

A Collaborative Learning Design Environment to Harmonize Sense of Participation

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Abstract: From a viewpoint of “knowledge management”, collaborative space for learning is an aid to encourage organizational members (e.g. employee) to acquire or create important organizational intellect (e.g. knowledge) through group activity (e.g. a free discussion). In this paper we focus on design of collaborative space, which is a key for organization to grow, and aim to improve the quality of collaborative space by establishing a rational design principle and developing design support system. To arraign the goal, we have been building collaborative space ontology as a foundation of the environment, and developing a collaborative space design support system which provides designers with design guideline and the support functions based on collaborative space ontology.

1. Introduction

From a viewpoint of “knowledge management (Davenport 98)”, collaborative space for learning (Eleuterio 00, Ayala 00) is an aid to encourage organizational members to acquire or create important organizational intellect (knowledge, skill or competency existing in the organization) through group activities. It may be expected, for example, that a free discussion encourages creating new organizational intellect and that apprenticeship under seniors encourages newcomers to inherit existing organizational intellect. Collaborative space as an aid for organizational learning has a good property to distribute implicit intellect (e.g. competency) over an organization (Nonaka 00). In practice, by setting up a collaborative space, a manager aims at offering organization members an opportunity to acquire not only explicit intellect, but implicit one which is difficult to acquire through individual activities. Thus, design of collaborative space is a key for an organization to grow.

There are many learning theories on collaborative activities such as “Sociocultural Theory (Vygotsky 78).” We have done comprehensive studies on those theories to build a “Collaborative Learning Ontology (Inaba 00)”. Following that research, in this paper, we aim at expanding and adapting the theories to both a practical scene and an educational scene in the organization. Depending on the goals and the contexts of the organizational group activities, adaptation of the theories to the scene should be carefully considered and the well-adapted collaborative space should be designed with the rational design intention. To improve the quality of collaborative activities is very important for the development of the organization.

Nonaka et al. proposed “Middle up-down management”, which is a form of an organization to activate the process (Nonaka 00). In Middle up-down management, a “Knowledge practitioner (K-practitioner)” (e.g. employee) plays the role of generating the creative power mentioned above, while a “Knowledge producer (K-producer)” (e.g. employer) plays the role of coordinating the top’s visions and K-practitioners’ practical activities.

When a K-producer designs a collaborative space, it is expected that he/she well realizes the condition of an organization. The condition, however, is hard to capture, because it varies every moment according to the K-practitioners’ active behaviors. In our previous research (Tsumoto 02), we have introduced two different forms of collaborative spaces, that is, less-regulated one and well-regulated one, and have introduced an IT foundation to integrate the two forms of collaborative spaces. The former mostly addresses a collaborative space with less-clear goals and expects bottom-up intellectual activities to emerge in an organization. A typical communication mode in a less-regulated collaborative space is opportunistic document exchange in practical work. On the other hand, the latter mostly orients to a collaborative space whose features, i.e. participants, roles, goals, etc., are designed in advance and expects intellectual activities is pulled together to attain an organizational goal. A typical way of communications in a well-regulated collaborative space is discussion on a certain practical problem to be solved in the organization. Collaborative space goals fit the organization needs if the goals and participants’ roles are appropriately established following an organizational vision/strategy. Our project aims at integrating two forms of collaborative spaces into one framework. While the less-regulated one is explained in (Tsumoto 02), this paper focuses on the K-producer’s task of well-regulated collaborative space design and shows our pivotal ideas on a knowledge-based support

environment for the task.

2. Collaborative Space Design

Designing collaborative space is one of the K-producer's activities to regulate a collaborative space. The product of the activity is a collaborative space model that consists of goals, roles of participants, target tasks, the members to participate, and the variety of materials relevant to the tasks. In order to promote creation and inheritance of organizational intellect, we aim to improve the quality of collaborative space by establishing a rational design principle and developing a design support environment.

Crystallization of collaborative space design intentions promises two benefits; one is improvement of the design quality and the other is cultivation of participants' synergy, because the rationality of the design is well explained to both a designer and participants. However, it is not easy for the stakeholders to share the design intention since it is highly abstract and implicit and sometime lacks consistency. A key to overcome the difficulty is to establish a common conceptual foundation, that is, ontology to represent the design intention.

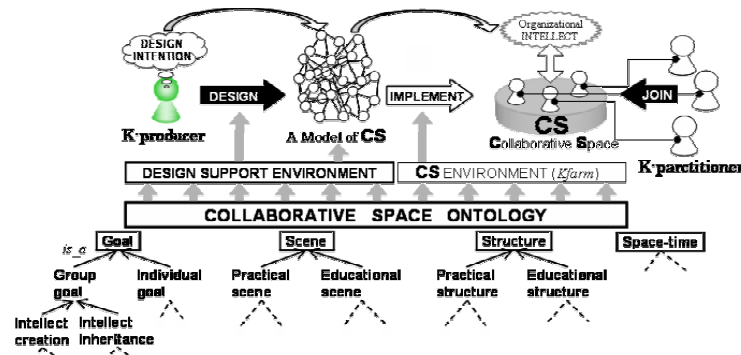


Figure 1: Ontology-based Collaborative space design

We are building collaborative space ontology as a foundation of the environment. Ontology (Mizoguchi 98) has been brought to public attention since ontology plays many crucial roles to lay a foundation for knowledge based modeling of collaborative space as shown in Fig. 1. In this research, ontology is a fundamental conceptual framework to maintain the consistency among different viewpoints for a variety of stakeholders to model the collaborative space. We show K-producer the ontology to design a model, but hide it from K-practitioners who uses a designed model.

Collaborative space ontology is a system of the concepts which constitutes variety forms of collaborative space. Collaborative space is a complex concept consists of goals, tasks, a scene, participants, activities, and so on. At the topmost of the ontology, the concept of collaborative space is classified into two sub concepts, that is, collaborative space at a practical scene and one at an educational scene. At the practical scene, a1) the primary goal of collaborative space is to create new intellect for the organization, and a2) the task is as it is in practice and is not simplified in any sense. On the other hand, at the educational scene, b1) the goal is to inherit the existing intellect in the organization, and b2) the task is simplified to scaffold learning and often separated from the practical context.

Collaborative space contains the following four elements.

- **Goal of Collaborative space**

A goal of collaborative space represents desirable changes of organization's intellect. A goal is basically classified into two: the change of organizational intellect as the *group goal* and the change of an individual intellect as the *individual goal* and each of them are further classified into two categories, that is, "*intellect creation*" and "*intellect inheritance*." For example, a group goal of new intellect creation in practical collaborative space means a K-producer expects K-practitioners to create entirely original intellect. On the other hand, a group goal of inheriting intellect in the educational collaborative space means that a K-producer expects novice K-practitioners to learn the existing expertise from senior K-practitioners.

- **Scene of Collaborative space**

In collaborative space design, it is important to clarify a "scene" for the group to achieve the goal of collaborative space. A scene is characterized by a goal and a task and classified into a *practical scene* and an *educational scene* by the goal of collaborative space. A practical scene is characterized by a practical task and the goal to achieve. At this scene, it is important to improve quality of the task outcome and the task performance. The specification of the task includes a set of intellect necessary for running the task and the desired outcomes of the task. By contrast, at an

educational scene, the primary goal is not necessarily to achieve the task. For example, there are cases where the goal is to acquire the required intellect through the task designed with educational intention. The specification of the task of an educational scene includes a set of intellect to be learned through the task. In those cases, designers may set up the simplified task comparable to the practical task to scaffold learning the intellect.

- **Structure of Collaborative space**

Structure of a collaborative space is shaped by roles of participants and the interaction among them. The structure should be designed reasonably to achieve the goal of the space. *Practical structure* and *educational structure* are top level categories of the collaborative space structure. Practical one is appropriate structure to achieve the practical goal and consists of participants who have the competency to achieve the goal. Design intention of this structure is to assign high priority to running the task. Educational one includes participants whose goal is to acquire organizational intellect, and is designed with education intention to give high priority to inheritance of the organizational intellect.

The role assigned to a participant implies his/her desirable social behavior to the others to cause change of organizational intellect or his/her own intellect. The structure also specifies a set of intellect which is expected to be held by the participant in advance to collaborative activities. Based on the specification a designer can select the appropriate person for the role.

- **Space-time of Collaborative space**

The space-time of collaborative space specifies when and where the collaborative activities expected to be carried out. Space may be physical space such as a classroom or internet space such as chat or bulletin board. It also specifies resources such as documents, equipments relating to the collaborative space, and so on.

3. Collaborative Space Design Support

Fig. 2(A) shows the block diagram of *Kfarm* (Hayashi 02a) with collaborative space design support subsystem. *Kfarm* is a distributed system consisting of a K-granary, at least one K-ranch house, and some K-fields. The K-field and K-ranch house are environments for a K-practitioner and a K-producer respectively. The K-granary is a server of the organizational intellect model, called IGG (Hayashi 02b) which represents an interpretation of K-practitioner's activities.

Fig. 2(B) shows the screenshot of collaborative space design support subsystem of *Kfarm* which provides a K-producer with the support functions based on collaborative space ontology. It shows the desirable design procedure of collaborative space step by step and guides a designer onto an appropriate design process. It also provides a list of candidate values to the collaborative space properties and encourages a designer to assign appropriate values to collaborative space properties. The property to characterize a collaborative space is called "collaborative space property." The function shows collaborative space properties to be considered, and provides the recommendation of values which seems to be appropriate to the properties based on collaborative space ontology. Encouraging a designer to conform to the ontology, the design intention of collaborative space is expected to be explicit and appropriate. The intention is modeled as an internal model of the system and provided to the designer and participants to the collaborative space when needed.

In the following, we will see supporting behavior of the system along a typical flow of the design activity. The first step of the design activity is to decide a goal of collaborative space. The K-producer selects one or more than one goal from a list of goal concepts which are specified in collaborative space ontology. The base for the decision making is information on a "sign" provided by K-granary.

Then, the K-producer makes an abstract design on collaborative space structure by referring to "collaborative space patterns." It offers design guidelines of a collaborative space object ensuring consistency and conformance based on the collaborative learning ontology we formulated (Inaba 00). A collaborative space pattern shows a typical model of collaborative space which conforms to collaborative space ontology. It consists of two kinds of patterns: structure patterns and flow patterns. A structure pattern represents a typical pattern of collaborative space structure which is appropriate for achieving the goal; they mainly describe typical relation among the goal, participants and participants' roles. A flow pattern represents typical sequence of more than one collaborative space to achieve a goal.

Then, the K-producer refines abstract design step by step. Suppose that the K-producer assigns the role of "creating a new plan" to collaborative space property. By referring to the concept of the role defined in ontology, the system shows the candidates of the role and the candidates of the K-practitioner who is suitable for the role based on the information on the organizational intellects provided by K-granary (Fig.2 (B-1)). By referring to the information, the system shows the candidate persons to the role, who know the target intellect relevant to the task and have competency to run the task. Based on the information, the K-producer may assign the role to one of the candidate K-practitioners in the collaborative space. Since IGG records the history of intellectual growth in long span, the

K-producer can find the suitable person whose activities are beyond the memory of the K-practitioners (Fig.2 (B-2)).

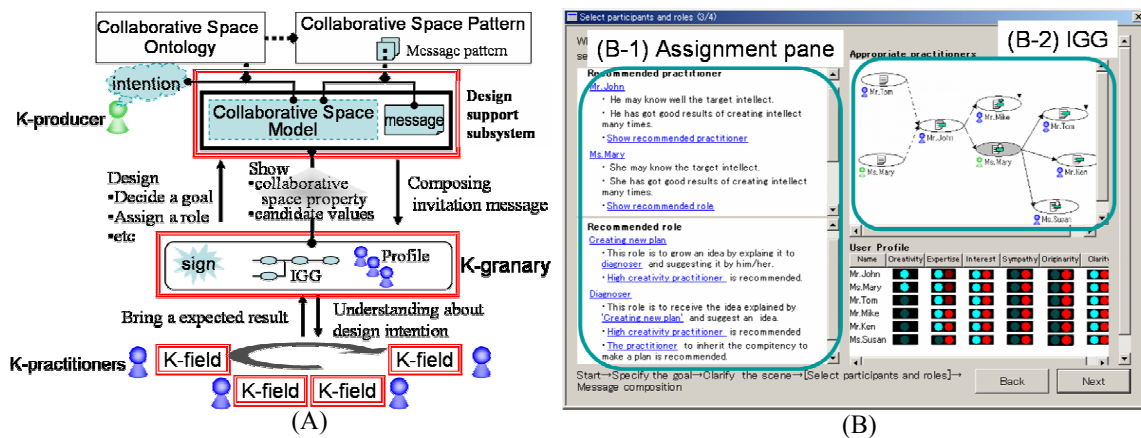


Figure 2: *Kfarm* with a Collaborative Space Design Environment (under development)

4. Conclusion

Collaborative space is one of the important factors for growing up an organization. For improvement in the quality of that, we propose collaborative space ontology which a K-producer uses as a base for designing collaborative space. Collaborative space ontology provides a designer with rational design principle and basic concepts, and represents a basis for sharing a collaborative space model among a K-producer and K-practitioners. The typical collaborative space models based on this ontology, which are used for templates at designing, are prepared as collaborative space pattern. With using these ontology and pattern, we built support function on *Kfarm* for a K-producer to design high quality collaborative space. *Kfarm* presents a K-producer with setting items and candidate of values required for the design with reference to concepts described by the ontology. Future direction of this study will be to accumulate and refine the collaborative space design patterns through trial operation.

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