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# Structuring and Systemizing Knowledge on the Internet - Realizing the Encyclopedia Concept as a Knowledge Medium

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## Abstract

We reconsider the encyclopedic concept as a knowledge medium for the scientific community in the Internet. Referring to the ancient concept of encyclopedia, we reconstruct the encyclopedia for the new interactive carrier of information as a knowledge medium, representing and organizing knowledge for the scientific community anew on Internet. We envision those knowledge media as communication spheres for agents and exemplify them with the performance of the NetAcademy project.

## 1 INTRODUCTION

The quantity of knowledge that is generated nowadays and the speed at which it is distributed distinguish the modern information society. Despite the enhanced availability of information, its applicability remains far behind the potentials. Information overload is one aspect of this problem. The central challenge nowadays is to turn information into knowledge, i.e. into information that becomes active in humans. In order to achieve this we recall and apply the ancient concept of encyclopedia and revive it to take full advantage of the features and potentials of new carrier of information [Schmid 97b, Schmid-Isler, 98a].

In the paper we propose a holistic approach for structuring and organizing scientific knowledge in the Internet, which takes advantage of the potentials of interactive information and communication technology by applying the following core concepts:

- encyclopedia as an encompassing concept for management of given, i.e., defined knowledge,
- computational media as a holistic concept for the organization and management of the knowledge creation process.

In the introduction of the paper our concept of encyclopedia, of computational media and their potentials are given, referring to the example of the NetAcademy platform, a medium for the scientific community on the Internet. The content of the paper, after that, is organized as follows: Section 2: Analysis of knowledge management and encyclopedia, section 3: General model for computational media; section 4: Computational encyclopedia as an instantiation of the general model; Section 5: The NetAcademy as a computational encyclopedia. Section 6 concludes the paper.

## 2 THE CONCEPT OF ENCYCLOPEDIA

In this section about knowledge management we first refer to the achievements which have been made from the times since, in ancient Greece, the notion of encyclopedia was born, until the 18<sup>th</sup> ct. where, with the encyclopedia editors Diderot and d'Alembert, the concept of the encyclopedia reached maturity [Schmid-Isler 98]. We then investigate if and how these solutions remain valid and how they are to be developed according to the advantages of today's new media.

### 2.1 The Historical Context

Since reflection and philosophy began, they focused on the theme [Schmid-Isler et.al. 98a]: How to foster, how to manage knowledge?. Let us refine this quest by three issues:

- What are the criteria for categorization of knowledge?
- What are the criteria for validity of knowledge?
- What are the successful methods to accomplish order?

In the western world it was at the Greek philosopher Platon's academy (founded 386 b.c. in Athens, being closed down by the Christian emperor Justinian 529 a.d.), that the first principles of systemizing knowledge and the first methods to generate knowledge were elaborated. These principles were:

- Establishing a **repository** for shared knowledge, aiming at an encompassing accumulation of knowledge (encyclopedia translates as: an encompassing circle for education);
- Establishing an **academy** for the scientific community, i.e. regular congregations for wise men to reason about knowledge and abduct new knowledge by doing so;
- Establishing a **method** to ensure congruent reasoning.

Following the three principles will be explained in more detail.

#### 2.1.1 *Encyclopedia as Knowledge Repositories – (1) Managing Knowledge*

Encyclopedia means a compendium of knowledge, either general or specialized, focusing on one field of interest [Columbia 94], [Schmid-Isler 98a]. Encyclopedia are often compared to dictionaries. While a dictionary is basically devoted to words, an encyclopedia refers to both data on and discussion of each subject covered. An almanac is a periodical publication containing much ephemeral data.

The first and most important aim of Encyclopedia is to document and maintain authentic knowledge, ensuring and testifying its preservation over time and space. Secondly, it is to provide adequate categorization and systematization of knowledge, providing easy access on knowledge for any interested person.

There are different approaches to classify knowledge, e.g., to structure knowledge in a *pre-established order* (as in the artes liberales and any religious schools), or in a *hierarchical classification* (as Carl Linné used in his category system for biology and zoology), or in a *alpha-numerical list* (as is the case in common dictionaries), or in a *ranking order* according any given preferences and value judgement [Schmid-Isler 98].

⇨ Classification criteria provide a compact meta-description of knowledge.

### 2.1.2 *Organization of Communities: Academia and University – (2) Distributing Knowledge*

Arguing about cognition and establishing orders for knowledge has been a noble tradition in philosophy since reflection was born. As Snell states, reasoning about knowledge started in ancient Greece since their language has the unique characteristic to build abstract terms, which philosophy surmises [Snell, 80]. Congregations of wise men got established at specific places, academies, as a means to discuss and teach knowledge. Platon's academia, Aristotle's lykaion, the monastery schools, the hence arising universities (since the 11<sup>th</sup> ct.) and, since the Italian Renaissance beginning in the 15<sup>th</sup> ct., the academies [Schmid-Isler 98a]: They all eventually established conventions about the *processes of academic acknowledgement* for the scientific community. Measures to guarantee scientific quality in accordance with established methods have been developed referring to the academic career, to exams and titles, to quality assessment processes, to reviewing, publishing and intellectual property rights etc.

⇨ The main aim of Academies is to provide the methods and organizational framework (roles and protocols) according to which the processes of teaching, evaluating and generating knowledge are performed.

### 2.1.3 *Methods to Accomplish Order – (3) Creating Knowledge*

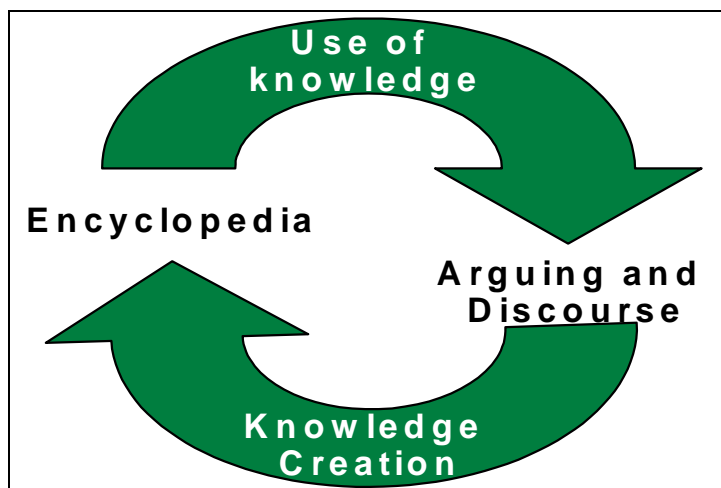
Along with the concepts of the encyclopedia and of the academy there was a continuing reflection and quest for a general method to assure congruent reasoning about knowledge. Platon was convinced that only *mathematics* could offer certainty in the ocean of the arbitrariness of reasoning about truth [Whithead 47]. It was Leibniz, a German philosopher and mathematician, who introduced the constructive or operational component which allows a systematic development of knowledge [Peckhaus 97]. He turned the discipline of logic into a discipline of mathematics by substituting „truth“ with: „proven by calculation“.

⇨ Today, we dispose of an instrument which allows the application of mathematics and calculation onto processes of any kind, allowing to delegate reasoning about knowledge, which was a privilege to mankind, onto machines – onto the *computers*.

## 2.2 The Encyclopedia Knowledge Cycle

The above described three aspects of knowledge (1) management, (2) distribution and (3) creation are closely related to each other. The encyclopedia as a repository of given knowledge is the base for knowledge distribution and generation. The result of reasoning, using various methods, and therefore of generating new knowledge, will flow into a next generation of encyclopedia. Thus, the three aspects together form a spiral of knowledge generations, which will further be called the Encyclopedia Knowledge Cycle [G. Mazzola, 1997].

The Encyclopedia Knowledge Cycle distinguishes two approaches to foster knowledge (c.f. 1):



*Figure 1: The Encyclopedia Knowledge Cycle*

- *The encyclopedic method.* This is an encompassing management of given knowledge, founded on library and information science. This method deals with structuring, categorizing, filtering and organizing authentic knowledge, making it accessible for a given community by the means of an appropriate repository, say an information carrier.
- *The epistemologic method.* This is the process-orientated method that continuously puts knowledge on the test-bed. Founded on Platons method to strive for knowledge [Bormann 78], the epistemologic method (or reasoning) means to view knowledge either as something that has to be developed following a method, or to view knowledge and its development methods as something that has to be reviewed.

The two methods are closely interrelated: The encyclopedia, as a historically verified means to secure and identify the commitments of a scientific community, is dependent on methods to gain cognition – episteme - providing the means for further growth and liability of knowledge. Reasoning in quest of cognition eventually crystallizes new facets to the encyclopedia.

With reference to the technologies and media applied for the realization of encyclopedia, the interrelationship between the two aspects could be realized with a different degree of tightness. Knowledge repositories are, since ancient times,

- on the one side, living (or: understanding) information carriers, i.e. human beings which are able to open a dialogue about the information while conveying it to a person,
- on the other side, dead (or: mute, ignorant) information media as signs, pictures, text scrolls, books, movies and the like, which are not interactive.

Dead media, though capable of documenting a precise state of knowledge, are cut off the reasoning process. There are several explanations for this, let us mention three of them: (1) discrete dynamics of update **versus** continuous dynamic of knowledge generation; (2) methods are not applicable directly to the contents on the carriers, and (3) discourse happens out of the medium.

Due to those shortcomings, traditional i.e. mute encyclopedia are prone to lose their importance for the knowledge generation process. Moreover, in a paper based encyclopedia the reader has to infer over the given content by himself, which means tracing cross references and the like. Electronic interactive media make it possible to delegate this task to the machine. E.g., Electronic Encyclopedia available at CD-ROM or hypertext Systems allow an easy tracking of hyperlinks and cross-references. But, besides providing enhanced access to information, the first generation of electronic encyclopedia follows the traditional encyclope-

dia concepts and suffer from the same drawbacks as being observed by printmedia-based encyclopedias.

⇨ With the emergence of artificial knowledge repositories, capable to interpret the information they carry and with their union with the telecommunication technology (i.e. Internet), we are facing unprecedented possibilities to revolutionize and revive the concept of an Encyclopedia Knowledge Cycle by accordingly uniting the concept of Encyclopedia with the concept of academic arguing to an encompassing knowledge source.

### **2.3 Chances and Challenges for the Encyclopedia Knowledge Cycle in the Information Age**

The convergence of information and communication technology resulted in a new interactive medium [Schmid, 97a]. The characteristics of this new medium deeply affect the principles of systemizing knowledge already mentioned:

- Today, the World Wide Web develops into a huge repository of unstructured knowledge bits and bytes. As the contents eventually run there, a structuring of encyclopedic manner has to be built. (First successful attempts, although limited in their effectiveness, have been made with the Search Engines and Web Directories like yahoo or altavista.)
- Today, the Internet allows for remote knowledge exchange, file accumulation and almost synchronous cooperation activities of people around the world, anytime. No wonder, the organizations based on communication, as academic institutions, are challenged by deep changes. Virtual universities [Noam 96], tele-learning and various platforms for the accumulation, dissemination and discussion of knowledge are emerging, facilitating and altering academic research methods.
- Today, the overpowering dominance of computational logic applies to almost everything. Provided there is a formal representation of knowledge, reasoning can be performed more and more by computers, thus enhancing and liberating human vocations.

Despite the described achievements, the already described challenge remains the same: How to manage knowledge? But, the paradigms for this challenge have changed: For centuries, the scientific community stored and generated knowledge mainly by means of writing and printing, while today knowledge increasingly gets accumulated, disseminated and reviewed on interactive networks.

⇨ We are aware, that we need to develop a new scientific approach to meet this change of paradigms facing the encyclopedic and the epistemologic tradition of the academic world. We thus suggest the inclusion of the Media Metaphor.

## **3 COMPUTATIONAL MEDIA – A CONCEPT FOR STRUCTURING KNOWLEDGE AND KNOWLEDGE MANAGEMENT**

We reconsider the notion of a medium as a carrier of information and explore a new notion of medium as a concept to structure and activate information. Media are envisioned as spheres for communities of agents and they are modeled as multi-agent systems. We call this notion of a medium the computational media metaphor and the media we model according to this model computational media [Lechner/Schmid, 99]. Computational media comprise the following components:

1. *Logic* to represent information in its relation to the real world. It comprises a logic as the means to represent information as well as possible worlds relating this logic to the semantics of the community using the medium.
2. *Channels*, to distinguish and distribute knowledge over space and time and to facilitate coordination among agents. The channel system encompasses communication mechanisms and corresponds to the notion of a medium as a carrier of information.
3. *Organization*, comprising both a set of roles defining the rights and obligations of agents and protocols defining processes and communication relations of the community.

Communities of human and artificial agents, striving towards a common aim, employ this organized channel structure to process and to communicate information.

The three components of a medium establish a structured way to compose a medium. E.g. two media may have the same logic– however differing channels, i.e., differing means to distinguish and address agents and different co-ordination mechanisms and facilities, yield a different media.

This model captures several characteristics of “new media” as they are established by information and communications technology. A medium is no longer an isolated carrier of information – it is a component in a net of interwoven media. Media can share e.g., logic, or channels and an agent may participate in several media. Media can be (provided they have an appropriate organization) considered to be channels in encompassing media.

## 4 COMPUTATIONAL ENCYCLOPEDIA

*We define computational encyclopedia as computational media that apply the paradigm of the encyclopedia knowledge cycle for structuring and systemizing the knowledge repository and for facilitating knowledge creation and management processes.*

Let us describe how we envision and model computational encyclopedia as a holistic approach to knowledge management on the Internet. We begin with a description of a *computational encyclopedia* according to the *computational media metaphor*. For structuring and defining the organization of the computational encyclopedia we employ two orthogonal concepts:

- (1) According to the domain of discourse into volumes: the computational encyclopedia can be organized as a collection of what we call “*volume*” (encyclopedia).
- (2) According to the encyclopedia knowledge cycle into “*views*” representing the encyclopedic and epistemologic method.

### 4.1 Computational Encyclopedia as a Computational Medium

Following the concept of computational media, the vision and model of a computational encyclopedia as a sphere for communities of agents is described. We start with the organization, as the requirements towards agents and channels and continue with a detailed description of both the components channels and logic and the community of agents.

The *organization* of a computational medium comprises a set of roles and processes (protocols). An encyclopedia mirrors the roles, science has developed for assuring the quality of knowledge, i.e. peer-review processes for publications and editorial boards with roles as editor, reviewer, author, member of editorial board. Those roles have certain rights to access the

knowledge in the encyclopedia and certain obligations in the encyclopedia knowledge cycle. There is furthermore the role of a search agent with the knowledge about applied categorization and systematization including the capability for answering queries presented to it.

The *channels* are carrier of information and as such relate agents and facilitate the communication between agents. Channels can be described in the logic and can be computed at runtime. Thus, the adequate documents containing information as well as changes in the categorization and systematization can be reflected.

The *logic* represents the domain of discourse as well as the systematization and categorization in a computable manner. Thus, it represents the means to reason about the documents of the encyclopedia according to the systematization and categorization. Possible worlds relate the knowledge represented on a medium to their semantics. Since computational reasoning is at present hardly possible for documents as files themselves, the contents are represented in the logic by meta-information, including, e.g., keywords, author, data etc. Thus, here the document itself is the semantics of such a representation in the medium. Both the logical representation and the extra-logical semantics are part of the medium itself. The agents' knowledge consists of subsets of the information that can be represented with the logic.

## 4.2 Volumes of the Computational Encyclopedia

An entity of channels and logic organized to support a community of agents dedicated to creation and communication of knowledge in a well defined domain of discourses, define a specific volume of an encyclopedia.

The mere representation of knowledge is not enough. Systematization and categorization of knowledge are essential aspects of the Encyclopedia. Thus, each volume may have its own systematization for the knowledge and its own means to implement reasoning about the knowledge.

The language chosen to describe the domain of discourse in the different volumes might be heterogeneous. Thus, to form an encyclopedia, those volume encyclopedias have to communicate via a mediation or translation mechanism.

## 4.3 Views of the Computational Encyclopedia

The views distinguish the encyclopedic and the knowledge generation aspect of the holistic medium. We consider two views (c.f. 1): (1) the encyclopedic view and (2) the knowledge generation view on the computational encyclopedia.

### 4.3.1 *The Encyclopedic View*

Encyclopedia contain the agreed upon knowledge of the community in form of definitions. Thus this view is constituted by channels containing such knowledge. This specific role of the channels is denoted by their organizational description. Thus, the organization with the roles determines which agents and channels participate in which medium. Encyclopedia have an order on the knowledge they present, and this order is customizable and implemented by the channels. The encyclopedia can have several systemizations and categorizations implemented each as a sets of channels. The channels are the base for intelligent search agents, providing hereby point wise access to the database.



The encyclopedia grants access to the information it contains to any visitor, while it allows only selected participants, i.e., the ones capable and allowed of playing the role of an editor of the encyclopedia to edit the encyclopedia and its entries.

#### 4.3.2 *The Epistemological View*

The epistemological view reflects the ongoing process of scientific discussion. Thus, this view comprises channels together with their meta-description reflecting the arguing aspect of knowledge creation as publications, discussions, proposals and the like. Again, the role of this channels is denoted by their organizational description. The meta-information, which includes a list of keywords expressed in logic manner, makes the documents contained in the medium accessible for processing. Some of the keywords stem from the Encyclopedia and the relations between the Encyclopedia terms allow semantic access to the documents.

This view represent the documents and the relations between them as it is common in the traditional media: publications are browsable by appearance data (as in a journal), according to a common topic (as in a conference proceeding) or by searching for any keyword in the meta-information (as in a library with a sophisticated catalogue including semantic relations).

This view uses the paradigm of reviewing processes for quality management and supports them accordingly. Thus agents representing humans play the roles of author, editor, member of the board, reviewer in this medium. An other important agent is the search engine capable of intelligent retrieval and combination of knowledge based on the applied logic.

#### 4.3.3 *Inter-View Processes – Implementing the Knowledge Cycle*

The (two) views on the holistic medium are characterized by different channels and organization. However, the holistic concept of the Encyclopedia implements via inter-view channels and processes strong connectivity between the links based on the common logic and aim. Note that documents (or any other agent) can -in different roles – participate in both views. Both views have their own processes (e.g., of quality management). However, there are inter-view channels and processes, that provide a more tighter integrating of the two organizational views. Let us describe them.

In the Encyclopedia view, e.g., a committee of editors decides upon which documents (or part of documents) are considered to be authentic. The document itself with the meta-information becomes part of the encyclopedia view while remaining in its old role in the arguing view:

When part of a document becomes (by playing a role in the encyclopaedia) part of the encyclopedia, technology can be employed to represent this concept in an adequate structure. Namely by changing the document in a hypertext and by linking the encyclopedia role to the document(s) it originated from. An authentic contribution changes stepwise from a linear document to a hypertext and towards playing a role in the encyclopaedia.

Our approach, in particular, supports the notion of an encyclopedia to be the basis for knowledge generation. New publications can be designed with hyperlinks to entries in the encyclopedia view instead of including the full text. For the representation in the medium, links are adequate, while when playing, e.g., in another medium the role type “conventional, flat publication” the hyperlink to encyclopedia is represented by its full text.

With such a structured representation of documents those documents become accessible as subject of logic reasoning themselves. Relations via those hyperlinks can be employed to rea-

son about the contents in documents and, more important, about the semantic relations between documents.

## 5 THE NETACADEMY: A COMPUTATIONAL ENCYCLOPEDIA

In this chapter, we present the NetAcademy project [Schmid, 97b], [www.netacademy.org] as a prototype for the new concept of a computational encyclopedia. The NetAcademy is designed to be a virtual platform for the scientific community, fostering creation of knowledge and supporting the whole lifecycle of knowledge. Following we will explain the application of both the encyclopedia knowledge cycle and the metaphor of computational media in the NetAcademy.

### 5.1 Implementation of The Encyclopedia Knowledge Cycle in the NetAcademy

In the figure given below the entrance page of the NetAcademy is depicted:

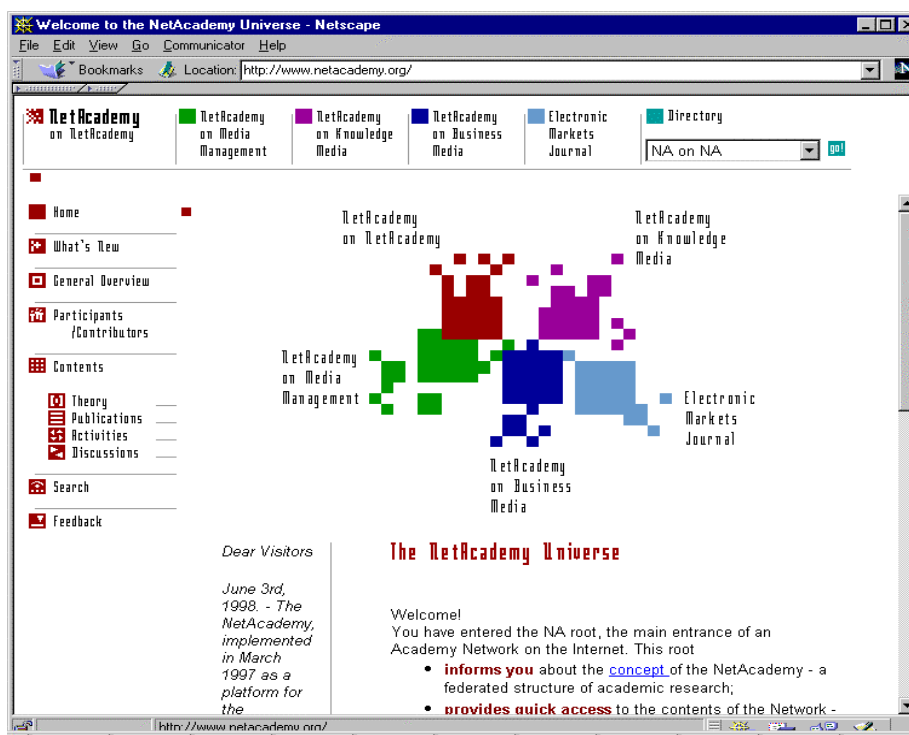


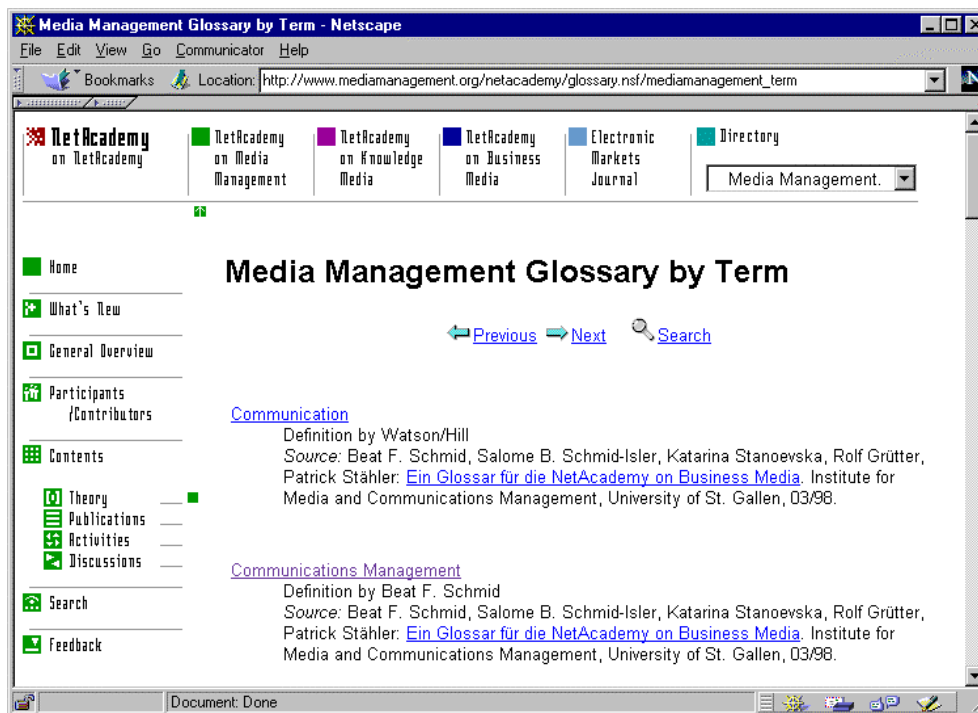
Figure 2: Entrance page of the NetAcademy at www.netacademy.org

The NetAcademy entrance page visualizes the recursive structuring and content organization of the NetAcademy. *The horizontal bar* represents the width (choice) of research volumes settling on the platform. Each volume is related to a specific community conducting research in a well defined domain of discourse. Currently, three volumes are active:

- The Community on Business Media (www.businessmedia.org), which deals with research on electronic markets and E-Commerce, including the peer-reviewed online academic Journal "EM –Electronic Markets"
- The Community on Knowledge Media (www.knowledgemedia.org), which is concerned in innovative approaches, technologies and methodologies for knowledge management.

- The Community on Media Management ([www.mediamanagement.org](http://www.mediamanagement.org)), which is a research space concerning the definition and management of the effects of new media on the economy, society, politics, law and culture.

The vertical bar represents the organizational views of the NetAcademy. The NetAcademy provides services for the scientific community following the epistemological view. Those services are online publication, mechanisms for search and retrieval of information and quality assurance processes. The glossary with the publication database, represent the epistemological view of the knowledge cycle (c.f. 3).



**Figure 3:** The Glossary of the NetAcademy- The Implementation of Encyclopedia

The Encyclopedia aspect of the NetAcademy, the *NetAcademy as Encyclopedia* is implemented by the glossary [Schmid et al. 98], as well as the search engine based on it [Stanoevska-Slabeva et al. 98]. The glossary provides a collection of keywords with their definitions and explanations. This glossary, presented in an alphabetical order of keywords is essentially the virtual counterpart of a traditional encyclopedia.

The realization of the glossary based on the Q-Technology for representation and processing of ontologies [Schmid et al. 96] provides further value-add. Based on this technology relationships between terms, such as “*is-a*” or “*part-of*” can be expressed in the glossary’s semantic net and used for intelligent search [Stanoevska-Slabeva et al. 98]. Thus, the glossary allows to define and customize relations between the keywords for different domains of discourse. Based on the federated paradigm for integration of heterogeneous information sources [Sheth et al 90], it furthermore allows to relate different versions of encyclopedia or the domain specific vocabularies to a mediating vocabulary of the universal encyclopedia, i.e., the Encyclopedia having different domain-specific volumes [Stanoevska-Slabeva 97].

## 5.2 The NetAcademy as an Application of the Computational Media Metaphor

The NetAcademy instantiates the computational media metaphor as follows: The *community of agents* of the medium are the publication database, the registration database and the search engine as well as the participants and the guest account. The *channels* are the different types of publications with their meta-description. The *logics* of the NetAcademy is the glossary of a NetAcademy and the search and query mechanisms implemented on it. This comprises the terminology a NetAcademy employs and establishes a set of connections between channels and agents via the semantic relationships defined in the logic. The *roles* in the NetAcademy for participants are author, reviewer, editor. We distinguish furthermore (plain) publications and publications which are part of the glossary [Schmid et al. 98], i.e., which play a role in the encyclopedia view on the NetAcademy. The *processes* in a NetAcademy is the publication process including steps as submission, selecting reviewers, reviewing, evaluating and sending the answer to the reviewer. The possible world of a NetAcademy is the aspect or view of the world, a NetAcademy refers to.

The NetAcademies together form a federation [Sheth et al. 90] of communicating NetAcademies. A NetAcademy is an agent-channel combination, processing knowledge and transporting knowledge over the time. There is only one distinguished role in the NetAcademyNet, the role of the "NetAcademy on NetAcademy", featuring the communication between NetAcademies. The protocols in the NetAcademy are the Inter-NetAcademy searching, mediating and retrieving of information. The logics of this medium is the mediation mechanism, i.e., the mediation between the different vocabularies. The configuration of the media establishes the federated structure. The NetAcademy on NetAcademy is the root of the NetAcademyNet.

Each NetAcademy features its own domain of discourse and a glossary for it. The glossary allows to relate different discourses of domain – according to homonyms and synonyms. Thus, we obtain a collection of related, domain specific encyclopedias. Moreover, this forms an open distributed and decentralized structure: any community can join with their encyclopedia an established Net of Encyclopedias, by providing the semantic link between the NetAcademies. Thus, the concept is open and provides hereby an additional competitive advantage to conventional encyclopedias which are closed systems managed in a centralized way

The contents of the NetAcademy are provided by the scientific community and the quality assurance mechanisms of the scientific community for publication apply not only to the normal publications but to the distinguished entries in the Encyclopedia. Definitions being part of publications can become part of the Encyclopedia. Thus, the Encyclopedia aspect of the NetAcademy is a real handbook for the scientific community. Naturally, by providing links between the Encyclopedia and the normal knowledge base of the NetAcademy, the Encyclopedia in the NetAcademy becomes much more attractive for researches. It is an excellent means to search for specific information in a collection of publications of a scientific community by using the semantic links between different terms and by providing the relevant and related publications online.

## 6 CONCLUDING REMARKS

We envision for the future a living computational encyclopedia for the scientific community, where bits of knowledge continuously cluster like a crystal to an intelligible and redundant system of universal knowledge. Compared to conventional encyclopedias, computational encyclopedias are no longer a static repository of organized knowledge (comparable to cut flowers), but a living organism of evolving knowledge in the different stages of a lifecycle (com-

parable to a flourishing garden). The main competitive advantages of such new forms of encyclopedia are:

- *Accessibility*: The access as is offered by Internet is democratic, i.e., for everybody, any time, anywhere, to the same conditions and the encyclopedia becomes ubiquitous, i.e., independent from physical locations.
- *Effectiveness and efficiency*: The costs of establishing a conventional encyclopedia and keeping it up to date are huge. An encyclopedia, which is interwoven with a strongly motivated community generating and relying on the knowledge collected in the Encyclopedia provides an efficient means to keep the knowledge base up to date. Moreover, changes in the encyclopedia take immediately world-wide effect ensuring hereby effectiveness of the encyclopedia.
- *Organization and Navigation*: The new carrier for encyclopedias provide convenient ways to access the knowledge or to search for knowledge as well as manifold ways to relate knowledge. Several different organizational views can be laid upon the contents presented in an encyclopedia expressing different systematization, organization and representation paradigms. Thus, there is no need to stick with one predominant organization paradigm, or with mainly linear orderings of contents as media on traditional carriers have to do.

We perceive our approach of a holistic medium distinguishing an Encyclopedia view to be a prototype for the new forms of organization of knowledge management and the new media that emerge. For example we could refine the organizational structure of computational encyclopedia and consider it as a dictionary, as a journal, as a conference proceedings, as a newsletter and possible much more different organizations of knowledge.

## **7 ACKNOWLEDGEMENTS**

We are indebted to the Bertelsmann Foundation and the Heinz-Nixdorf Foundation, the partner organizations of the Institute for Media and Communications Management. The NetAcademy project received funding from those partner organizations. The Swiss National Funds sponsored projects related to the NetAcademy and Ulrike Lechner received funding from the Grundlagenforschungsfonds of the University of St. Gallen.

We are particularly indebted to the NetAcademy team for the implementation of the NetAcademy: David-Michael Lincke, Dorian Selz, Petra Schubert, Siegfried Handschuh, Bernd Schopp. However, the participants, editors and executive editors made the concept and its realization to a living community. We are indebted to them for manifold contributions. We would like to thank all the members of the Institute for Media and Communications Management for stimulating discussions.

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