A Process Framework for an Interoperable Semantic Enterprise Environment

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Abstract: This paper describes a Process Framework for an Interoperable Semantic Enterprise Environment (PF-ISEE) for conceptualising knowledge by coupling business process activities and the Knowledge Transfer Cycle. The PF-ISEE is triggered by an activity and starts the Knowledge Transfer Cycle. The Knowledge Transfer Cycle provides six core concepts with methods, tools and templates to create, manipulate, store and retrieve information. Within the Knowledge Transfer Cycle, special methods are applied in the context of knowledge intensive business process activities with a representation model that can be a global, role depended or an application inherited concept representation. The paper introduces the main advantages and challenges of each core concept and explains its position in the Knowledge Transfer Cycle. Furthermore, it is shown how the PF-ISEE can be part of an Enterprise Semantic Web in order to integrate semantic tools and technologies in standard enterprise applications.

Keywords: Semantic interoperability, enterprise semantic web, semantic information retrieval, knowledge-co-production, knowledge-cooperation, knowledge transfer cycle.

1. Motivation

Cooperative knowledge management focuses primarily on the exchange of information between working groups or individuals within or across organizational structures in enterprises. The creation, use and maintenance of knowledge is inherently tightened to the core business process of the company, namely to those process activities that are knowledge intensive in the sense that the knowledge needed for the fulfilment of a process step needs to be retrieved or even generated from information sources during its execution. The working environment within a single process step in accordance to the semantics of the information is crucial for the correct interpretation and application of this information and for data processing. Such an environment consists of organizational, static and dynamic contexts. Since the beginning of digital data processing the context and the semantics of the information had to be available for a correct interpretation and knowledge creation.

However, the semantic relationship between context, content and user (Rosenfeld and Morville 2002) within the application was usually implemented in the application logic tier (explicitly coded) in a rather static way that does not provide enough flexibility to use the information outside of the intended application domain. With increasing focus on content orientation instead of application orientation more and more information can be transformed and used as universal content objects in different applications. Thus, it is possible to build up novel business models, dynamic business processes as well as virtual and adaptive services. The necessary information about the context and semantics for the appropriate usage of the information is often captured in the application logic layer of their origin. It is only insufficiently considered in loosely coupled information integration scenarios with different contexts.

The useful knowledge can be created from information if the semantics of the information matches the semantics in the applied process activity. Such an active task is embedded in the coherency of knowledge, information and processes (Figure 1). Semantic Interoperability emphasizes the importance of information in enterprise environments and focuses on enabling enterprise content in order to interoperate with software systems outside of their origin (Pollock 2004). The original meaning of information in any context and within any given application with any user gives the real ubiquity to the information.

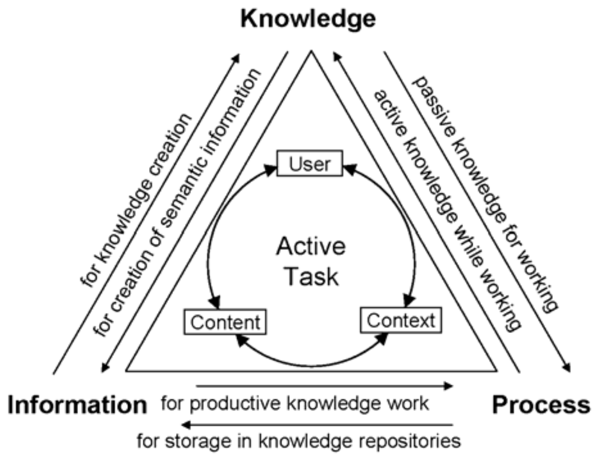

Figure 1: Coherency of knowledge, information and process

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This paper describes a way how to support users

- when extracting (tacit) knowledge as a knowledge worker (Knowledge Co-Production) and
- during the process of knowledge implication as a knowledge consumer (Knowledge Co-Consumption).

In both cases the user and the user's main application have to be considered as a Knowledge Unit which is supported by the PF-ISEE. The Knowledge Unit consists of a main application and the user who works on it to achieve the goal of the current task within a knowledge intensive process (Figure 2).

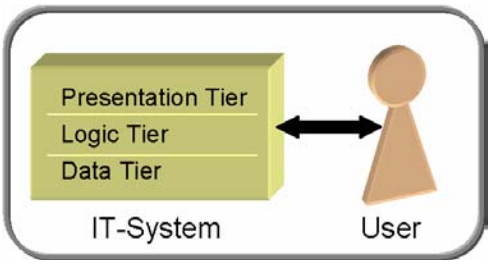

Figure 2: A Knowledge Unit consists of an IT-System and the interacting user

In present research, Knowledge Units have been insufficiently considered in the design of Knowledge Management Systems and thus it is currently underexploited by knowledge managers, because either the user is in focus or the application. This depends on the operational or organizational approach of the knowledge manager. But approaching these two parts as a symbiosis might be important and useful in the IT oriented Knowledge Management.

Knowledge Units are assumed to be the smallest constituents on which the PF-ISEE operates in order to store the active process-oriented knowledge of the user as interoperable content objects. In return, the PF-ISEE offers the capability to supply the Knowledge Unit with content objects during the process.

The Knowledge Co-Production and the Knowledge Co-Consumption are supported by the Knowledge Transfer Cycle in the PF-ISEE described above. The Knowledge Transfer Cycle connects Knowledge Units with an information space system (a type of knowledge repository).

The architecture of the information space system is detailed described in (Böhm et al. 2005) as a role and task oriented pre-built information model. This system offers a number of basic methods which manipulate content objects as well as knowledge objects and stores them in an appropriate structure (Hoof 2003). Upon request, the information space system delivers these objects to a Knowledge Unit using a semantic information retrieval – at any time, in any environment, in any application and to any user.

Due to the close relation between the Knowledge Unit and the information space system a Knowledge Unit represents an significant knowledge source that becomes a part of the knowledge management in the enterprise environment.

2. Interoperable semantic enterprise environments

Enterprise management systems combine a large variety of enterprise applications in an integrated and modular technical solution for modern service oriented business models. This approach comprises information management systems, various B2B and B2C applications as well as administration software and systems for planning purposes. In addition to this trend, the Semantic Web community developed technologies and tools to analyse and transform information by annotating their semantics to represent their meaning.

Business and operational software systems such as Enterprise Resource Planning systems, Costumer Relationship Management systems, finance and accounting software as well as commonly used software as CAD systems, Product Lifecycle Management systems and Engineering Data Management systems and others are either not able to use the semantic tools and technologies at all or they use them insufficiently. Therefore, the inherent data are captured within the application and cannot, or only with difficulty, be prepared to be used in various contexts that are different form the original application.

The approach of the Interoperable Semantic Enterprise Environment introduces a way to transform the active knowledge in the user's mind, the current context and the activated knowledge concepts semi-automatically into knowledge objects and shows how to store them in the information space system (Figure 3).

Within the PF-ISEE, the connection between the enterprise application in the Knowledge Unit and the information space system is controlled by a knowledge transfer process. Thus, the current context of the Knowledge Unit can be linked to the activated concepts of the knowledge representation if it already exists. This combination is necessary for the semantic information retrieval of knowledge objects from the information space system in changing working environments (variation in place, in time and in relation to the Knowledge Unit).

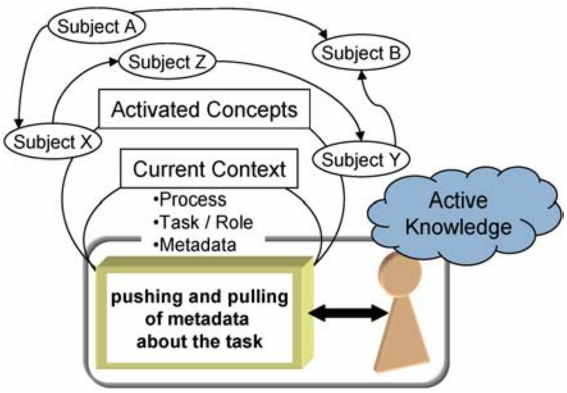

Figure 3: User's active knowledge, current context and activated knowledge concepts of a process activity.

Knowledge Units are necessary to support the knowledge intensive parts of business processes and therefore part of the value-added business activities. Due to this fact, the PF-ISEE bridges the organizational model (business process models for analysing) and the operational model (business models for execution) in enterprises for the aspects of business process oriented Knowledge Management.

2.1 Knowledge co-production

Knowledge typically emerges in human's brain while solving problems. When researchers work in groups they communicate continuously with each other (Fuchs-Kittowski 2001). During their work, a group builds up a distributed comprehension and the team members have to be able to respond to changing environments which can be organized by the transfer of knowledge (Wickes et al. 2003). The knowledge transfer, based on knowledge sharing (Figure 4), runs through three different layers: data, information and knowledge. This cycle can be applied to the Knowledge Unit, whereas IT systems aid users in the data layer and the information layer. The user can now understand the semantics of information correctly. Understanding information as a whole is the key to transform information into knowledge.

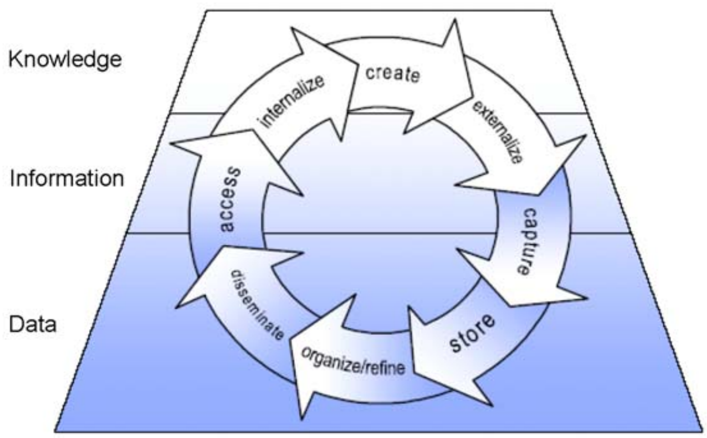

Figure 4: Knowledge Sharing Cycle (Hyperwave 2001)

The Knowledge Co-Production supports the process-oriented knowledge expatiating the user's active knowledge. The user, thereby, may make their knowledge available about solution strategies, processes or technologies, products or services to others just during the productive work in the current process activity. Likewise, the Knowledge Co-Consumption supports the knowledge transfer at which a user may obtain the right information with the correct meaning referring to the active process activity.

The intention of the PF-ISEE is to support all reachable Knowledge Units particularly if they are partners within business processes. The Knowledge Co-Production is therefore an omnipresent stand-by process instance, which can be triggered by users or by the information space system.

2.2 The knowledge transfer cycle and the core concepts

The Knowledge Transfer Cycle (KTC) controls and triggers the core concepts to connect knowledge intensive tasks with the business process in order to put knowledge to work and to benefit from it (see Probst 2003) as well as to get knowledge from work for permanent storage. By using the core concepts, the KTC integrates methods that support the creation of new knowledge, collect, create or transform relevant information and thus provide means to store explicit knowledge. The cycle works at different levels of information processing quality (Fuchs-Kittowski 2001) and supports the semantic information processing by implementing a close participation with the user as well as a machine-controlled syntactic information processing. A more detailed description on the

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different kinds of information processing can be found in (Kubicek et al. 1998).

The information models in the information space system can be continuously adapted to the usage and knowledge objects can be modified in their semantic annotation (pragmatics) by providing a dynamic coupling of the Knowledge Units to business processes and by the omnipresence of the Knowledge Co-Production. The information space model possesses a flexible structure with a content object oriented and knowledge object oriented codification strategy that adapts itself dynamically and automatically according to the usage patterns. Therefore, the information space system can provide information for different contexts without overstraining the user with too much information. The following six core concepts describe methods on the model of the information space system to create, customize, deliver and manage both content and knowledge objects (Härtwig et al. 2003).

The exchange of information in the PF-ISEE is based on standard protocols and services between core concepts and the information space system. In this way, the core concepts can be understood as services based on the service oriented architecture (SOA) that can be connected by web services offered by the information space system.

2.2.1 Information engineering

This operation subsumes the processing of structured (e.g. customer records), semi-structured (e.g. forms) and unstructured data (e.g. documents created by word processors) from different sources into content objects. An information space system must be able to operate on a large number of information with different formats to serve as knowledge repository. This information must be extracted from static documents as a well as from dynamic information sources (ERP, CMS, PLM etc.). The import of information with its correct deposition in an information management system still represents a challenge, as there are a large number of aspects to consider such as consistency and security, to name the important ones only. Different formats need to be decoded and the content has to be decomposed into smaller units while maintaining its integrity and the reference to the original document. The management of the information, starting at the content segments, is extended to its metadata (such as information about the author, date of creation and access rights) and it should also take structural information into account. The relevance of the distributed processing has recently gained momentum, as major vendors such as Microsoft (MS-Office 2003 and the InfoPath-Framework) and Adobe (Acrobat-Elements, Adobe Document Server) offer solutions for the distributed creation, editing and storage of electronic documents (mostly form based). The reasons for this trend can be found in the increasing penetration of digital documentation workflows in business processes that even include the end user (e.g. in E-Government or E-Business). The need to open up these forms of digitized collaboration for IT based Knowledge Management solutions will impose new challenges for research in the future.

The conversion of document parts into information objects and then further into knowledge objects that codify their content using annotations for syntax, semantics and pragmatics relying on techniques for information extraction that are already available in some products on the market (for example Aero Text by Lockheed Martin (www.lockheedmartin.com), IDOL Server by Autonomy (www.autonomy.com)). At the same time, methods for information extraction are still a viable area for research that focuses mainly on higher expressiveness and richness of the extracted items as well as on higher reliability (precision) of the results (Witschel 2004). Moreover, a knowledge object contains an application independent representation (XML) that enables its interoperability for subsequent processing by the Knowledge Units (user and IT system) and within the semantic enterprise environment.

2.2.2 Information abstraction

The processing of a knowledge intensive activity within a business process is usually centred on the individual user who is carrying out the task and thus remains inaccessible to other knowledge workers with similar interest regarding their information needs. Such parallel information demands are usually detected using defined communication events (explicit inquiry of the knowledge bearer). An accumulation of such events can motivate the knowledge bearer to document the requested knowledge and make it therefore accessible for retrieval. During this process, implicit knowledge becomes explicit information that can be transferred into knowledge again. This process, which is triggered by repeated requests and whose primary motivation is the relief of the knowledge bearer after documenting their knowledge is subsumed by the concept Information Abstraction in the information space model.

When a user realizes that the own acquired knowledge might be useful for others, the user could adapt the related information and their sources for them. Using the operations of Information Abstraction could increase the level of detail for other users significantly and make information more easily accessible. This in turn accelerates the knowledge acquisition process for other users as they are directed to the right information sources and are able to use content objects that have been qualified by the expert. The supporting IT system that implements the information space model should provide indicators for situations where useful information abstraction could be carried out and it should also ease the time and effort needed to document the knowledge (e.g. by integrating the documentation process into the individual organization of the knowledge intensive work). Coupling this operation with the knowledge bearer, their active knowledge and the current activity also provides a formalization of the appropriate semantics in the current context (pragmatic information) that can be used to provide the required information to other users in similar situations.

2.2.3 Information annotation

The development from the information object or content object into a knowledge object is captured in the concept of Information Annotation. Content objects will be augmented with situation-dependent usage contexts (called pragmatic information) that describe the organizational working context in which the object can be used (cf. Figure 5). In doing so, a connection between the activated concepts, the current context and the active knowledge of the user is established and stored in the knowledge object when it is added to the information space. The level of pragmatics enables the usage of knowledge objects according to the original usage scenario (the original intention). It therefore eases the use of explicit knowledge objects without the necessity for direct and simultaneous feedback to the knowledge bearer, who is otherwise an inherent part of the social process for distributed knowledge acquisition.

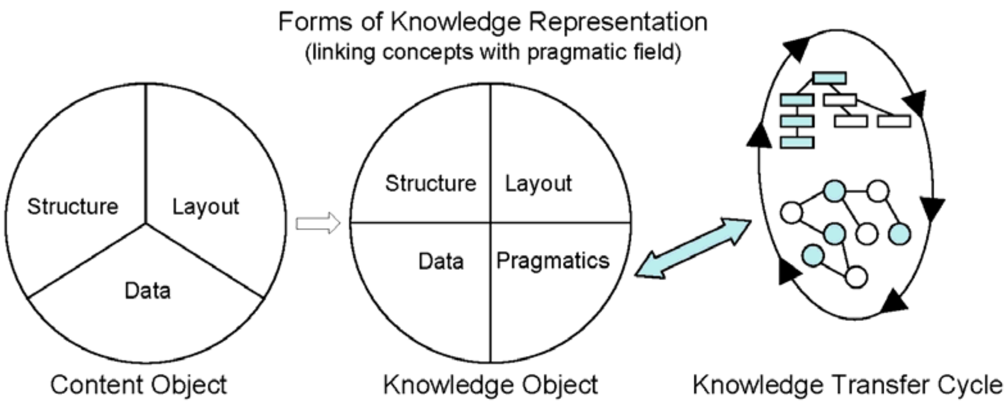

Figure 5: The transformation from a content object to a knowledge object.

The precise distinction of the objects on a content-oriented and a pragmatic-oriented level should contribute to the precision of retrieval processes and deliver more specific descriptions of the objects (expressiveness of the metadata). Such a rich semantic annotation can be used to employ an alignment of information objects or knowledge objects to the ontologies in the company that are often arranged in a hierarchy: at enterprise-level, at department-level or group-level and at individual-level.

The major application area of the Information Annotation is the semantic integration of the knowledge objects in the information space model on the one hand and into the conceptual level of the enterprise core processes on the other hand. Thus, the operation is also responsible for the alignment of different knowledge representations. Semantic integration should be deeply rooted within the applications and can be accessed using an Interoperable Semantic Connector (ISC) to enable an easier integration of enterprise information from a variety of applications at enterprise level. Such integration would enable the use of enterprise information in application contexts that have not been taken into consideration at the design time of the various enterprise application systems that were used for a certain but fixed purpose or application scenario.

Ontology modelling tools, which are using the interface of the ISC component, will be integrated for the implementation of the models. The modelling process follows an iterative cycle with the main activities: creation, deployment and maintenance of the corresponding concept structures. There are already a number of tools available, such as Protégé-2000 from the Stanford KSL, which implements an open source solution with a plug-in architecture for the creation of concept hierarchies, creating instances, and views in several formats. Another alternative is the Link Factory Workbench from the Belgian Company Language and Computing, which provides a collaborative authoring environment, application generators for semantic indexing, automatic coding, comparing and linking ontologies, related concepts matched on formal relationships and lexical information. The application of open standards for the ontology representation (OWL) ensures tool independence of the created models and guarantees their interoperability.

2.2.4 Information sharing

Users with similar role profiles and responsibilities in an organisation often work on related or similar tasks but are separated at different locations or work at different times and can therefore not benefit of this situation directly by sharing their knowledge, for example, by communicating their experiences directly. In order to take advantage of such circumstances that have its origin in similar information demands one could consider the use of Knowledge Management methods and their support by the PF-ISEE.

A PF-ISEE implementation assumes that several employees within the company have the same or at least partly similar implicit and explicit information models (ontologies). The PF-ISEE builds up a vertical information space for these users that operates orthogonal to the parallel executing business process chains and integrates information on the basis of common information needs and assigned tasks. The information exchange based on the execution of process activities is not bound to the chronological application flow and offers the possibility of an asynchronous information transfer across process boundaries. Therefore, an employee A in a certain role can start working on a process activity independently of an employee B in a similar organizational role, but they can still share their experiences while working in the same information space which is spread by the information space system.

The decoupling, as described above, allows an implicit cooperation of employees, without requesting the knowledge worker to have a mandatory, direct and immediate communication. Nevertheless within the PF-ISEE the information space system will not replace but support the negotiation and feedback processes that accompany the knowledge transfer process. The explicit work with information objects and knowledge objects that are connected to the information which emerge from knowledge intensive activities serve primarily the structuring and documentation of the individual work organisation. This important (intrinsic) motivation aspect is especially valuable for repeated process activities that demand a large amount of information processing and that are structurally the same but vary in content of the activity (e.g. market research). The connection of these knowledge processes by a group oriented criterion (role) leads to the operation of Information Sharing that allows implicit cooperation. The responsibility of the information space model is to connect the individual knowledge processes and to provide an easy access to the group oriented knowledge that is documented and stored in the information space system by establishing appropriate levels of abstraction.

2.2.5 Information shaping

The execution of business processes involves usually several employees from different departments that cooperate along the execution chain of the business activities. Typically, the individual actors have different organizational roles and responsibilities. While the execution of classical enterprise core processes is sufficiently supported by IT systems (e.g. ERP systems) as the needed information is available at the time of execution, the situation is much more complicated for knowledge intensive processes. Due to the need to obtain or acquire knowledge that is needed to process the current activity, new information is created that often cannot be transported to subsequent process activities, as the established business process execution systems do not support this class of information. Consequently, local information sinks are created that are often exclusively used by the employee who is executing the associated activity. As a result, discontinuities in the transportation of information are produced that can significantly affect the efficiency of the process performance as knowledge has to be acquired (locally) several times by different employees, although the needed information is already available from previous process activities. It is the responsibility of the information space system to capture the knowledge that is produced during the process execution and to deliver the accumulated information to all process activities that could benefit from it, depending on the semantic and pragmatic annotation of the knowledge objects.

With respect to the process execution, the Information Shaping operation works horizontal along the instances of the business process. Since the emerging information varies in size, structure and information depth and is a result of creative labour they are hardly to capture in static information systems. It is therefore a duty of the information space system to connect the "information islands" of the individual activities, link them to information sources and provide access to the aggregated information on a conceptual level using an ontology layer. Finally, the information space system should represent a common view on all information relevant to a business process that enables an easy creation of needed knowledge in every process activity.

The operation Information Shaping can be extended to a chain of interconnected business processes (process chains). The information that is developed in the process chain should be delivered to the subsequent process by an Information Management System. Important supplemental information as described above is frequently not taken into account and will not be transferred in the next business process in the chain. That information is lost or not accessible if the current process terminates. The PF-ISEE prepares these information objects for process independent use and provides access to relevant knowledge objects for successive processes.

2.2.6 Semantic Information Retrieval

The access to information is a central operation in knowledge intensive business processes in order to acquire new knowledge or to supply the codified knowledge that is needed for the current process activity. It initiates the Knowledge Transfer Cycle and is responsible for delivering relevant information. Another important aspect is the consideration of different levels of abstraction when querying the information objects and the knowledge objects in the information space system as well as the pragmatic information that have to be taken into account, too. Such a consideration that operates on a content based level and uses the semantics of the application context implements a semantic filter that allows a more detailed response to inquiries by the user.

The individual knowledge worker without the support of a PF-ISEE processes the tasks in the current activity in a situational context. The supporting system cannot anticipate the action pattern; search requests, selection of information sources from preceding process activities and that information are not available if the activity is repeated or need to be reused later, as they only exist in the implicit memory of the user that carries out the activity. Even if some of these elements are documented for later use (e.g. an important information source) is the access often limited to the author and not automatically spread among colleagues with similar information needs. Another aspect is the lack of transparency that makes it difficult to trace the steps needed to fulfil the activity successfully. As a consequence, the transfer of the process execution is difficult if the levels of knowledge of the employees are different. This becomes even more difficult if the transfer cannot be planned but need to occur ad-hoc, e.g. because of illness of employees. Another problem is the creation of “island competencies” for information intensive activities that hinder the transfer of a responsibility to another employee even more. If such employees leave the company, it can directly affect the process quality, especially in knowledge intensive business processes, like research and development.

The usage of a context sensitive content management system can make such information sustainable for a group of employees with related responsibilities. The PF-ISEE assigns an inquiry to the right usage context and process activities, classifies information sources and makes action patterns traceable by integrating them into an information logistics strategy as a part of the information space model. Using this information that accompanies the business process, the PF-ISEE is able to provide the user with relevant information in a repeated or similar situation without an explicit inquiry (push methodology in contrast to the pull methodology, where the search is initiated by the user).

The information space model uses concepts from the area of knowledge representation and semantic tools to qualify a syntactic information retrieval exploiting the richer annotations of information and knowledge objects. The aim is the correct interpretation of the semantics of retrieved information within the actual working context of the business user (place, time, Knowledge Unit).

3. Process framework for an interoperable semantic enterprise environment

The PF-ISEE offers support for interoperable semantic information services. These services combine structures and methods for future information exchange in a loosely coupled enterprise environment.

Apart from the productive knowledge work of humans, the PF-ISEE, as an assistant system, controls the Knowledge Transfer Cycle (KTC) and organizes an Interoperable Semantic Enterprise Environment (Figure 6). The core concepts Information Engineering, Information Abstraction, Information Annotation, Information Sharing, Information Shaping and Semantic Information Retrieval are arranged around the KTC to support the codification of tacit knowledge as a pragmatic part of the enterprise content and to provide this information in new business contexts.

These core concepts are a part of the information space system that stores the enterprise content objects (Ngonga 2003). The communication within the PF-ISEE is realized by web services which handle messages in a loosely coupled manner. This approach shifts the PF-ISEE onto the level of large-scale, interoperable system based on standards like SOAP, WSDL, BPEL4WS, OWL-S etc.

In figure 6 a business scenario is shown to illustrate the architecture of the PF-ISEE with an example. A common business process runs and involves a business partner (in this case a Knowledge Unit). The Knowledge Unit receives a message (1) which contains information about the task, the product or a service. Without the PF-ISEE the user finishes the task by sending a new message back to the business process (4). The traditional scenario has two drawbacks: From the business perspective, the externalisation of the user's active knowledge is not supported and in consequence lost for later reuse. From the perspective of the user, there is neither an assistant to expatiate the tacit knowledge of the user nor a way for a contextual search to integrate information into their current work.

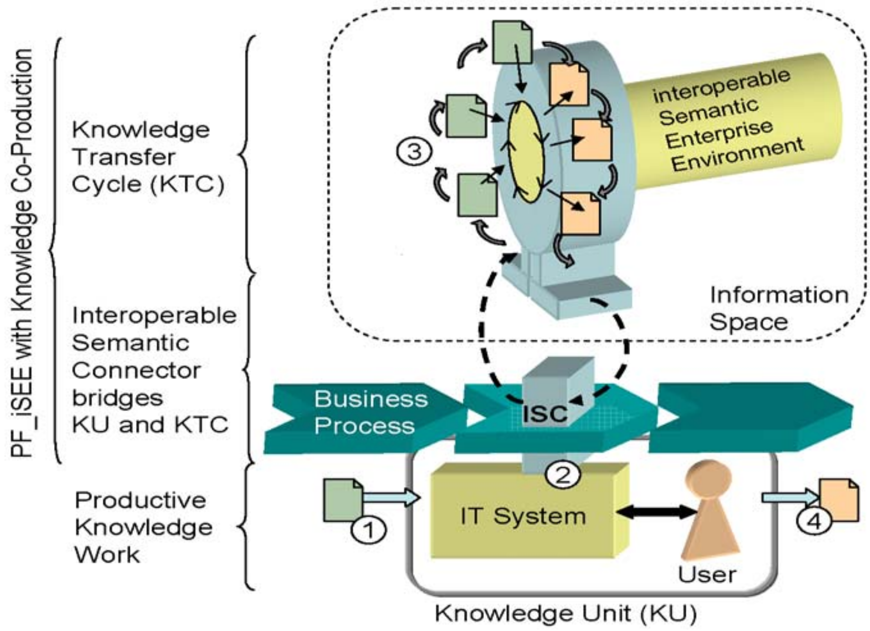

Figure 6: Process Framework for an Interoperable Semantic Enterprise Environment

To overcome these drawbacks, the Interoperable Semantic Connector (ISC) observes actions performed by the user.

In the extended scenario, the ISC composes the current context and combines it with the user's input (2). This collection of metadata of the Knowledge Unit comprises concepts, process descriptions and parts of the current task which are integrated by the ISC into the KTC. No matter how the metadata are natured, each core concept is involved to analyse and to treat it if required. For example, if an ambiguity between instances of concepts is recognized by Information Engineering, it will mark the concepts in a way the Information Abstraction prompts it to the user. A further example: The metadata will be arranged by Semantic Information Retrieval to retrieve relevant enterprise content in order to satisfy user's information need without active look up (push method).

In these examples, the KTC was started by the system, but when a user notices the need to run the KTC, he can trigger it manually or he can interrupt it at any time.

The ISC extends operational software and applied application systems as a component to interoperate with semantic tools and to use semantic technologies. Thus, a participation and integration of the Knowledge Units into the interoperable semantic environment of the enterprise is gained. The concept of the ISC is shown in figure 7. It describes the integration of the extended IT system (as a part of the Knowledge Unit) in the Knowledge Transfer Cycle through the ISC.
Further, this concept outlines the two interfaces of the ISC:

- one between the connector and the KTC, and
- another one between the connector and semantic tools.

With this concept, the Knowledge Unit is able to take part in the KTC and hence it is prepared for the Knowledge Co-Production as well as the Knowledge Co-Consumption.

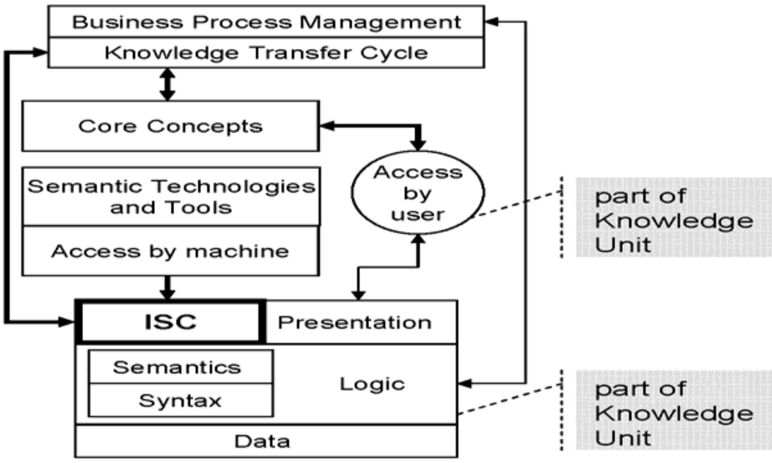

Figure 7: Concept of the Interoperable Semantic connector

With this concept the application logic of the software system extends the handling of data (Figure 7 layer 2 of the 3-tier model) by separating syntax and semantics, because the ISC opens the way to flow-off the semantics while processing data. Controlled by the KTC, the user can store this semantic information in combination with the current context. For this separation, a content model is necessary to assign the different content types permanently to the context and semantics.

The core concept Information Annotation uses this content model to describe the pragmatics of the enterprise content in the required declaration. This pragmatic part of enterprise content has a higher prominent level (loosely coupled, different knowledge representations) than the inherent semantics of application's data codified in the logic layer. This enriched enterprise content is far more suitable for semantic integration than low level content in certain organizational working environments.

The software component ISC offers two interfaces for interacting. The first one is a dedicated API focused on semantic technologies. Using this interface, the ISC can organize the bi-directional access into the enterprise environment. For example, the application data can be read by a semantic tool to create ontologies, to build up semantic indexes, to compare and match concepts or to link several concepts to external ontologies. The second one is designed in a more generic way to achieve a broad horizontal integration of as many Knowledge Units as possible. This type of interface can, for example, connect the ISC to the smart tag functionality of the Microsoft Office application (Coan 2005) or the smart document technologies (Durant 2003) provided by the Microsoft Corporation. Another way to integrate the ISC into the application is at compile time when the source code is available. Both cases follow the aim to observe the presentation of the data as well as to recognize the activities of the users.

4. Conclusion and future work

This paper presented results from ongoing research in the field of IT supported Knowledge Management. The focused Knowledge Transfer Cycle bridges information systems and the working environment of the professional user within the enterprise in respect of the current working context. The Process Framework for an Interoperable Semantic Enterprise Environment is a concept which combines implementations of an information space system with state of the art technologies, like XML, BPEL4WS, OWL-S etc. with so-called Knowledge Units. The introduced strategy includes Knowledge Units in the whole cooperative Knowledge Management with strengthen IT aspects and in this way it opens the new field Computer Supported Knowledge Management (CSKM).

The aim of the CSKM should be to force the development of frameworks and software for a ubiquity support of the users in an enterprise environment. The CSKM consolidates the mutual approach of the operational and organizational factors of the Knowledge Management to enable a human centred and knowledge oriented enterprise system management. Knowledge worker are motivated to externalize their tacit knowledge, but they will be demotivated to do that if they don't have the appropriate IT support for it without a coordinated organizational guide concept. New challenges like aging workforces can't be solved with old tools and new strategies or with new tools and old strategies. There is a wide range for that complex field of the CSKM in the combination of new software and new management methods to shift an enterprise to its full potential in the global knowledge society.

Implementations of the core concepts and the specification of the ISC will be a task in the near future. Afterwards, a demonstrator of the PF-ISEE will be build up comprising the prototypes of a Knowledge Unit including the ISC, the information space system with the core concepts as well as the Knowledge Transfer Cycle modelled with BPEL4WS.

If some Knowledge Units were connected with the KTC in the PF-ISEE, there would be more than one knowledge representations. Continuative research and development to upgrade the Semantic Information Retrieval, in a way shown in figure 8, aims at building up a query mechanism which is able to work through more than one knowledge representation form (ontoloy, taxonomy etc.).

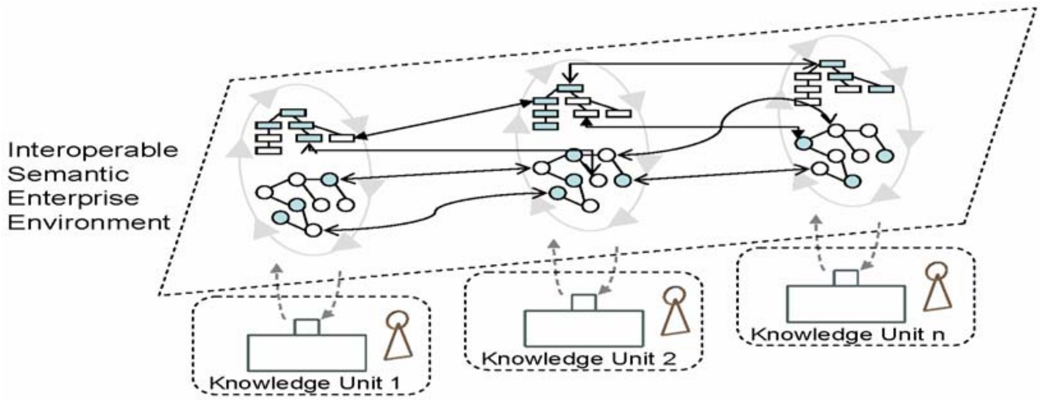

Figure 8: View to an Interoperable Semantic Enterprise Environment

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