Awareness Mechanisms for Coordination in Asynchronous CSCW

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ABSTRACT

There have been very few studies dedicated to awareness mechanisms for asynchronous group interaction. Besides, most mechanisms do not differentiate the support provided to group members according to their role. This paper presents a discussion about awareness mechanisms required to support coordination in group interactions when members work asynchronously. Several mechanisms are described and the implementation of some of them is examined.

1. *Introduction*

Awareness mechanisms are essential to group support systems in order to transform irregular interactions of group members into a consistent and perceptive performance over time. This is important whether members work synchronously or asynchronously. However, most research on awareness has been dedicated to synchronous interaction, with little care for the problems in asynchronous work. Although the objective is the same in both cases, the type of awareness and the corresponding mechanisms are different. When group members work asynchronously, awareness mechanisms become crucial to their interactions, because participants are not connected all the time.

Besides differences due to the interaction mode, awareness mechanisms should vary according to the role played by a group member. A member who is playing a coordination role requires a different type of data about the group activities. If the group coordinator has available mechanisms to provide him with awareness on the events relevant to his role, he probably finds easier the task of leading his group to a successful accomplishment. This paper deals with the problem of designing awareness mechanisms for coordination activities in asynchronous interactions.

Many of the examples provided in this paper are taken from the authors' experiences with the development of an asynchronous system for decision meeting preparation [BELLA95, BELLA96, BORGE99]. The system handles a discussion database, in which the information is stored in an extended IBIS [KUNZ70] structure. There are two main implementations of the system [CAVAL97, ESPIN97] .

Few awareness mechanisms for asynchronous interactions have been presented in the literature [SOHLE98, DOURI97]. Yet, some of them deal with the very basic notification mechanisms that are manually generated and therefore inefficient. It will be argued a cooperative system should provide a large set of awareness mechanisms, most of them designed according to the needs of the cooperative application or the roles played by participants in these applications.

Although the role of coordinator in group activities has been extensively researched [MALON94, SCHMI96], awareness mechanisms intended to help coordinators to perform their tasks have been

marginally studied. High levels of conflicts, premature decisions and lack of participation are only few situations requiring an immediate coordinator's intervention. The group may reduce its effectiveness and efficiency without mechanisms to make coordinators aware of such circumstances. These mechanisms are particularly important in asynchronous interaction.

Asynchronous coordination has distinctive features from the synchronous one. First of all, in synchronous interaction there is no danger of irrelevant messages from the coordinator. In asynchronous work, messages from the coordinator have to be *in context* because the recipient should not be interrupted with (temporarily) irrelevant notifications if he is participating in another part of the joint work. Secondly, synchronization of certain parts of the work may be hard to achieve in asynchronous work. For instance, it is a coordination task to make sure a participant is aware that a third participant's work progress is only possible after receiving the second member's contribution; moreover, the second participant may have not logged on for a certain period of time. A third difference lies in the time frame for evaluation of the work done: while in synchronous interaction, the evaluation can be done on-line, in asynchronous collaboration, the work performed can only be meaningfully assessed over extended periods of time. Finally, the coordinator is (in general) not around all the time in asynchronous work and thus, much coordination information must have been given in advance or made available for consultation.

1. Awareness for Coordination

On group interactions we can identify the need for activities related to make the group working well and focusing on their tasks. Table 1 lists the most important activities a coordinator has to perform to achieve his goals. For each activity we provide the symptoms indicating the need for some action from his part, and the problems the group may have if a corrective action is not carried out.

Some previous works have recognized the need of awareness information specifically intended for coordination. A few of the most representative ones are iDCSS [KLEIN95], CRC [MACAU96] and Interlocus [NOMUR98]. An interesting issue concerning awareness for coordination, which must be dealt with, is the privacy the individuals have and which is compromised with the awareness information [HUDSO96]. Actual work with a groupware system (NOTES) found people worried about being observed by managers [ORLIK96].

It is clear that some summarized information is useful for the coordination function. In a meeting preparation system [ref], for instance, the coordinator needs to know which parts of the meeting agenda have not been discussed in order to incentive participation in those items. The summarized information may take many forms: averages, medians, maxima and minima, totals and histograms may be some quantitative measures of information. Information may also be qualitative: total or partial coverage and tasks accomplished or not are examples of this type of summaries.

Some summarized information may induce undesirable behaviors from participants. The example of a coordinator observing patterns of logging on to the discussion may have a simple response from the participants to maximize their performance in this respect: keep connected all the time. Clearly, if "pattern of connection to the joint discussion" is designed to be a useful information, it will be so only if combined with other measurements. The awareness information for coordination provided should be considered as indicative of a *possible* need for a coordinator's action, due to ways in which people interact.

Motivate ideas. The coordinator must be aware of parts of the joint work lacking creative contributions. The system may help by informing the coordinator which portions of the work do not have any submissions. This is not useful when there is just one idea, which is repetitively re-stated, but in other cases, the information may be valuable. This information may be provided for the current time (summarized snapshot) or over time (history of contributions over a specified period of work). The information may be obtained for the group or just for a specific participant. In the latter case, it is important to notice people have very different ways of participation and numbers do not mean much in this respect.

Coordination Activities	General Description	Symptoms that indicate the need for action	Problems that will cause
Motivating Ideas	Induce the birth of new ideas	Absence of ideas or replicas to other member's ideas	Poor or lack of results; poor participation
Keep Morale High	Keep group members motivated to group activities and to achieve goals	Too much individual work; low level of interaction; non-constructive conflicts	Few benefits; disbelief in team work; high level of competition
Manage Interaction	Keep team working efficiently	Low level of commitments; tasks not performed by the deadline	Disruption of group activities; unbalanced work distribution
Provide Ways and Means	Logistics	Bottlenecks, pending activities; high level of dependencies; waiting	Disruption of group activities; low performance
Consolidate Ideas	Abstract and organize groupwork, relate tasks to high level goals	Loose ideas; tasks not explicitly related to goals	Lost contributions,; low level of interaction; low motivation
Keep Group Harmony	Maintain interaction in a high level; detect and resolve conflicts	High level of conflicts; strong language; aggressiveness; time wasted in disputes	Low level of cooperation ; inhibit participation
Provide Technical Leadership	Keep the level of the results high; avoid early adoption of solutions	Superficial statements; low level of discussion; early adoption of solutions	Low quality of results; work discarded
Quality Control	Keep the process on track of defined standards; guarantee compatibility of documents and results	Lack of standards; standards not adopted Groupthink; lack of alternatives	Non repeatable processes; no standards used on results

Table 1 - Group Coordinator's Activities for Collaborative Work

Keep morale high. The coordinator may be advised of certain undesirable group behaviors. For instance, pairwise interactions may be a signal of some problem between the two people involved. The coordinator may check the contributions and detect if there is a negative conflict in the making. On the contrary, in some systems it may also be possible to determine people are not referring to the contributions of specific co-workers: a possible symptom of ignoring each other's work.

Manage the interaction. The system may provide much information about a participant's performance within the group. As already stated, this information must be handled with care. This information may help detect a certain participant is behind schedule or has not met the deadline to accomplish a task. The delay may be justified and in most cases it would be a bad idea for the coordinator to send a message complaining; it probably would be better to offer help or suggest a new feasible deadline. The system may also help to detect inequities in the workload and the coordinator may try to re-distribute it. Again, it is natural people have different abilities and it may be impossible to achieve "perfectly even" workload distribution.

Provide ways and means. The system can detect certain anomalies in the development of a joint work. For instance, various participants were actively contributing in certain part of the joint work, but suddenly, this activity halted. This stop may be natural because participants reached consensus, but it may also be the case participants required data and nobody had it. The stop may also be due to a submission which discouraged anyone else to keep contributing. In the latter two cases, the coordinator should be aware. Suspicious cases like the example should be informed to the coordinator for investigation and eventual action.

Keep group harmony. It is normal some negative conflicts arise within a group. A common source of them is the identification of ideas with their authors; when the idea is criticized, its author feels he himself is indirectly attacked. Also, there may be threatened interests involved in any design or discussion. How could the system help detect conflicts of this nature? One approach is to try to find rough language phrases in contributions. This detection may not work well because many derisive comments can be made with normal language constructs. It may turn out easier and more effective to observe pairwise interactions or sudden interruptions of dialogues, as suggested above.

Consolidate ideas. The system can detect isolated ideas: contributions having no connections with other argumentation. Also, if two contributions are similar and need to be merged into one. The coordinator may need to re-structure the joint work to order and consolidate the ideas.

Provide technical leadership. Poor discussion or few choices lead to poor decisions or solutions. The system can check whether or not several options were considered before a decision, design or solution was adopted. If the answer is no, the coordinator should be notified.

Perform quality control. Low quality solutions can also be a consequence of groupthink. This may appear as few proposals for a certain issue and many comments supporting them. One can infer people did not bother to state alternatives, either because they did not want to appear as troublemakers or disloyal, or because any other choice would have such few chances against the proposal made by a respected leader. The system can also detect this situation and notify the coordinator. Use of standards can also be detected in certain designs. If the components are not recognizable pieces, the system can advise the coordinator so that corrective action should be taken.

2. Awareness Mechanisms for coordination

One may think the greater the amount of information provided the better is the mechanism, but this is not true. When we are provided with excessive data we tend to disregard and neglect it [FURNA95]. Thus, information should appear at the right time and be as concise as possible to avoid information overload.

A few collaborative systems have implemented some awareness mechanisms for coordination. GroupSystems [NUNAM91] has the *opinion meter*, a voting mechanism oriented to get quick feedback from meeting participants. Group Work Environment [NGWEN96] and DOWN [PINO95] let see participants' preferences and provides two metrics to analyze them: consensus and agreement. Timewarp [EDWAR97] provides a set of "lenses" allowing to see some awareness data.

Level of participation (Participameter). A cooperative work presumes people participate in other member's activities. It is not desirable members perform their tasks with little or no concern about what is going on in other activities. Therefore some level of snooping should be encouraged. A coordinator should be able to monitor this level of interest on other members' activities.

We distinguish between participation and contribution and propose different mechanisms to measure them. While contribution may be measured by the number of statements or tasks generated by a member to the group, the notion of participation is subtler. A group member might be participating by simply accessing other member's contributions. Although a group would not progress with only this kind of participation, this attitude is preferred to complete alienation.

Measure of group participation varies according to the task being performed. In a DSS, the number of votes cast by a member's proposals may measure his participation. In a discussion group, the total number of statements read may measure the overall participation. We can also distinguish between total alienation (group members who do not know what is going on) and the following of it from a distance (e.g., those members who read the headers of contributions).

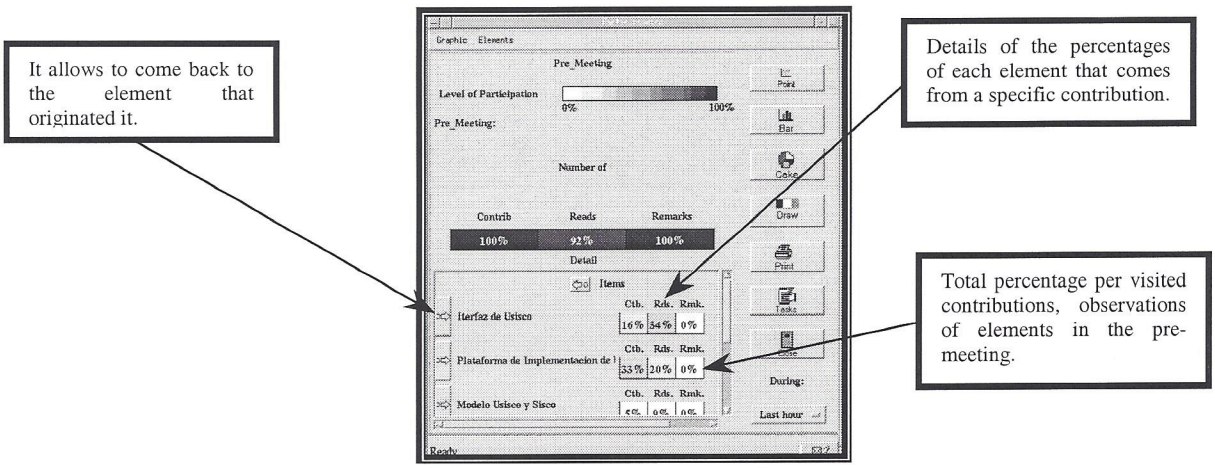

Figure 1: Main window of the "*Participameter*".

These behaviors should be presented to the coordinator in a summarized form. We proposed the *participameter* as the indicator of the group activity. In a discussion group, the *participameter* may show the level of participation as a percentage of the total participation. Given the total number of contributions, we can monitor in what percentage of this total is each group member running at a given moment. If this percentage is persistently low, it might indicate to the coordinator that some action becomes necessary. In a GDSS it may also indicate that a call for a ballot is premature.

Density of contributions. The contribution distribution should provide the coordinator a general appraisal of the number of contributions. After the coordinator is advised by the system of a low number of contributions, he can generate messages to encourage participants with, for example, devil's advocate provocative questions or assertions. A concentration of contributions on a certain issue at the expense of other issues should also be informed. In this case, the coordinator may act by closing the reception of new contributions to the over-worked issue.

Impact of ideas (*Impactmeter*). This mechanism tries to determine the impact certain ideas have in the group. A single idea may induce many contributions while another one may be considered by the group as irrelevant. Notice that impact does not necessarily imply quality. One strange idea may be a shock to many participants and trigger several answers.

Measurement of impact has already been studied in Information Science. There, the goal is to measure the impact a certain publication has had on the scientific community [GARFI79]. In our context, a simple measurement would be to count the number of subsequent contributions one statement has generated. Further improvements can include measurement of reactions over time (a quick number of answers may the symptom of a shocking type of contribution, whereas a sustained number of answers over time would signal a thoughtful type of contribution).

Some type of impact may also depend on the type of information being handled by the system. In a discussion, for instance, a high number of supporting arguments for a certain contributed position may imply the position is of a high quality. In a DSS, the number of votes a certain proposal receives may be a measure of its acceptability.

Level of maturity. When a work may be considered ready? We can either define a direct criterion to decide about it, like in quality control programs, or measure the level of satisfaction the group has reached about its goals. In either case, an artifact can measure this level of maturity. A prematurely interrupted discussion may induce poor decisions. An over discussed issue may be a waste of time.

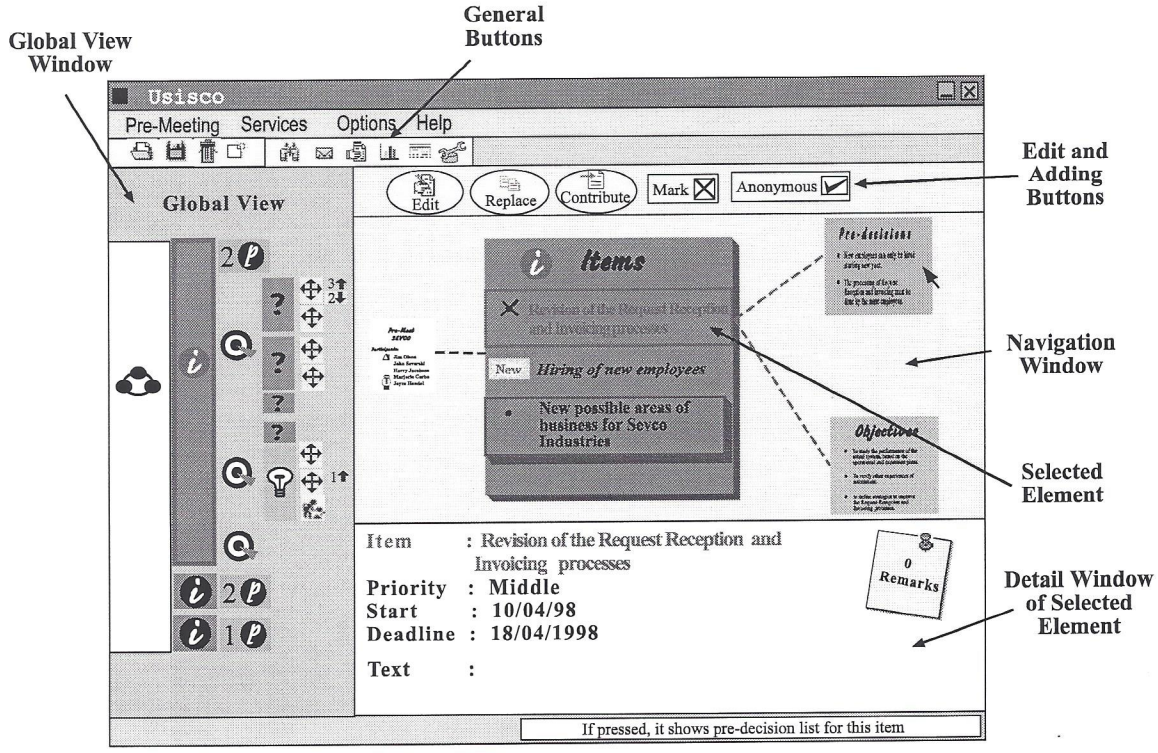

Figure 2 - Our system's global view (left) allows to see the density of elements

If a maturity criterion can be defined, the system should compare the resulting activity with the desired degree and let the coordinator know. Alternatively, the system may automatically initiate an opinion poll and present the results to the coordinator.

Level of conflict. Conflicts may occur in different ways in a working group. Some forms are beneficial and desirable to group activities, especially those related to divergence of opinions. Others, however, are destructive and should be resolved as soon as possible. The coordinator should be kept routinely informed about apparently total lack of conflicts, a symptom of "groupthink", and the possible presence of destructive conflicts.

Information and time of posting. Information may lose importance over time. In some cases it might be interesting to know the age of the stored information. For instance, an asynchronous discussion extending over a three weeks period may be analyzed by the coordinator at the beginning of the third week; if most of the information was contributed during the first week he might use that hint to try to determine whether the discussion is mature enough or it needs some re-activation. A summarized view of the database using visual cues is called for, since it is not practical to look at long lists of element creation dates.

Planning conformity. A group should always work with a plan. Without knowing the planned steps to an objective, it is difficult to measure progress. A good plan and its corresponding observance provide awareness of the future to members of a group, in special those playing a coordination role.

A good plan should also establish the interdependencies among tasks performed by group members. While a group member is interested in his/her performance and the related interdependencies, a coordinator is interested on the progress of the group as a whole. To detect overdue work and crucial activities deviations is of great usefulness to a group. This, however, can only be achieved if a group has a working plan, available to all group members and closely followed by the coordinator.

A task progress analysis based just on what has been done is not the ideal way to provide awareness to other group members carrying out interdependent tasks. As the work is not instantaneously recorded when doing asynchronous interactions, it is also important to know when the work is expected to be available to the group. Reporting preliminary achievements or tendencies to the group may also be important. These may or may not be in conformity to the original plan.

3. Conclusions

We have claimed coordination activities require a specific set of awareness mechanisms normally unavailable in groupware applications. We analyzed the requirements of such awareness mechanisms from the viewpoint of asynchronous interaction, another topic that has been neglected in the literature. This establishes the basis for further work either on how to obtain the summary information or on implementation issues.

It is essential the system provides the coordinator with the necessary information to best perform his tasks. Without appropriate information about group activities, the coordinator may either be unobtrusive or react erroneously to certain situations. In this paper we described which were those situations and the type of information indicating their materialization.

Besides analyzing these situations, we proposed some awareness mechanisms aimed specifically to the coordinator. A couple of these mechanisms have been implemented [ref]. It is very important that these mechanisms present summary and straight information in order to avoid the risk of information overload. This is one of the main characteristics of awareness information.

The effectiveness of such mechanisms in coordination activities has still to be ascertained. Experiments with group interaction applications should demonstrate the efficacy of the group under monitoring provided by these awareness mechanisms. These experiments should be carried out on future work. It is important to attend to the fact that what matters is the result of the group goals as a whole and not thAcknowlee specific task of the coordinator. However, we assumed that a good coordination is an essential condition for improved group's performance.

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