborative environment enables people to work in secureonline workspaces, in which they use e-mail, Internet web browser anddesktop applications in order to share knowledge, build closer organizationalrelationships and streamline work processes. Such an environment alsoencourages employees to share information in open discussion forums,thereby providing access to tacit knowledge. Moreover, collaboration toolsoffer better user interface for internal and external users, thus providing thelink between the organization and its partners and customers.

Implementation of Knowledge Management

Knowledge management is based on the fundamental concept thatone of the most valuable assets of an organization is the experience andexpertise that reside in the heads of its officers, managers and employees. Inorder to derive the maximum benefit from this intellectual capital, ways andmeans must be devised to manage this knowledge, capture it and share it withothers, particularly the co-workers. If executed and implemented in a propermanner, knowledge management is expected to create a more collaborativeenvironment, cut down on duplication of effort and encourage knowledgesharing. In the process, there will be considerable savings in terms of time andmoney[16].

However, in most organizations, employees are reluctant to sharetheir knowledge freely. In fact they feel that their special knowledge is thevery reason why they are important to the company and why the companykeeps them employed. By keeping the knowledge to themselves, theybecome valuable to the company resulting in employment security. But suchan attitude of hoarding knowledge leads to duplication of work, turf wars,inefficiencies and high costs.

PARTIAL TECHNIQUES AND TOOLS INCLUDED IN EACH STEP

At this section it is useful for the understanding of the technology management tools - mentioned above- to give a full description and those typical applications[17]:

1) Brainstorming

Brainstorming is an idea-generating tool widely used by teams for identifying problems, alternative solutions to problems, or opportunities for improvement. This tool originated in 1941 by Alex F. Osborne, when his search for creative ideas resulted is an unstructured group process of interactive 'brain-storming' that generated more and better ideas than individuals could produce working independently.

2) Delphi Method

The Delphi method is a very structured approach used to acquire written opinion or to receive feedback about a problem on detailed questionnaires sent to experts. Used by the Rank Corporation during the 1950s, the use of questionnaires prevents interpersonal interaction that can often stifle individual contribution whenever some participants dominate the discussion. Participants' anonymous responses are shared, and each participant can revise his or her response on the basis of reading other opinions. After repeating this process several times, the convergence of opinion will lead to team consensus.

3) Idea Advocate

First used by the Battle Institute of Frankfurt, Germany, the idea advocate is an excellent idea-evaluation tool. The team assigns the role of idea advocate to a participant who promotes a particular idea as the most valuable from a list of previously generated ideas. The more an idea advocate promotes different ideas, the more powerful is the selection process, since every idea is fully examined by the evaluation team.

4) Creativity assessment

Developed by Leo Moore, the creativity assessment technique is applied as a sorting and rating process to a long list of brainstormed ideas. It should help teams with evaluation and categorization by selecting ideas on the basis of predetermined criteria.

5) Venn Diagram

A Venn diagram can be used to identify logical relationships, and it is very useful in displaying the union and intersection of events or sets. It can graphically illustrate the mutually exclusive concept and other rules of probability or the outcome of an experiment.

6) Cluster analysis

The cluster analysis tool is best utilized after a brainstorming session to organize data by subdividing different ideas, items, or characteristics into relatively similar groups, each under a topical heading. Mainly a discovery tool, it often surfaces perceived problem areas, concerns, or items that naturally belong together.

7) Dendogram

The dendogram displays, in a tree-type classification format, clusters of characteristics or ideas to be analyzed for potential breakthroughs in product design and development. It can also be used to detail possible solutions to problems or examine process improvement opportunities.

8) Matrix data analysis

The matrix data analysis tool is essentially a display of data characteristics used by integrated product development (IPDT) to perform market research and describe products and services. Matrix data is arranged for easy visualization and comparisons. Relationships between data variables shown on both axes are identified using symbols for importance or numerical values for evaluations.

9) Factor Analysis

A factor analysis is an assessment technique that surfaces product, process, or service factors that may require immediate attention or further analysis. Similar to benchmarking, product and/or service factor ratings are compared to best in class or to one's own organization to determine competitive strengths and weaknesses.

10) Opportunity analysis

Opportunity analysis is an effective tool for a team to evaluate and select the most preferred opportunity among many. Similar to criteria filtering, identified improvement opportunities are rated against criteria such as organizational importance, feasibility of completion, and potential benefit against resources needed to implement the top-rated choice.
Typical application

11) Reverse brainstorming

Reverse brainstorming can be used as a final evaluation technique(tool) through the critical questioning of the value or applicability of previously team-generated ideas. In addition, this process attempts to uncover potential problems or other serious consequences when an idea or proposed solution is implemented.

Supplementary methods

Additionally three supplementary methods can be used for technology assessment:
1. Methods of analysis
2. Intervention methods, and
3. Reflective studies

Methods of analysis are used to analyze a specific aspect related to a technology assessment problem. These methods include forecasting, construction of scenarios, analyses of technological options, definition and analysis of impacts (such as life cycle analyses), market studies, policy studies, and etc. Parts of them are textbook methods. Such methods are used in the above-mentioned studies, but can also support the decision process in more process-oriented types of technology assessment.

Intervention methods serve as heuristics for interfering in the decision process on technology development (for example methods for interventions in innovation networks). These methods are exclusively used in process-oriented types of technology assessment.

Reflective studies concern the organization of the decision and development process itself. They focus on the optimal way to integrate societal influences in the development process and on ways to promote the development and implementation of technologies that respond better to societal desires than existing technologies. These studies are of a general socio-economic type, and have no particular repertoire of methods[18].

A second distinction concerns the scope of methods:

Methods that serve as Project Layout: These methods aim an integrating different perspective of the subject of study or of the decision process to be addressed. They mostly entail a complex set of actions to be performed.

Methods that serve as Tools: These methods serve as tools mostly as parts of larger projects.

III. Alternative Tools: Layout Of Study

Technological forecasting: it aims at developing pictures of the future developmentof technology. Sometimes particularly in ATA (Awareness TechnologyAssessment), these pictures are considered as predictions of future technologies. InCTA (Constructive Technology Assessment) forecasts also are carried out, but they are generally considered more as probable futures (under 'business as usual'conditions or 'technological options'). However,technological forecasts have considerable limitations, particularly if conceived inthe strict predictive sense[19].

Impact Assessment: Very elaborate impact assessment methods are scarce in thefield of technology assessment. Within this field impact assessment has often hadthe character of impact identification, based on expert interviews, brainstorms andcommon sense. The proper analysis of impacts has been left to experts in thespecific fields. The evaluation of impacts again is often the task of the technologyassessor.

Scenario analysis: Scenarios may be used to describe possible future states ofsociety, including technological developments. Two types can be distinguished: (a) Scenarios which concern an organization or specific problem, and in which theenvironment of the organization or problem is modified. These types of scenariosare especially used in corporate planning. (b) Scenarios, which concern the societyas a whole or larger parts of it. These types of scenarios are especially used forpublic technology assessment.

Tools for Analysis

Trend Extrapolation: A well-known and generally used model as a foundation of these forecasts is the product life cycle. This model supposes that products had a 'life', i.e., they were created, grew, flourished, and eventually became obsolete and were replaced by new products. The model can be used to forecast the diffusion of a product. A limitation is that trend extrapolation can only be performed when a new technology is already on its way. The longer the technology already exists, the better will the forecast generally be[20].

Structured Interaction: Getting the opinions of experts or relevant actors is often very important. However, it is often important structured interactions with actors, and their mutual interactions. Brainstorming has been a very popular method to generate new ideas. Whether this method really produces new ideas is very questionable.

Intervention Tools

The consensus conference is mostly used in participatory technology assessment. Lay people are brought together in a many-day workshop setting to discuss a new innovation. They are entitled to call upon experts. In the end, the lay people have to come to a conclusion on the subject at the stake. The method is appropriate for innovations, which involve ethical issues, for instance in genetic engineering or issues of birth control.

Criteria for choice

The question is, what is the criteria for choice of the type of technology assessment, project outlay, and tools for the solution of a specific problem. Although this is an open question, some suggested criteria are given bellow:

1. Phase in the development
2. Degree of polarization
3. Origins of the problem
4. Type of technology
5. Position on the R&D Agenda
6. Time dimension

Evaluations of Tools

Publication, structuring, linking

In this category, we will discuss tools and specific functions of tools which enable the users to publish new contents within the system and to add links and structures to the contents.

Most tools used in publication originate from the area of web publishing, usually standard content management systems are used. Generally, content management systems support integration and access to data sources, since most commercial products are able to access numerous data formats and storage systems, making distributed contents easily accessible to all users involved. The flexibility is limited, though, because there are no interchange standards which allow exchange of contents between systems. Presentation is variable, as contents are stored independent of the output formats, and in some products there is support for formal descriptions as well as access control.

Table 3: Publication, structuring and linking tools

Functions	**Requirements**				
	Cross-platform accessibility	**Flexibility of integration**	**Variability of presentation**	**Overcoming language differences**	**Access control**
Content Management	+	O	+	O	O
Unstructured documents	+	+	-	-	-
(Semi-) structured documents	O	-	+	O	O
Keywords/abstracts		O		O	
Hyperlinks	+	O		O	O
Integration with taxonomy/ontology		_		+	
Categorization/clustering	O	+	+	O	
Meta knowledge base	-	-	O		O

Content management systems are able to manage both unstructured documents, in which the elements of the text do not carry any machine-readable information, and (semi-) structured documents, in which some or all of the elements have a specific meaning (such as carrying information about the author, date of publication etc.). Unstructured documents poorly support the requirements in cooperation. While they are easy to import and integrate, they do not support different forms of presentation, nor do they allow the storage of descriptive metadata or access control information within the document.

Therefore semi-structured documents should be used, which may be augmented with information concerning formatting (e.g. headlines) for presentation, metadata for understanding and access restrictions for security. Integrating different semi-structured or structured document formats may be challenging, though. Keywords and abstracts are added at the time of publication in order to describe the contents of the text using natural language. They only require format conversions during integration, as no controlled vocabulary is used. This goes along with limited descriptive powers in environments which use a different "corp-speak". Abstracts are more helpful here, but their expressiveness is still limited.

Hyperlinks between contents are the most straightforward way to connect contents. Being a part of basic internet technology, they are platform independent, but it is necessary to ensure their consistency if contents are moved or removed. They may help to attenuate language differences, as they can provide an easy way to retrieve further information. Access control has to be guaranteed by other means, e.g. the respective repository.

Another tool which is frequently mentioned in the context of structuring knowledge is the integration with formalized description systems such as taxonomies and ontologies. The main advantage of these systems is the fact that they are an efficient way of overcoming problems of understanding. If contents are annotated with metadata related to a system of unambiguous categories or subjects which is shared among the partners, relevant documents can be found regardless of the specific terminology used. These content-related meta data are, however, a significant hindrance to the flexibility of integration. Especially if new participants in the value creation use different description systems, a laborious manual mapping of concepts has to be conducted.

Annotating contents retroactively is also very costly. As an alternative or complement, one may use automatic clustering or categorization tools, which group similar documents. They have to access the repositories in which the documents are stored. Some text mining tools on the market are already able to access a wide variety of storage systems and formats, but they will fail if unsupported (e.g. very exotic or proprietary) formats are used. They are positively related to the aspect of flexibility, as they can easily process and thus integrate large quantities of data. Besides, they can support a flexible presentation as they can be used to build task-specific categorizations or to suppress irrelevant contents. As these methods use only a statistical analysis and no semantic understanding, their benefit for the bridging of language gaps is limited.

A meta knowledge base, which is used as a central repository for the description of knowledge sources and their properties, appears to be a useful part of the knowledge management system. However, working implementations of this concept are rarely reported in the literature and standards for the technical and semantic description of the data sources are mostly missing. As data sources have to be described manually, the use of meta knowledge bases is rather inflexible. They are potentially valuable for the construction of task-adequate information supply, as they allow an easy combination of relevant sources if the respective descriptions are available. Besides, the repository could be used to facilitate access control, as it may be used as a central storage for restrictions. Among the publication functions, one has to balance the lacking descriptive powers of unstructured documents with the lesser flexibility of semi-structured formats. Besides, the problem of integrating descriptive systems remains unsolved. Furthermore, solutions for access control and rights management are weakly supported by the existing tools.

Integration of external knowledge

When attempting to integrate knowledge and information from external sources into theKM system, one has to face two tasks: the first one is transferring external knowledge into internal storage systems; the second one is evaluating, analysing and aggregating external knowledge prior to importing it.

Table 4: knowledge integration tools

Functions	**Requirements**				
	Cross-platform accessibility	**Flexibility of integration**	**Variability of presentation**	**Overcoming language differences**	**Access control**
transfer from external sources	O	+		-	-
evaluation, analysis, aggregation	**O**	-	+		**O**

IV. Hypothesis

Presentation of knowledge

One may either present knowledge independent from a specific search request in order to give an overview of the available contents, or process search results to improve the quality of knowledge access.

Table 5: Knowledge presentation tools

Functions	**requirements**				
	Cross-platform accessibility	**Flexibility of integration**	**Variability of presentation**	**Overcoming language differences**	**Access control**
Visualization of structures	O		O		
Knowledge maps		-	-	O	
Mining-based visualization	O	+	O	O	
Related documents	O	-		O	
Links to communication software	+		-	O	
Direct access	O	O			

There are a number of tools for the presentation of contents which may be added to conventional navigation structures (cf. Tab. 4). Contents and their structure can be visualized not only in trees, but also using three-dimensional or non-euclidic geometry, e.g. in hyperbolic browsers. The integration requirements are the same as for search engines, as the visualization tools will require interfaces to all relevant data sources. Again, the flexibility and completeness of results are limited by the interfaces provided. They will suffer if proprietary storage systems and formats are used. The main benefit of these visualizations is their ability to provide intuitive, clear access to complex structures of contents. Some tools allow user specific configurations, especially concerning the depth and complexity of the visualization.

Knowledge Maps are another form of visualisation. They include contents as well as organizational units and people. Hyperlinks enable direct access to documents or contact to people. Building and evolving knowledge maps requires a lot of manual work. While creating links to resources is not technically challenging, the need for manual integration of new (and removal of resigning) partners and the lack of interchange formats make the use of knowledge maps difficult. It has to be noted, though, that the integration of links to people is an interesting way to improve the accessibility and to bridge differences in the terminologies used.

Design and Launch KM Initiatives

At this point of project implementation, the task forces have beenformed, pilot projects have been identified and designed, and manpowerand financial resources have been allocated. The project is now entering thethird stage, which involves the successful launching of pilots and gathering ofinitial results. With the KM pilot projects provided with adequate funding forfull implementation, it is necessary, at this stage, to develop methodologiesthat can be replicated and implement measures to capture and share thelessons learned

V. Conclusion

Knowledge management is a set of relatively new organizational activities that are aimed at improving knowledge, knowledge-related practices, organizational behaviors and decisions and organizational performance. KM focuses on knowledge processes – knowledge creation, acquisition, refinement, storage, transfer, sharing and utilization. These processes support organizational processes involving innovation, individual learning, collective learning and collaborative decisionmaking. The “intermediate outcomes” of KM are improved organizational behaviours, decisions, products, services, processes and relationships that enable the organization to improve its overall performance.

A meta knowledge base, which is used as a central repository for the description of knowledge sources and their properties, appears to be a useful part of the knowledge management system. However, working implementations of this concept are rarely reported in the literature and standards for the technical and semantic description of the data sources are mostly missing. As data sources have to be described manually, the use of metaknowledge bases is rather inflexible. They are potentially valuable for the construction of task-adequate information supply, as they allow an easy combination of relevant sources if the respective descriptions are available. Besides, the repository could be used to facilitate access control, as it may be used as a central storage for restrictions.

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