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Constructing New Media

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Abstract: **Media are explored to envision, to design, and to implement platforms for knowledge management within communities. They actively shape, support and develop the community being resident on a medium. We study Intranets as media for knowledge management and provide an agent-oriented model for Intranets. We argue that organization and logical space of a community have to be reconstructed on the medium and that new knowledge and organizational structures can evolve by using the medium. We distinguish as counterparts the organizational structure and the knowledge being represented on the platform and the organizational structure and the knowledge of the community resident on the medium. We propose a media dialog and a media spiral between those counterparts as processes of shaping a community by a medium and of developing and implementing new knowledge and new organizational structures within a community on a medium.**

Keywords: Medium, Agent, Organization, Contract, Media Dialog, Media Spiral.

I Introduction

The buzzword "New Media" captures applications in ECommerce, EBusiness or Knowledge Management, as e.g., online shops, online auction houses, Intranets, CSCW or CSCL systems. There is a strong interrelation between the platforms provided by information and communications technology (ICT) and the society employing those platforms. Novel technology and novel platforms demand for novel models and a new understanding of the processes and methods to design and develop them. In this paper, we present two comprehensive models for media, study communities and their media and propose a media dialog and a media spiral for the design and implementation of media and communities.

We follow the notion of a medium as developed in sociology. Societies can be defined as 'system of places', where every agent has a place with rights and obligations. Those societies are called *media* and they bind the agent at a place [12]. Clans, firms, nations or marketplaces are examples for media. The platform is the physical part of a medium. We are interested in platforms provided by ICT.

This paper contributes to the design and implementation of media for communities of agents. We are interested in media modeled and implemented following the paradigm of multi-agent system for implementing decentralized, distributed information systems [3].

Agents may be humans, software agents, organizational units, i.e. any entity that may play a role in the game of exchange and communication. Agents may provide or collect information, evaluate and process information or perform transactions. Artificial agents may represent humans or companies in media.

Media constitute communities by facilitating communication among the members of the community. A community is a set of agents together with a medium, i.e., *Community = Set of agents + medium* [8]. The agents act on the medium via its channels in roles according to the protocols. The agents share a common logical space and common knowledge as prerequisite for use of the medium and for exchange via the medium. This common logical space and the common organization are shaped by the medium and its platform. Thus, a *community* can be characterized as ensemble of agents sharing a common logical space that (inter)act according to a common organizational structure and that are connected via a channel system.

Seminal to our approach are two models (1) The media concept [11] envisions media as spheres for communities of agents. (2) The media reference model [13] captures the architecture of media. It guides the design and implementation of media, as e.g., for ECommerce or Knowledge Management. Seminal to our approach are furthermore the concept of a dialog and knowledge spiral as explored in [9,10].

The models are utilized to analyze Intranets as media for knowledge management and to suggest an agent-based model of Intranets. Knowledge dialog and knowledge spiral are enhanced to a media dialogue and media spiral as concepts to design and implement media for communities of agents.

We focus on the organizational structure and knowledge (about the medium and about the domain being of interest within a community). We argue, that the development of a medium and, thus, of a community, is an iterative process, a *media spiral*, resembling the spiral process of knowledge creation, introduced, e.g., in [10]. Applied to the development of medium and community, the *externalization* reconstructs the organization and knowledge of the community on the medium. The *combination* relates information collected and analyzed on the medium and generates new knowledge and new organizational forms. The *internalization* transfers this knowledge back into the community. Finally, the *socialization* disseminates and enlarges it through communication within the community. The discussion of the spiral development process of media as well as the mechanisms driving and establishing this process is the contributions of this paper.

This paper is organized as follows. The following two sections provide an introduction of the two seminal models, the media concept and the media reference

model. Then, we discuss the notion and role of communities in general giving an insight in the actual needs and requirements of a community towards its constituting medium. Here, we discuss the motivation of agents to affiliate within a community, introduce two fundamental organizational forms, and relate the motivation to those organizational forms. Finally, we discuss the process of developing and constructing a medium. Here, we first discuss in further detail the two levels of organization and knowledge, one being represented on the platform and the other existing in the community of agents. We then introduce the media – creation - spiral, and describe the mechanisms establishing the four phases in further detail. In this section, we particularly describe how organizational structures are reconstructed on media. We conclude with a discussion of our approach.

II The Concept of Media

With the media concept [11], we capture *how* to envision and model media, i.e., we provide the metaphor and paradigm according to which media are being modeled (see Figure 1). As a metaphor, the media concept envisions media as spheres for communities of agents.

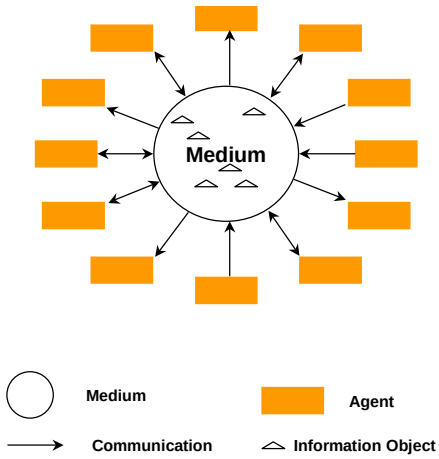

Figure 1 Medium for Communities of Agents

Media are described in terms of three major identifying components [11,13]:

1. A *logical space* with syntax and semantics of the information that may be stored in or communicated via the channels of the medium. This includes a common language and information about some domain (worlds), and information about the medium itself, i.e., its organization and channel system as well as the agents.
2. *A system of channels* to distribute information over space and time and to enable the exchange of information and goods. Note that the channels correspond to a medium considered as a mere carrier of information.
3. *An organizational system* to describe with *roles* the types of its agents, i.e., the behavior expected from agents and with *protocols* the interactions between agents on the channel system.

A medium consists of a channel system for the transport of information over space and time, a logic, for capturing syntax and semantics of the information and an organizational system (roles and protocols) for structuring the behavior of its agents.

Agents are proactive, autonomous entities, capable of processing information. Agents can dispose of a representation of their desires, and the community they belong to. They act in order to reach their goals according to roles and rules imposed by the medium.

Channels are the fundamental prerequisite for communication and interaction between agents. A common logical space, including a language or symbol system and the semantics space is prerequisite for communication within a community. An organization is necessary to capture the places of agents and the rules of interaction the agents have to comply with in communication. Thus, a well-defined organization, a common logical space and a channel system are prerequisite for collaboration among agents.

III The Media Reference Model

The media reference model (MRM) [13] captures the notions and components necessary to model media for applications in, e.g., ECommerce or Knowledge Management. The MRM describes *what is to be modeled*.

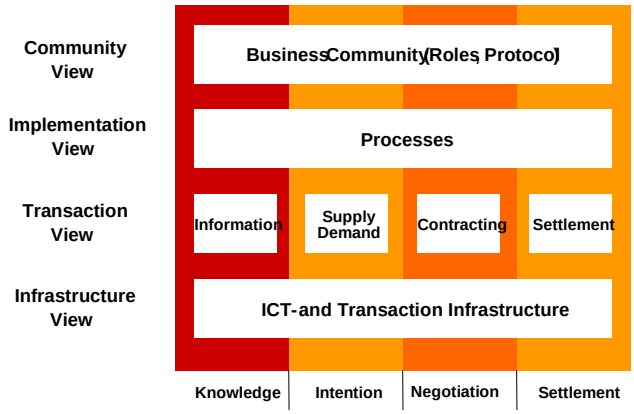

Figure 2 Media Reference Model (MRM)

The media reference model, depicted in Figure 2, distinguishes four views and four phases according to four basic action types [13,14]:

III.1 Views of the MRM

The layers or views relate the platform, implemented on information-and communication technology to the community's agents:

The *community view* deals with the aspects relevant for modeling the community, i.e., its organizational structure with roles and protocols, the common interests and values, as well as the common language. A community and its sub-communities pursue common goals that can be reflected in the establishment of protocol(s) for efficiently reaching those goals. Thus, the logical space as well as the organization is to be defined within this view.

The *transaction view* provides the generic interaction or communication services, supporting e.g., the signaling of intentions, the agreement on contracts, or the actual handling of the transaction within the settlement of contracts.

The *implementation view* implements the specified community design, i.e., the specification of the community view with its organizational role- and rule structure, as data structures and (business) processes on the services (dedicated channels) offered by the transaction layer.

The *infrastructure view* provides the means to physically implement the services of the transaction layer, i.e., the means to process information and transport information over space and time. Here, the respective needs for security or safety of the infrastructure are being provided.

We are interested in how the organization and logical space of a community can be defined and constructed on the channel system. Thus, the focus of this paper lies on the establishment of the shape of the (business) community and on the processes, i.e., on the community and implementation view. The implementation of those structures and processes depends on the existence of transaction and infrastructure services. We take those services as given.

III.2 Phases of the MRM

The phases distinguish the various kinds of communication acts in communication [13]:

In the *Knowledge Phase* assertive information about the world, the agents, or the medium is provided and communicated. Here, the common logical space with syntax and semantics as prerequisite of the interaction in the three remaining phases is being established. This common logical space typically includes information about some domain, the channel system, as well as the organization. Agents may obtain knowledge about the behavior expected from them, about the channels on which they may exchange information, and about the protocols which they have to follow in communication. This might include a meta-level of information about the language and its semantics employed on the medium.

In the *Intention Phase* agents signal their intentions developed from the knowledge provided in the knowledge phase and from their desires and goals. They rely on the linguistic means of the common logical space, and use services provided by the transaction layer. Those services may comprise product catalogs, representing the offers of suppliers resp. market platforms, or blackboards, allowing suppliers and demanders to present their intentions or offers to exchange goods or services. The communication acts in this phase do not alter the organization of a medium.

In the *Negotiation Phase* agents negotiate contracts. The messages in this phase are binding, in the sense that they oblige agents to act as indicated in those messages. Offer, counteroffer, accept, and reject are such messages. Typical services of this phase are services supporting the communication and formalization of contracts, e.g., by matching complementary supplies and demands, or by providing configurable contract forms. This phase ends – in the case of success - with a contract, i.e., with an externalization of a protocol. The communication acts of this phase are legally binding. They alter the organization since, e.g., agents have to behave as described in an offer when the offer is being accepted.

In the *Settlement Phase*, agents act according to the negotiated contract, using services offered for this purpose by the transaction layer. In commerce, this means, e.g., shipment of goods and transfer of money, in knowledge management, this means providing or processing of information according to some protocols or workflows. The communication acts of this phase diminish the obligations described in the contracts.

Note, that the phases are designed to distinguish, what in speech act theory is called the illocution of the messages [5,17]. E.g., Making an offer is a binding act that obliges the agent to act according to the offer, while signaling is not binding. The four action types distinguish themselves in their organizational illocutions. Intentions do not have any organizational implications, messages of the negotiation phase imply organizational consequences and messages of the settlement phase diminish organizational obligations.

III.3 The Role of Contracts

In this subsection, we discuss the concept of contracts in further detail, stressing their use as a comprehensive means to define organizational structures in general [15].

A contract consists of roles that capture liabilities and assets of agents and rules resp. protocols. It determines how agents have to act and interact in the future to settle the contract. Thus, contracts are (an externalization of) communication and interaction protocols.

Contracts describe complex interactions. E.g., think of a contract regulating the information exchange or provision between two agents. It might determine that an agent has to regularly deposit relevant information about some domain of interest, e.g., market rates or company information, while a second agent is allowed to access that information. Thus, push and pull protocols, one-time, repeated or regular exchange of information can be captured in contracts.

The advantages of contracts lie in:

- The reduction of coordination and hereby transaction costs of complex or repetitive transactions (as e.g., in subscription services for providing regularly information or simple standardized business processes).
- Establishment and manifestation of stable relationships and predictable exchange relations as a prerequisite for planning.
- Flexibility of the associated communication protocols and interaction relations. Since contracts are negotiated, the communication protocols can be adapted in negotiation to the needs of the communication partners complying with the existing organizational structure (which may be described in contracts).
- Recording and/or enforcing the settlement process. Provided the contract is externalized in some appropriate description format and provided that commu-

nication takes place on an adequate medium, the settlement can be recorded and even be enforced.

The actual implementation of such contract-based organizational structures depends on the following conditions to be kept:

- Agents have to have messages to signal, negotiate, sign, and settle contracts.
- Agents need a common logical space, to coordinate offers and demands and to formulate contract conditions (See, e.g., [4] or [10]).
- Agents need coordination mechanisms like, e.g., auctions and locations, where they can meet and which support those coordination and negotiation services.
- The medium has to govern the agents according to the contract.

Note that contracts do not have to always be stated explicitly in a medium. Let us illustrate this with two examples:

A corporate communication policy in an Intranet is a contract determining, e.g., that every document has to have a responsible owner, who is obliged to regularly check the information to still be accurate. This relation owner-document can be interpreted as a contract between the users and the documents. Agent can reason about the relation agent document and make decisions whether to trust a document - based on this information.

An URL can be considered to be a contract between the page (and its owner) on which the URL is given and the page the URL points to. Thus, an URL can be interpreted as a contract, in which the owner of the document X has to give notice to the owners of all pages pointing to X when the document changes. A second, stronger interpretation of URL as contract is to capture that the document, which points to another document, is valid if and only if all the documents it refers to are valid as well.

In both examples the contract is implicit in the sense that the contract is part of – the organizational role- and rule structure - of the medium. But is not explicitly represented and thus is not part of the channel system. Note that the platform typically does not have the power to govern the agents to adhere to such types of contracts as given above.

Note that any organization can be modeled as a possibly hierarchical structure of contracts.

IV Communities and their Media

A medium plays an active role in establishing, shaping and constituting a community. By communicating information, the common logical space of agents is being established or changed. The medium, more precisely, the platforms implements (part of the) organization of the community.

We are interested in applying the multi-agent paradigm for modeling and implementing the platform. Thus, the platform with artificial agents can be designed to mirror the community of human agents. Let us discuss this with two examples. In both we assume that each human agents is represented by a software agent.

Consider a community in which a human agent, say A, is obliged to act, whenever a human agent B gives some orders. The agent of A has to act, whenever the agent of B gives some orders or at least A's agent has to notify A that B has sent some message which could contain an order.

Consider a protocol saying that B has to approve anything A publishes on the Web. This can be implemented by agents where the artificial agent of A publishes a document if and only if he got an approval message from B's agent. Alternatively, the approval is sent to a dedicated agent that is responsible for enforcing that only approved documents are published. This agent removes all documents for which he does not know of any approval.

Note that in both examples, the community of human agents is not implemented identically on the platform. The logical space of human agents is much richer than the one of artificial agents. Typically, only "official" channels and "official" aspects of organization are explicitly being implemented on the channel system of a medium.

Crucial for the design of media for communities is to design the platforms that meet the requirements of the community - while taking advantage of the potential of technology. E.g., the platform has much fewer power to govern the agents then the community or organization itself. However, protocols can be designed such that agents are being discouraged from not adhering to them.

A community is characterized by common interests and values that. Understanding and capturing the motivation of agents and structuring and meeting them with the means of the medium is crucial for the design of communities.

In this section, we explore the motivation of communities to affiliate, the organizational design of communities on media that implements the motivation of the community ,and finally the logical space as prerequisite for communication within the community. The goal is to study how the notion of a community of human agents translates to a community of human and artificial agents.

IV.1 Interest and Motivation of Communities

A community[1] is an ensemble of agents that share common values and interests using a medium to communicate within a common logical space according to some organizational structure, described by roles and protocols.

The common interest is the actual driver of the community and, thus, the motivation for a community to evolve, i.e., for a group of agents to affiliate. The common logical space is a prerequisite for sensible and goal-directed communication and, thus, for achieving the common goal through communication and interaction. The organizational structure guides that interaction, so that the community strives towards the common goal.

[1] Note that we do not aim at giving an exhaustive or interdisciplinary discussion of communities. We restrict ourselves to literature in the field of ECommerce and discuss communities only to learn about the reconstruction of communities on a platform.

In the literature, one can find a variety of classification schemes distinguishing different types of communities. To name just one, Hagel/Armstrong distinguishes four types of communities: communities of interest, communities of transaction, communities of fantasy, and communities of relationship [7,16]. We restrict ourselves to the community of interest and the community of transaction.

A *community of interest* pursues the common creation and dissemination of knowledge. The members of this community exchange information and combine it to become new information. According to the MRM, the interactions are more or less limited to the knowledge phase.

Communities of transaction have the common interest to create economic value. Their interactions correspond to – business – transactions, as defined by the four phases of the MRM, leading to the establishment and settlement of contracts. Here, the communication and interaction usually follows certain predefined rules, for signaling of intention, for negotiating of contracts, for signing of contracts and first of all for the settlement of contracts. Remember, that the roles and the rules holding for the settlement phase are defined within the contracting phase and are documented in the signed contract. Those protocols have to comply with the general protocols holding within the community. They concretize them by adding further restrictions guiding the settlement of the transaction.

An example for a typical community of transaction is a community consisting of potential sellers and buyers of a product. The meet on an auction platform to signal their intention, to negotiate the price relying on the auction mechanism provided on the platform, to sign the contract, and to settle the contract. For the settlement, they ideally also rely on payment and logistics services provided directly on the platform.

Note, however that a community might include both, communities of interest and communities of transaction. Think of a "traditional" enterprise: The goal of a company is to create value and many of the value creation processes can be described by a set of roles and rules. Thus, the whole organization is a community of transaction (resp. a set of communities of transaction). Within this business community, for solving non-routine problems, special task forces are often being set up, sharing the interest or goal to solve that problem. They build a temporary community of interest, being interested in creating knowledge, which finally helps them to solve the common problem. We will get back to that example in the following section, when we discuss the organizational forms, which can occur in a community.

IV.2 Organization

A community evolves from common or complementary interests or goals, which are achieved through communication and interaction within the community. This interaction follows certain rules and structures, determined by the organization of the community.

According to [9,10], we distinguish two basic organization models: *task force* and *bureaucracy*. A task force is an institutionalized form of a team or a group that brings together representatives from a number of different units on an intensive and flexible basis, usually to deal with a temporary issue. As such, a task force is a flexible, adaptable, dynamic, and participative organizational form. *Bureaucracy* distinguishes itself by formalization and by a high degree of specialization. This organizational form is characterized by (1) fixed and official order by laws or administrative regulations, (2) hierarchy, that is, levels of graded authority, (3) management based upon written documents, and (4) operation based on specified/specialized work. This organizational model allows for effective routine work and repetitive tasks.

The advantage of bureaucracy lies in its efficient completion of repetitive tasks while the advantage of task force lies in its support of the combination of knowledge and the creation of new ideas [10].[2]

We can relate those two basic organizational forms to the two major types of communities, introduced in the previous subsection. Communities of interest usually depend on the flat organizational structure of a task force, whereas communities of transaction need some kind of bureaucratic structures, guiding the transaction and manifesting the processes within the settlement phase, thus providing some reliability and predictability.

Note, that in general, those organizational forms do not exist in a pure form, but often side by side within the same community [10]. Let us get back to the example of a "traditional" company. Here, we can identify bureaucratic structures, determining standardized routine workflows of the value creation process and of course the different levels of authority within a company. There are also task forces, with a flat organizational structure, which develop from the need to solve a single, non-routine problem. Usually, they pursue knowledge intensive, creative work, neglecting all bureaucratic boundaries.

W.r.t. to organizational models, there is a trend towards a (1) reduction of complexity, (2) customer focus, (3) decentralized project work in teams and (4) reduction of bureaucratic structures [2]. This goes along with the growing importance of knowledge creation and dissemination within an organization (community), which is supported by flat organizational structures and processes, as given within task forces [9] or - n terms of communities - communities of interest. Nevertheless, especially communication and interaction between organizations (business partners) depend on the establishment of (pseudo) bureaucratic structures determining interaction processes between organizations in the common value creation process as they exist in communities of transaction.

Note, that the current implementation of the organizations on IKT platforms follow two different paradigms: (1) representations as, e.g., in operating systems where the accounts, role and group systems describe the

[2] Organizational models vary in their peculiarities w.r.t. to those basic organization models and they can be considered to have some recursive structure. According to [1], the criteria applied to establish the units within an organization, one-dimensional and multi-dimensional models can be distinguished.

access rights of users and the protocols describe and enforce the users to comply with the role descriptions and (2) profile systems which describe the interests of users. Here, the protocols of personalization and customization support communication and organization according to individual interests.

The first concept resembles bureaucratic, community of transaction like concepts, the second, task force, community of interest like structures, respectively.

IV.3 Logical Space

A common logical space or common knowledge is prerequisite for agents to interact. This logical space comprises a common language, with a common syntax and semantics.

In general, the language of the (human) agents is some "natural" language. Thus, the communication and interaction consists of the exchange of messages being a sequence of sentences in those natural languages.

Knowledge – about the organization and about the domain – can be tacit, hidden in the mind of the individual, or explicit (s. [10] and also below). Explicit knowledge (first of all that about some knowledge domain) can be stored in form of documents and is usually also formulated using the common natural language. Those documents can be stored on some electronic means, i.e., (a network of) computers. Interrelations between documents resp. their content can be externalized e.g., through their location within the directory structure of a file system or through direct (hyper) links. As we explain in the following paragraph, also – part of - the organizational structure can be represented explicitly on the electronic medium.

V Building a Medium

In this section, we discuss the process of building media for a community of agents. We argue that this process is a continual iterative process, alternately (1) building new organizational structures and knowledge on the medium through communication and reconstructing the organizational structure and the knowledge of the community on the medium and (2) adapting, changing or enhancing the organizational structure and knowledge of the community through the medium.

This process can be explained as a dialog between the organization and knowledge of the community and the organization and knowledge explicitly represented within the medium. This dialog resembles the dialog between tacit and explicit knowledge in the knowledge creation process [9].

In the following, we first introduce the knowledge creation process, i.e., the knowledge spiral relying on a dialog between explicit and tacit knowledge. We then apply this process to the creation of new media, leading to the establishment of a "media spiral". Finally, we describe the implementation of each of the four phases of that spiral in further detail.

V.1 Media Spiral

Nonaka / Takeuchi [9] distinguish *tacit* knowledge, which is basically hidden in the minds of an individual or organization and hard to communicate and *explicit* knowledge, which can be presented in some formal, and communicable form. They propose a knowledge creation process, in form of a knowledge spiral. Here, knowledge is created and disseminated by alternately transforming tacit knowledge in explicit knowledge resp. vice versa and combining tacit resp. explicit knowledge to create new tacit resp. explicit knowledge. This spiral consists of four phases: (1) In the *socialization* phase, tacit knowledge is disseminated and combined with the tacit knowledge of others through communication and interaction (2) Through formalization, tacit knowledge can be transformed to explicit knowledge. This process is referred to as *externalization*. (3) In the *combination* phase, explicit knowledge is combined leading to the creation of new explicit knowledge (4) in the *internalization* phase, explicit knowledge is transformed to tacit knowledge by internalizing explicit knowledge (often referred to as learning.)

We argue that the establishment of a medium (and a community) follows the same pattern. Corresponding to the two types of knowledge, we identify two types of organization and knowledge, (1) We refer to the the organization and knowledge of the community *resident* on a medium asthe tacit organization and knowledge (2) and to the organization and knowledge explicitly *represented* on the medium as the explicit organization and knowledge. Remember, that knowledge, as part of the logical space, comprises the knowledge about the domain and the knowledge about the organization.

The "*media spiral*" then consists (like the knowledge spiral) of four phases. Let us shortly describe them. We give an in depth discussion within the following subsections.

Through *externalization*, the tacit organizational structure is reconstructed on the medium and the knowledge is stored and organized on the platform (in form of documents, contracts, and profiles, see the following paragraph). This becomes necessary in order to allow artificial agents to act according to the rules of the organization and, thus, to support and act on behalf of human agents. (Moreover, the explicit representation of the organizational structure enables the negotiation, the control and finally the enforcement of organizational structures. Note however that reconstruction needs not to be complete. Furthermore, data about the users´ behavior can be collected on the medium providing further information about the organizational structures and the domain.

The *combination* process relies on the medium's ability to process information. E.g., it can relate the access profile of individuals to their interest profile, leading to new organizational structures according to the criteria "interest".

The *internalization process* is based on services disseminating new knowledge among the agents and thus transforming it to tacit knowledge of the organization. Those are the services of the knowledge phase.

In *socialization*, new tacit organizational structure and knowledge can be disseminated within the organization through communication and interaction. New structures and knowledge can evolve merely through those communication processes.

Let us give the in depth discussion of the four phases in the following sections.

V.2 The Phases of the Media Spiral

In this section, we discuss the implementation of the media spiral in further detail as illustrated in Figure 3.

V.2.1 Externalization

In the Externalization phase the – part of the tacit - organizational structure as well as the domain knowledge of the community are reconstructed on the medium.

As discussed in the previous section III.3 contracts allow to specify, negotiate, agree upon, and finally control and enforce bureaucratic structures and processes. This structure can be temporary. Thus, contracts allow a dynamic and flexible adaptation to changing requirements of the tacit organization. Therefore, we use the concept of contracts as a comprehensive means to reconstruct bureaucratic structures.

Another organizational dimension, being rather independent of the bureaucratic structures and important for the establishment of and work within a task force reflect the interests and capabilities of an individual. This dimension can be reconstructed by establishing user profiles. “Contracts” with information services can be set up using this profile information to support the knowledge creation process. This corresponds to a pre-defined personalization of the system, where the human agent takes over the configuration. The profile information about the capabilities and interests can furthermore be used to establish information services supporting the establishment of task forces itself (see also combination and internalization).

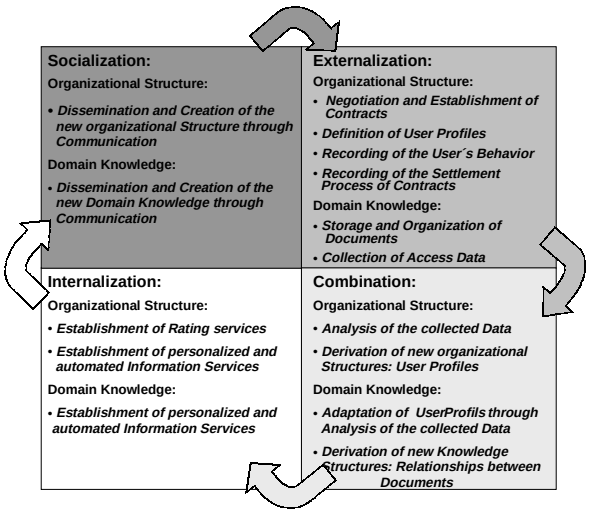

Figure 3 The phases of the media spiral

The domain knowledge is reflected by the documents stored (and created) on the platform. Usually, the content is provided in natural language. The structure of the file system and the linkage of documents, e.g., through hyperlinks, are an externalized semantic relations between the documents. Further insight in the actual organizational structures as well as in the structure of the document space can be gained by collecting data about the user’s communication and interaction behavior. We distinguish three major types of information. (1) Information about the communication and interaction behavior of the agents, i.e., about the message exchanges (2) information about the settlement of contracts. Here, actions relating to the accomplishment of a contract can be recorded (3) information about the access to the underlying document pool. (See also, [6])

As we will see in the next subsection, this explicit information can be used to derive new explicit knowledge.

V.2.2 Combination

In the combination process, explicit knowledge about the organization and the domain is analyzed and combined to generate new explicit knowledge. Thus, the combination phase relies on the capability of the medium, to collect and to process information.

These three general types of information introduced in the previous section can be analyzed and processed to build new explicit knowledge in the following way:

The information about the communication and interaction of the agents can be used to establish a relation between agents, relating people with some common interests or goals (e.g., by collaborative filtering). By relating the communication act with the content of the exchanged messages, the relation can even get more comprehensive. This relation can then be used to update the profile of the individual, and, thus, to support the information dissemination (E.g., information being accessed by one person, can also be transferred to an agent being related to that agent according to that relation. Information about the settlement process can be used to gain knowledge about the reliability and “quality” of an agent. By comparing the actual behavior with the behavior specified within the contract, one can detect delays and non-conformance with the contract conditions. "Better business bureaus" (see, e.g., Marketmaker at maker.mit.media.edu) are examples for such a service.

The access behavior also provides additional information about the interest profile of the individual user and also establishes the relation between groups of agents and about groups of documents. Thus, one can classify people who access the same documents, and documents that are accessed by the same people as belonging to the same category. This information can be used for recommendation services.

Note that we do not claim to present an exhaustive overview of the data which can be collected or of how this data can be analyzed and combined to new knowledge. For a detailed description of the variety of data which can be gathered on electronic platforms we refer, e.g., [6,16].

V.2.3 Internalization

The – new - explicit organizational structures and knowledge can then be internalized through the establishment of - information - services. The use of those services by the agents results in the transformation of

explicit knowledge into tacit knowledge resp. the adaptation of the tacit organizational structure.

Examples of such services are personalized information or recommendation services. They use the updated interest profile and the newly established relations between agents and documents to automatically provide information, which should be of interest to the individual agent. The profile information about the interest and capabilities can also be used to build recommendation services used within the recruiting process of new task forces. Moreover, the knowledge about the reliability of an agent, can be used to build up rating services or personal trust relationships. They can be useful within contract negotiations and of course also within the building process of task forces. Collectively, those services transfer the underlying knowledge and information structures back into the tacit organization and knowledge.

V.2.4 Socialization

Through communication and interaction, the organizational structures as well as the newly gained knowledge is disseminated over the organization. Additionally, new organizational structures can evolve through communication reflecting new communication needs within the community. Similarly new tacit domain knowledge can be generated through interaction between the agents.

VI Conclusion

In this paper, we introduced media as platforms for communities. New Media with their ability to store and to process information, can not only support a community but also play an active role in the constitution and development of a medium and, thus, of a community itself.

The central contribution of this paper is the “media spiral”, applying the knowledge creation process to the creation of new media. Here, we argue that we have to differentiate between the tacit organization and domain knowledge of the community being resident on the medium, and the explicit organization and domain knowledge explicitly represented within the medium. New tacit organizational structures and knowledge can evolve from the communication and interaction of a community of agents via the medium. New explicit organizational structures and domain knowledge can be generated through reconstruction and combination. Here, we rely on the ability of the platform to process (collect and analyze) information. We also show how tacit organizational structures can be reconstructed and how tacit domain knowledge can be represented on the medium, and how the explicit organizational structures and domain knowledge can be internalized through the establishment and use of information services.

The externalization of organizational structure and knowledge provides further possibilities to support the community of agents: A formalized form of contracts allows the control and enforcement of those contracts, and thus of the organizational structure. Moreover, an appropriate explicit and formal description of all components of the medium facilitates artificial agents to autonomously on the platform on behalf of human agents. [8].

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