8-15-1997

Embodying Social Capital Facilitatorsin a Collaborative Authoring System

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This paper addresses selected analysis and design considerations for collaborative software. The paper explains how social "border" activity differs from the "focal" activity of a system and discusses why considering the "border" may be important in collaborative system design. The paper presents some definitions and a social border framework which might serve to guide a collaborative systems analysis and design. An example of how this framework impacts one existing collaborative authoring system based on a preliminary application of the requirements analysis framework is provided. Methods and metrics that may be used to assess the impact of design for the social periphery are also provided.

Motivation

Systems analysis and design is concerned with modeling tasks, data, and interactions in the construction of electronic systems. For situations involving groups and collaboration, the system must account for social mechanisms that facilitate the task at hand. Group and task interactions that are taken for granted in face-to-face systems are often not accounted for in groupware systems. Brown and Duguid (1994) distinguish the focal task of a system from the "border" of a system. The border consists in part of the social periphery and is defined as resources lying beyond the canonical artifact which are available to all persons interacting with that artifact. This paper proposes a framework for analysis and design related to the social periphery. The framework is strongly influenced by the thinking of Coleman (1988), Putnam (1992; 1995), and others on social capital. The framework is preliminary and intended as a discussion piece. We believe it will allow collaborative systems researchers to gain further insight into how to design for the social periphery making collaborative group efforts more effective.

Definitions and Framework

A preliminary review of the literature yields more questions than answers. As information scientists, the sociological and psychological literature (Moreland & Levine 1992; Liang 1994; Arnold & Kay, 1995; Boisjoly, et. al. 1995) contains definitions and conceptualizations that are difficult to operationalize in systems. Thus "group", "consensus", "social capital", etc. must ultimately be represented in the system as control structures, input/output statements, calculations, and assignments. The definitions and framework proposed here are meant for further discussion and are stipulated with an eye to defining what can and cannot be made part of a system design, and for those parts that can, providing some clue as to how.

Selected Definitions

Group A group (Hare, 1976) is a collection of people who have shared values or goals. There are multiple dimensions (Moreland & Levine, 1992) which are used to define "groupness" making it problematic to provide one clear definition. Groups may be homogeneous or heterogeneous over a number of dimensions -- sex, age, ethnicity, etc. From an operational perspective, in order to accomplish a goal, a group acquires or develops resources and skills. Through conformance to a set of norms and roles, group members create cohesiveness expediting group processes. In the context of this paper, groups must share a goal, may develop or have resources to expend on reaching the goal, and may develop or have norms and roles that facilitate this process.

Social periphery Brown and Duguid (1994) emphasize the necessity of the social periphery in systems. The social periphery is the social context within which a task is undertaken. It is one of the components of the border. It is made up of those developing or existent group attributes which contribute to accomplishing a task. One example of social periphery might be the awareness of other members' level of interest and contribution to group tasks.

Interaction Interaction is a broad, general term defined as mutual or reciprocal action or influence. Individuals may interact with each other related to tasks, expectations, values, etc. In addition, individuals and systems may interact. Interactions may be isolated or built upon a history of prior interactions. Interactions include the verbal and non-verbal behaviors that occur among people (and systems). For purposes of this analysis, we stipulate two broad classes of interactions -- task (cognitive) interactions and group (socio-emotional) interactions.

Social Capital Putnam (1995) suggests that social capital strongly influences civic engagement. More generally, Coleman(1988) suggests that social capital occurs within social structures and exists in various forms. While various authors have defined different measures of social capital, in most cases it is tied to the notion of social obligations and expectations. Social capital, like other forms of capital may be used in transactions. Certain collaborative tasks may be dependent on the existence and use of social capital.

Framework for Systems Analysis

In the design of collaborative systems, both the focal task and the social periphery need to be considered. Few frameworks address when and how the social periphery should be taken into account. The following framework, intended as a supplement to existing system analysis and design frameworks, considers three dimensions of collaborative work: task goal, task interaction, and group cohesion. Systems that differ along these dimensions will benefit from distinct types of social periphery tools.

Task Goal

Numerous authors have provided formal and informal classifications of tasks (Hollingshead & McGrath, 1995; Stefik, et.al., 1987; Nunamaker, et.al, 1991). These classifications have tended to break down along the lines of business functions or basic process types. We suggest a slightly different breakdown reflecting a bias toward generalization of the task classes. These types are all cast in the context of a group effort:

- **Development** tasks involve generating ideas, plans, or artifacts. In all cases something new is generated by the group.
- **Negotiation** tasks involve the resolution of conflicting ideas or points of view. The outcome of negotiation may be at varying levels of consensus.
- **Review** and decision making tasks involve the critical assessment of alternatives and in the case of decision making may involve selection. To the extent that the task involves combining alternatives to form a hybrid solution, the task may evolve to a development or negotiation task.
- **Execution** tasks involve the performance of some coordinated set of work activities.

Once the type of task is identified, task interaction and group cohesion conditions, which support the social periphery, are considered.

Task Interaction

In the conduct of a collaborative task, there are varying levels of interaction among group members. We suggest that the level of task interaction is most measurable in terms of the degree of agreement that must be achieved related to the contribution of individual members. Each level builds on the previous levels.

1. **Contribution**. Group members contribute and are aware that other members are contributing.
2. **Acceptance**. The group members accept that the contribution(s) are relevant for the current group task. This acceptance does not imply complete agreement with the ideas or quality of the contribution, just a recognition of relevant contributions.
3. **Consensus**. The group members understand the relevance of contributions and accept their importance from the group point of view, even if they have some personal differences.
4. **Agreement**. At this level, the group members develop a shared view of the task. All of the group members are of the same opinion about the results.

At the lower levels, tools which facilitate assigning and scheduling of tasks would provide the necessary support. At the upper level, support would be required for informal interactions among group members, for private negotiation and persuasion, and for extensive communications including mechanisms that support non-verbal communication.

Group Cohesion

While this last dimension is not completely orthogonal to the task interaction dimension, it is sufficiently different that it is considered separately. It is not surprising that some groups collaborate on tasks more easily than others. When collaborating on a task, the group draws on resources beyond the immediate task to reach the goal. Some of these resources may be viewed as social capital. Social capital is operationally defined as the highest level of group cohesion represented by the existence of expected reciprocity in the group. There are four levels of group cohesion:

1. **Awareness** is the minimal requirement for group work. It represents little outside support for the task, but awareness allows coordination.
2. **Acknowledgment** is the recognition in the group not only that there are different contributors, but that they have different talents and needs. At this level, there may be known differentiated roles and talents.
3. **Commitment** exists when the individual actively contributes to the goals of the group. A commitment is made to the group by offering resources that will move the group closer to the collective goal.
4. **Reciprocity** exists when group members, based on relationships with other members, feel an obligation not only to the abstract group goals but to the individual members.

We suggest that recognizing where a situation resides among the three dimensions can provide insight into what types of tools are appropriate to rebuild the social periphery that is often lacking in collaborative systems. Our goal is to experiment with these dimensions to determine which tools are appropriate for given situations.

System Design: An Awareness Agent Example

In building a system for collaborative authoring, system design focused only on the focal task has proved less than adequate. Usability studies of system failures have pointed to the need to account for some aspect of the social periphery or border. Design changes, intended to increase

task interaction and group cohesion have been incorporated in a number of subsystems. One system refinement, intended to support low level group cohesion and task interaction, is an awareness agent. The evolution of the agent is briefly outlined below.

The awareness agent provides a bitmap image of users who are currently active in the system. Bitmap images appear and disappear as users connect and disconnect. Clicking on a bitmap sets up a talk session with that user. Like other awareness systems, as opposed to conferencing agents, it represents a low bandwidth demand on the system.

The framework suggests several ways awareness and cohesion might be enhanced via an agent of this type.

1. A small region at the top of the bitmapped image might be used to display a short (10-40 characters) scrolling line of text. This would enable group members to annotate their images with their names, a short message, or to quickly exchange information that may be pertinent to their task. This would give group members more information and may help to increase awareness and cohesion.
2. System-generated information about user activity could be displayed over the bottom portion of the bitmap. This could be very general such as "editing", "reading", "commenting", etc. It could also be more specific, giving information about the document and time on task. Giving detailed information may allow group members to help each other more efficiently. On the other hand, too much information may increase cognitive load.
3. System-generated information may be used to establish an activity measure based on user/system interaction (i.e. key strokes and button presses). Based on the data, the bitmapped images might be modified. An "active" user would have a crisp and bright image; an inactive user image would be faded. This feature would provide a general indication of user status. We think that this method of presenting a user's level of activity may be easier to apprehend than reading a textual display. (We find that users make a similar judgment now using a tool called "Private Eye" which provides a longitudinal view of general user activity.)
4. A polling and averaging function might be used to assess group status. A rating scheme might allow members to make an assessment -- e.g. "Feel Great", "OK", "Working", "Lost", "Frustrated". The average of these values could be computed by the system and fed back to the group. The display might take the form of a tint on the overall bitmap. Such a feature would allow the individual members to contribute anonymously and to have an impression of the entire group's shared attitude towards the task.

All of these features are designed to increase group members' awareness of the rest of the group. This may help to generate a feeling of group membership among the synchronous users of our system, although they may be geographically distributed (Moreland & Levine, 1992). By facilitating a more cohesive group structure, we hope to indirectly increase the social capital generated between the group members.

Methods and Metrics for System Evaluation

Belonging to a group or community can induce a set of expectations in group members related to contributions, obligations, reciprocity, etc. and that other activities may be seen as trading on the value of this "social capital". Putnam posits that social capital increases civic engagement (Putnam, 1995). Coleman suggests that social capital reduces the cost of doing business, accessing information, or establishing community norms. A number of studies (Coleman, 1988; Liang, 1994; Boisjoly, et. al. 1995) have included measures of social capital, but few of them use metrics we can employ for collaborative systems.

The measures that we plan to use are similar to those employed in other studies of ad hoc group performance (Finholt et. al. 1990). Questionnaires will be used to assess perceptions of the group related to group commitment, individual performance, cohesion, coordination and responsiveness. These self reports, compared across control and experimental groups may provide an indication as to whether a given subsystem has an impact of group cohesion and social capital.

Quantitative measures include many things that can be collected by the system without the need to explicitly query the subjects. These include time to completion of task, time to completion of subtasks, number of interactions between individuals, duration of communication events, number of comments on a document per participant, number of characters contributed by each person, total time on project, etc.

The data will be subjected to a correlation analysis. The hypothesis is that self reports indicating strong group cohesion will be associated with better times to completion, higher numbers of interactions, etc. among members. Additionally, there will be a significant performance difference between groups that have border support and those that don't.

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