Process Awareness in Divergence-supportive Knowledge Communities

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Abstract: DIVergence Awareness (DIVA) is a technological framework for management of divergence occurrence in knowledge communities, which is a precursor to the creation of new knowledge in these communities. The DIVA workspace system is aware of the members' profiles (skills, interests, etc) and their evolution; and as a result, it can deliver custom-made contributions to the members in an attempt to manage divergence within the community. In this paper we introduce process awareness formalism as an addition to the existing formalism of DIVA in order to enhance knowledge creation and knowledge sharing processes within the DIVA process. The added formalism achieves these objectives by facilitating identification of the *process awareness* requirements of the actors based on both the roles they play as well as the tasks they perform within the DIVA process.

Keywords: Knowledge sharing, divergence, knowledge community, awareness

Categories: H.5.3, I.2.4, J.4

1 Introduction

The web-based knowledge communities are special kind of Discussion Forums that are considered as today's main method for knowledge sharing in virtual communities. These systems have their roots in the traditional *structured messaging* systems of the late 1980s initiated by researchers in the field of CSCW (Computer-Supported Cooperative Work). These platforms are designed to facilitate communication

between remote participants at same/different times [Borenstein et al, 93] & [Malone et al, 93]. Discussion forums do not rely on time-dependent turn taking floor-control mechanism; and instead, participants may communicate whenever they wish or are able to do so.

The groupware technologies that support discussion forums are mainly Internet web sites that use the Internet technology embedded within HTML. Like newsgroups, discussion thread systems provide support for discussions and organize them according to topic and subtopic where users can participate. Unlike newsgroups however, their services are not normally catalogued as part of the public Usenet service on the Internet, and therefore the Usenet search engine does not search what is written in a forum, although more recent versions of these systems that provide articulation of knowledge may also use some protocols in order to provide certain level of storage and search facilities.

In [Diaz & Canals, 04b], authors have adopted the Nonaka's knowledge creation spiral process [Nonaka, 94] in order to take into account knowledge codification as a method for developing knowledge repositories. This process consists of the following four steps:

Externalization means to make explicit some knowledge that is at the individual knowledge context, normally, by some form of formalism. It is carried out in isolation from other collaborating actors.

Submission/Publication is the act of making public a (new) knowledge.

Internalization is an individual process when someone realizes and appreciates the subject of a new contribution. The new knowledge will then become part of the individual knowledge context. Internalization can be detected by monitoring a person's *reaction* to a contribution.

Reaction is the act of giving some kind of response to a contribution.

A natural consequence of the act of sharing knowledge in virtual knowledge communities (or communities, for short) is *divergence occurrences* [Diaz & Canals, 04a]. Divergences occur until such time when the community reaches a unique perspective. Divergence occurrence is defined as "generation of alternatives, argument and different point of views about a topic of interest" [Ibid]. Contrary to the CSCW community that regards conflicts as being a synchronisation and versioning problem in need of some solutions, the knowledge management community tends to live peacefully with such convergences and sees them as opportunities for interaction and therefore, sources of new knowledge. It has also been demonstrated that as the

degree of people's involvement in various communication acts increases, so will the opportunities for divergence [Easterbrook et al, 93].

The general opinion in this article is that conflicts must be treated as a natural part of the knowledge sharing process that promotes emergence of new knowledge. As a result, any technological approach that supports knowledge-sharing activities must pay attention to divergence/conflicts and how to manage them. In this paper we propose an extension to the existing knowledge sharing process used in DIVA in order to enhance knowledge sharing capabilities of the actors. According to this extended formalism, the DIVA process will be a collaborative process where various actors perform certain roles, and each role performs one or more tasks using various artefacts. Such added formalism will then enable identification of the process awareness requirements of the actors in terms of collaborative semantic concepts such as other roles within process, their tasks, and the artefacts that they use for executing those tasks. This in turn will provide a mean by which actors' process awareness requirements can be defined as a precursor for enhancing collaboration and knowledge sharing within the DIVA process.

Next section introduces the DIVA technological approach that allows communities to coexist with conflicts and letting agreed knowledge to emerge naturally through acts of knowledge sharing. It also describes motivation for this study. In the next section the proposed additional formalisation is introduced in order to facilitate measurement and maintenance of the process awareness requirements of the actors within the DIVA. The last section of this paper analyses how awareness net can be applied to the DIVA framework and how this approach is helpful in designing the user interface of a DIVA based system.

2 Supporting Knowledge Sharing With Divergence

Diaz & Canals [2004] introduced a technological approach for supporting and management of divergence awareness in knowledge communities that for simplicity, we call it DIVA in this paper. This section presents a summary of this framework in a nutshell. Additional relevant characteristics of the DIVA will also be explained in the next sections when discussing the proposed extended formalism to the DIVA. The readers are advised to refer to the above reference for full details on DIVA.

DIVA is a technological model of a collaborative workspace that manages community forums while allowing divergence to coexist within the community as a source of creating new knowledge within the community. DIVA provides a

conceptual framework for creating new knowledge through management of divergence occurrences, enabling community members to contribute while moving between private and public knowledge spaces, and managing contribution threads seamlessly. The DIVA workspace system is aware of its members' profiles (skills, interests, etc) as well as their evolution; and as a result, it can deliver custom-made contributions to the members.

The DIVA workspace consists of a *private knowledge workspace* (PKW) and a *shared knowledge workspace* (SKW). The PKW is a non-public space that can be accessed by its owner only. It represents the private knowledge context and allows users to externalise any knowledge privately. More specifically, PKW contains personal knowledge, point of view, and alternatives. The SKW on the other hand, is a public space that can be accessed by any community member, and represents shared knowledge context.

The PKW is articulated with personal view of the shared knowledge space. In this paper we argue that separation of the DIVA workspace into public and private sections would require further formalism in a way that facilitates distinction between the boundaries of PKW and SKW on the basis of the activities that actors perform within the community, as well as the artefacts that they use in order to perform these tasks; a step towards integrating people, process and technology within the DIVA. According to the proposed integrated framework, the PKW and SKW requirements are defined in term of sets of collaborative semantic concepts that make up the bulk of the business process elements. This, among other things, will facilitate transition from the business process to the system and software lifecycle of the groupware systems that support mass customisation knowledge communities Towards this objective we introduce, in the next section, a process awareness framework in order to explicify the private and public contexts for the actors through measurement of their process awareness within the DIVA knowledge sharing process. This, in principal, will also facilitate design of appropriate user interfaces for the actors; the latter constitutes the authors' future work.

Through this extended formalism all actors collaborate and *interact* with one another by assuming one or more *roles* within the collaborative process that knowledge sharing takes place. Each actor is assigned one role at a time. Each role is associated with a set of *personal* and *collaborative tasks*. An actor can play various roles but one actor can play only one role at a time. By extending the scope of the knowledge sharing process from being a set of pairwise intellectual activities into a larger collaborative process where people perform various tasks and use various

artefacts, the notion of the process awareness will become a major issue. The process awareness is specialised knowledge about various aspects of the collaborative business process and as such, can be possessed by all the actors; hence our claim in integrating people, technology and process in a single awareness framework.

3 Introducing Extended Formalism: The Awareness Net

The *awareness net* used in this paper is a major component of a conceptual framework called Process Awareness Framework or PAF [Daneshgar, 97]. The PAF was initially created for identification of process awareness requirements of the actors in collaborative business processes in terms of roles, tasks and artefacts that exist within the collaborative processes. It was also intended to provide a measure for such awareness [Ibid]. Subsequent studies however revealed its additional capabilities including identification of the storage requirements of the knowledge-base systems for maintaining actors' process awareness [Daneshgar, 04], as well as identification of the user-interface design requirements for systems that provide support for knowledge-sharing processes [Daneshgar 05]. A summary of the theoretical aspects of the awareness net is explained in the following paragraphs.

From a graphical perspective, the *awareness net* is a connected graph that represents a collaborative business process. It consists of a set of collaborative semantic concepts and their relationships as its vertices and links. It can be used to define and measure process awareness of the collaborating actors in collaborative processes. When combined and linked, these semantic concepts make up a connected graph representing a collaborative process that we present here as an extension to the existing DIVA methodology. These concepts are briefly described below:

ACTORS: These are human agents and/or system components/agents that enact a set of *tasks* by assuming one or more *roles* within the process. In the awareness net there is no graphical representation for the 'actors' and instead, actors are represented indirectly by relevant *role*(s) that they play within the process.

ROLE: A set of norms expressed in terms of obligations, privileges, and rights enabling actors to perform certain tasks within the process. In Figure 1, three generic roles are identified for DIVA. These are Knowledge Manager who performs administrative tasks within the community, Members who constitute general population within the community, and specialised versions of members including Argumentator, Supporter, Initial Contributor, and Opposer, and are shown by larger circles.

SIMPLE TASK (or *task* for short): A concept that consists of a sequence of *actions* or *execution steps* in order to achieve a specific process goal. Smaller circles in Figure 1 represent various task associated with each role.

COLLABORATIVE TASK: Is composed of two or more *tasks* that have a common goal, and therefore (must) share a common *task/shared artifact*. In Figure 1, the sets of subgraphs that consist of a pair of tasks and their common *task artifact* represent various collaborative tasks within the process.

TASK ARTIFACT: This object carries shared knowledge resources about how various *actions* associated with a *collaborative task* are executed. It is shared by interacting *roles*. In Figure 1, thick lines connecting two tasks is a role artifact. Majority of the task artefacts for this study are software programs as well as other computer system and Internet resources.

ROLE ARTIFACT: This object carries private knowledge/resources about how to perform *actions* associated with a *task***.** In Figure 1, narrow lines connecting a role to a task are role artifacts.

Various levels of awareness can now be demonstrated for each role using Figure 1.

Level 0 awareness for a role is awareness about of his/her *role artifacts* and related *simple tasks*, regardless the collaborativeness of these tasks. For example, Level 0 awareness for the role Knowledge Manager (KM) consists of contextual knowledge about the tasks 'approve membership', and 'Publish', as well as about all the role artifacts that link tasks to the Knowledge Manager.

Level 1 awareness for a role is its level 0 awareness, PLUS all the objects on the awareness net that correspond to the related tasks and related roles. For example, level 1 awareness for the role KM consists of the knowledge about the following additional objects: 'Request Membership', 'Request to Publish', 'Member' plus the two tasks artefacts shared with the Member, plus the two role artefacts used by the Member.

Level 2 awareness extends level 1 by including additional remaining role contexts within the process. *Level 3 awareness* extends level 2 by including all the remaining task artifacts contexts that exist within the process.

And finally, a role's *level 4 awareness* extends level 3 by including all remaining objects on the awareness net, that is, everybody else's private tasks, as well as their related role artefacts. While levels 0 to 3 differ for each role, level 4 is identical for all the roles as it represents the entire connected graph. Various awareness paths for some of the roles in Figure 1 are shown in Table 1.

4 Analysis of the Results

The role KM is involved in one *simple* (private) *task* and two separate *collaborative tasks* (or, interactions) with the role Member. The first one deals with providing the Members with appropriate infrastructures that enable Members to publish their contributions on the community board. The second one involves finalisation of a (new) Member's membership within the community. A Member on the other hand can play any of the sub roles Argumentator, Supporter, Initial Contributor and Opposer; and as a result can interact with other specialised instances of the Member, as shown by the task artefacts connecting 9 to 2, 1 to 2, and 2 to 3. These specialised Member roles can also perform all the generic tasks that the parent role Member performs, whether privately (3, 4, 7 and 8), or in collaboration with the KM (5 and 6).

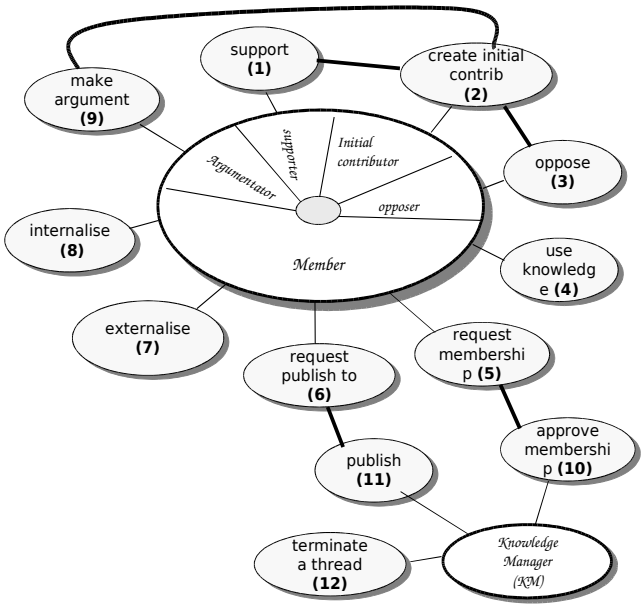

Figure 1. The Awareness net for the DIVA framework

We believe that among other things, various subgraphs of the Figure 1 can be used to demonstrate, at a conceptual level, various levels of process awareness for

each role, as well as the storage requirements of the objects/concepts that constitute bulk of the collaboration context, all in terms of the roles' activities and their artifacts within the collaborative process. A separate study intends to use the awareness net for identification of the various PKS and SKS for the actors within the community based on their process awareness requirements. The various levels of the process awareness for most of the roles are shown in the following Table.

Various levels of awareness correspond to various levels on interaction and knowledge sharing capabilities of those actors. The higher the level of awareness of an actor, the more will be his/her ability to share knowledge with other actors. For example, if the community culture dictates that the Knowledge Manager should monitor all private activities of the Member within the board, then perhaps providing level-4 awareness to this role would be appropriate. On the other hand, Members do not require a high level of awareness, and for as long as they can find their way in using appropriate function buttons for their tasks they would be all right; therefore we may simply provide level 1 awareness to the instances of the role Member.

Table 1: Various Awareness paths for the roles in Figure 1 Awareness Net

Role	**Level (0) Awareness**	**Level (1) Awareness**	**Level (2) Awareness**	**Level (3) Awareness**	**Level (4) Awarenes**
Member	1+2+3+4+5+ 6+7+8+9 + Member + relevant role artifacts	Level (0) + 10+11+KM+ relevant artifacts	Same as level (1), as no roles left from the previous level	Same as level (2), no task artifacts left from previous level	Level (3) + 12 + one role artefact
Knowledge Manager	10 + 11 + KM + all related role artifacts	Level (0) + 5 +6+Member + relevant artifacts	Level (1)+1+ 2+3+9+ Argumentaqt or +Supporter+ Initial Contrib + Opposer + their relevant role artifacts	Level (2) + three task artefact connecting 1 to 2; 2 to 3; And 9 to 2	Level (3) + 4 + 7 + 8 + relevant role artefacts

Argumentator (inherits awareness from its parent Member	Member's level (0) + 9 + Argumentator + relevant role artifact	Member (1) + Level (0) + 2 + Initial Contributor + one of each role and task artifacts	Member (2) + Level (1) + Supporter + Opposer + KM + relevant objects/contexts on the path	Member (3) + Level (2) + Task artefacts connecting 1 to 2; 2 to 3; 5 to 10 and 6 to 11	Member (4)

By using Figure 1 we can now identify and define PKW. The objects that constitute an actor's level-0 awareness constitute the actor's PKW. In other words, the groupware system that supports such knowledge community must ensure that these objects are present within the PKW of each actor. The added formalism also provides a means by which various levels of SKW can be defined for each actor depending on external factors such as community culture and organisational factors. For example, for many communities it may be appropriate to provide the KM with the level-4 awareness as s/he needs to monitor all private and shared activities within the community; whereas a Member may only need to have level-1 awareness because members normally do not need to know how to terminate a thread as this is the KM's personal task within the process. These considerations can guide groupware design in developing systems that among other things, maintains the awareness levels of the actors at predefined levels through provision of appropriate user interfaces.

5 Conclusion and Future Work

This paper introduced an extended formalism to the current specification of the DIVA in order to explicify the actors' private and shared workspaces based on the activities that they perform within the knowledge community. The extended formalism also provides a measure for the actors' ability in getting involved in various levels of knowledge sharing transactions with others, with these levels being determined by the organisational and/or community culture or some other external factors. The epistemological foundation of the proposed formalism is the belief that actors in knowledge communities are more like collaborating/interacting agents that need to have certain levels of awareness about various aspects/contexts of

collaboration. Such context is provided through the tasks that others perform within the community, the roles involved in the process, and the artefacts and knowledge resources that these roles utilise in order to perform their tasks within the community. In short, this paper demonstrated that the extended formalism could be used to conceptually identify the actors' awareness and knowledge sharing requirements within the knowledge community.

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