Common Context for Decisions and their Implementations

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Abstract

Decisions are frequently sent to implementers without the context that guided them. It should not be a surprise, then, that results are not as expected. The lack of supplementary information and a common context produces wrongly implemented or lost decisions. This paper proposes a solution to this problem based on groupware technology. In particular, a combination of tools including shared workspaces, process modeling with workflow and a discussion tool, is proposed. A case is used to illustrate the problem and its solution.

Key words: decision implementation, knowledge gap, workflow

There has been much emphasis on improving the decision making process but little attention has been paid to a correct and effective transmission of the decision-makers' intention to support the implementation phase following a decision. The gap between the end of a decision making process and its implementation activities may, in fact, turn the decision inconsequent, due to lack of interaction and negotiation between decision makers and those who will implement the decision. Often, decisions that are implemented without the necessary clarification and negotiation may generate outcomes, which are different from those planned at the time of the decision.

This paper addresses the causes for the gap that exists between decision makers and implementers around the complete understanding of a decision context and the form of implementation. It discusses why linking decision implementation activities to the corresponding decision meeting is essential to make the decision cycle fully successful. We claim that supporting the reach of a common context along the entire decision process with a computer system is both efficient and effective.

Although the need for relating decision meetings and the activities following them may seem obvious, cultural barriers and lack of appropriate tools induce just informal and very incomplete links. As a result, important decisions are not properly or timely implemented. It appears, then, that all efforts to make good decisions with Information Systems and/or Operations Research models and techniques are threatened by deficient implementation support. Therefore, there is a missing link between decisions and their implementations, which needs to be well understood and supported.

The gap between the making and the implementation of a decision can be generalized to a knowledge management problem, especially when it refers to the tacit knowledge. One of the main issues in the knowledge management approach is the different levels of abstraction each player has when he is performing inter-related tasks. The abstraction level can be generalized to a context problem. Therefore, knowledge exchange and context are two key issues to understand the problem and the solution approach. These issues are addressed in Sections 3, after the problem illustrated by a real case situation is reported in Section 2.

We identify three problems in the connection between a decision and its implementation. The first and possibly the most visible problem is when decision makers detect that implemented results differ from what they expected. A second problem is the typical insufficient information attached to the decision. The third problem is the fact decision makers and implementers have different contexts. These three problems generate the definition of five main requirements to the proposed solution.

The approach we chose for the proposed solution is the use of a combination of tools. These tools are: a shared workspace, a discussion supporting tool, a process-modeling tool and a Workflow Management System (WfMS). The latter one will be used to control the actual decision implementation. The process modeling tool will serve as a common context for the decision as viewed by both teams. This context will enable decision makers and implementers to discuss over a common basis. The discussion supporting tool will enable the clarification of issues which may arise during both the decision and the implementation processes. The shared workspace will enable both teams to bring their specific contexts to a common understanding. The group of requirements and the solution approaches are detailed in the fourth section of the paper.

Besides the four initial sections described above, the paper has three other sections. Section 5 has a general discussion on the suitability of the solution approaches. Section 6 presents an overview of related work. Finally, Section 7 concludes the paper.

1. The Problem

1.1. The knowledge gap problem

The knowledge gap between two individuals or two groups of people is well-studied in the literature. There are many proposals to fill this gap, mostly based on knowledge transfer. “One of the reasons that we find knowledge valuable is that it is close – and closer than data or information - to action” (Davenport and Prusak 1998). Knowledge can be evaluated by the decisions to which it leads or actions that it conducts them. Therefore, knowledge should

be shared when decisions and actions are passed from one group of people to another one. The more the knowledge is transferred between people working on inter-related tasks, the smaller is the possibility of misunderstanding. However, since knowledge usually resides in people's heads, it can be difficult to trace the path between the various phases of a decision cycle, in some cases generating a gap (Davenport and Prusak 1998).

Knowledge in many cases exists in the minds of experienced workers who can recognize familiar patterns and make connections between past and current situations. The importance of experience in knowledge is one indication of the suitability of using knowledge to deal with complexity. Knowledge is not a rigid structure that excludes whatever does not fit (Davenport and Prusak 1998). However, experience is not enough when dealing with complex situations. Actually, in some cases it may create barriers, inhibiting the participation of less experienced people. In a decision cycle, the knowledge gap is assumed to be filled by experience, i.e., experienced implementers will remember the actions they have to do to implement the decision correctly.

One first step towards incorporating difficulty in the analysis of knowledge transfer is to recognize that a transfer is not an act, as typically modeled, but a process. Szulanski (2000) analyzed how characteristics of the source of knowledge, the recipient, the context, and the knowledge itself affected knowledge transfer within organizations. He found that the importance of these factors varied over stages of the transfer process. Factors that affected the perception of an opportunity to transfer knowledge predicted difficulty of transfer during the early initiation stage. By contrast, factors that affected the execution of transfer, such as the recipient's ability to absorb knowledge, affected difficulty during the implementation phases.

The literature reports several examples of gaps related to the various levels of abstractions between two groups of people assigned to inter-related tasks (see, e.g., Costa, Antunes and Dias (2000a) for a study on the meeting report process). These situations occur in many fields, such as Software Engineering (Rus and Lindyall 2002), Organizational Computing (van Daal, de Haas and Weggeman 1998), and Medicine (Tonelli 2001).

A gap between two stages of a process is common place in many environments. Handfiled et al. (2001), e.g., reported the gap that exists between ERM (Environmentally Responsible Manufacturing) supporters and the users of ERM tools in terms of expectations, perceptions and orientations in a product design process. Similar to our approach, they also propose a process map, although the process steps are designed to support their specific tasks.

Another view of the information gap problem is related to the modeling of uncertainty that exists between what one knows and what one would like to know about an object. A common approach in this case is that based on fuzzy logic. The uncertainty about the information gap has to be modeled and quantified using fuzzy membership functions (Hipel and Ben-Haim 1999).

Although it is tempting to look for simple answers to complex problems and to deal with uncertainties by pretending they do not exist, knowing more usually leads to better decisions than knowing less, even if the "less" seems clear and definite. Certainty and clarity often come at the price of ignoring essential factors. Being both certain and wrong is a common occurrence (Davenport and Prusak 1998).

1.2. A case that illustrates the problem

The Trucco Company needs to install a Call Center to support one of its marketing campaigns to be launched next month. The project requires 10–12 work desks and the Project Manager decides to request 14 workstations to support the operation. She justifies the two additional pieces of equipment as back-ups in case of failure. She sends the request to the company Board. The request includes the equipment specification, an estimate of the cost and a justification for the number of workstations. She also informs the Board the Call Center operation will start operation within 35 days from that date.

The Board discusses the request in its weekly meeting. It decides to approve the request and establishes the amount of US$ 14.000 (the estimated amount) as the project budget, after a brief discussion on the need for the two additional workstations and the cost estimate. The decision is passed to the Purchasing Department together with the original documentation prepared by the Project Manager.

The Purchasing Department sends a RFP to its traditional suppliers. In view of the project deadline, a Purchase Officer defines that the equipment must be delivered within 15 days. The RFP contains the specification, deliverable conditions and the cut-off date, i.e., when the company expects to receive the proposals. Two of the three conditions have been established: the specification and the delivery date. The third condition – the budget – will be verified when the proposals are known.

After 3 days (at the cut-off date) the Purchasing Department received four proposals. Proposal A agrees to deliver the equipment as specified within 15 days, but it presents a price exceeding the budget in 20%, i.e., US$ 16.800. Proposal B also agrees with the deadline but it offers an alternative supply more powerful than specified, with a price exceeding the budget in 50% (US$ 21.000). The third proposal (C) presents the exact specification at a price within budget, but it requires 30 days to deliver the 14 workstations. Finally, Proposal D requires 20 days to deliver the equipment, it offers a very attractive price (US$ 11.200) but it does not comply with the specification (it offers a 20 MBytes hard disk, while the specification asks for 40 MBytes).

What happens next? There are several possible outcome scenarios. We describe three of them below. In scenario I, someone from the Purchasing Department believes the budget and the specification are the most important constraints and decides in favor of Proposal C. He thinks projects are frequently late. The Purchasing Officer also reasons the Purchasing Dept. arbitrarily established the 15-days, anyway. After two weeks, the Call Center Project Manager asks the Purchasing Department about the order and finds out the project will be late. Knowing she will not be able to accomplish the project goals, she angrily complains to the Board. She also tells them the campaign will probably be a fiasco.

In scenario II, the Purchasing Dept. concludes no proposals match the project requirements and it decides to check with other suppliers, strengthening the deadline and the specification constraints. After three days it receives proposals very similar to the first round. As a result, this scenario turns to one of the others, three days late. Another variation of this scenario is as follows: suppose one of the new suppliers has a proposal satisfying all requirements. The purchasing order is awarded to this supplier. It is not clear the equipment will arrive within 15 days (it is an unknown supplier). Let us assume the equipment arrives

within that period. However, there still may be problems: the Technical Support Dept. may find the quickly estimated time for installation to be too tight (the 15 days period was an arbitrary decision by the Purchasing Officer).

Scenario III is complex. The Purchasing Dept. believes Proposal D – low price, but with insufficient features – is a good opportunity, but before making a decision, it puts together all proposals and asks the Technical Support Dept. and the Call Center Project Manager whether the specification can be relaxed. Technical Support is not aware of the purchase and it is not able to respond, but it sees Proposal B as a good opportunity to deal with a request from another project for upgrading its equipment. The Technical Dept. envisages a plan in which Proposal B equipment could be acquired for this other project and its equipment, in turn, could be transferred to the Call Center Project. By coincidence, the specification matches the requirements. The Call Center Project Manager, on the other hand, prefers the simplest option, i.e., Proposal A. She thinks she can get a quick approval on a 20% project budget increment. A higher authority should then decide; this takes time (e.g. the Board meets once a week) and thus, some of the Proposals may be unfeasible by then.

This example was taken, with some modifications, from a real case occurring at a medium-sized company in Brazil. Two of the authors were consulting for that company and they had the chance to talk to some of the participants. That is how we built the scenarios.

In this example, we can observe the gap problem between a decision and its implementation. If people implementing the decision were the same who initially made the request, then probably no misunderstanding would have occurred. But of course, a small group of people cannot do everything within a company. However, even the same group may have problems when they change their working contexts. In other words, looking at a decision from its context is certainly different from viewing it from the implementation context.

2. Analyzing the Problem

The problem we described in Section 2 is more common in organizations than we may suppose. The gap that exists in these cases occurs due to a difference in context between the decision makers and the group in charge of the implementation of that decision. Lack of a common context, in many cases solved by a good communication mechanism, is the main culprit for this gap.

The typical way of realizing something is wrong with the implementation of a decision appears when the results are different from those expected by decision makers. In our example, suppose the outcome scenario is No. I. There is not much to be done: the campaign will be late and probably it will be a failure.

Let us further explore this assumed outcome. In the investigation process, the Head of the Purchasing Dept. will probably punish the person from his Dept. who chose option C. Investigations often end up concluding how operators failed to notice certain data, or how they did not adhere to procedures that appeared relevant after the fact (Woods 2002). Is that right? Perhaps not: it was not the purchasing officer's fault to be unaware about the importance of launching the campaign on time. He did what made sense given the situational indications and organizational norms. Besides, mismatches between written guidance and operational practice always exist (Dekker 2002).

Reactions to failures such as this focus firstly and predominantly on those people who were closest to producing or to potentially avoiding the mishap (Dekker 2002). Punishing people who work at the sharp end will probably hurt their confidence at work and thus, their initiative to make decisions will be reduced. Perhaps decisions were not as well-organized or well-designed as people had hoped; what everyone seems to ignore is that the environment is not facilitating people to make the right choices.

The symptom – results different than expected – is not all the sickness within the company. There may be lack of detailed information about what was required from the Purchasing Dept. If the request had specified the deadline was extremely important to be met, then obviously the outcome would have been different. Sometimes, then, detailed information from decision makers to implementers may help to fill the gap.

In some cases, nevertheless, even detailed information is not enough. Decision makers cannot imagine all the implementation choices there may occur and thus, they are unable to produce all possible information that may eventually become relevant. Failures can only be understood by looking at the whole system in which they took place. What is actually happening is people have different contexts and therefore, they do not work coherently (Agostini et al. 1996).

What is context? Context may be defined as a complex description of shared knowledge about physical, social, historical, or other circumstances within which an action or event occurs (Brézillon et al. 2004). For a step of a task, Brézillon and Pomerol (1999) distinguish the part of the context being relevant for the current performer's focus of attention from the irrelevant part. The latter part is called external knowledge. The former part is called contextual knowledge because it has strong relation to the current focus although it is not directly considered in it. Always at a given focus, part of the contextual knowledge is proceduralized. This proceduralized context is a part of the contextual knowledge, which is invoked, organized, structured, and situated according to the focus and used while performing the task at this focus.

Context evolves with focus. This dynamics of context can be observed as the movement between the contextual knowledge and the proceduralized context. Thus, a part of the context is static, e.g. the context at a step of the focus of attention is defined by a fixed number of contextual elements and a fixed proceduralized context, but the overall focus of attention is associated with a dynamic context through this movement between the contextual knowledge and the proceduralized context. Static and dynamic parts of the context are intertwined and must be considered jointly.

Brézillon (2003) points out it is possible to organize various types of context in a two-dimensional representation: in depth first, from the more general to the more specific, and in width first as a heterogeneous set of contexts at each level. In "depth first", contexts differ by their granularity. For example, a company context (with its tradition, habits, rules, etc.) is more general (at a higher level) than the context of an employee. In this case, context has strong relationships with the enterprise organization in terms of roles (Brézillon and Marquois 2003). According to its depth, a context contains more general information than contexts at a lower level. However, context at one level is not a simple instantiation of the context at the upper level (Brézillon 2003). A context can be represented by a system of rules (constraints) for identifying triggering events and for guiding behaviors in lower contexts.

A context at one level contains contextual knowledge when the application of rules at the lower levels develops proceduralized contexts. A context (the contextual knowledge part) is like a frame of reference for the contexts below it. For instance, a person visiting Costa Rica knows the language spoken there is Spanish (contextual knowledge in the context of the country), and he pays attention to speak this language there, assuming he knows it (proceduralized context in his individual context).

In "width first", each actor has his own context. An actor's context contains information on the reasons for his actions, the results of his activities, etc. The context of the software agent possesses information on the available means for the accomplishment of the task, the access restriction to the databases, a user model, etc. For a given granularity of context, i.e. the level in the hierarchy, there is thus a set of contexts rather heterogeneous because the context varies with the element (a person has a different context from the one of another person) and also with the associations that this element has with the upper and lower level. The horizontal movement from one individual context to another one goes through either the upper context (e.g. the group context) or a lower context (e.g. the project context). Note that at the group level, a group is, recursively, like an actor with his individual context and interacting with other groups in other contexts.

Pomerol and Brézillon (1999) discuss the transformation of contextual knowledge into some functional knowledge or causal and consequential reasoning in order to anticipate the result of actions. Data are facts, which have not been analyzed or summarized yet (e.g., see Watson (2002)); information is data processed into a meaningful form, and knowledge is explained as the ability to integrate the information in the person's body of knowledge.

We can easily explain the behaviors of some of the Trucco Company people in the case we are analyzing considering the context. In Scenario I, the Purchasing Officer has a context including mainly previous purchases (impact, results, typical flexibility in delivery times), knowledge about the current suppliers (reliability), knowledge on the Technical Support Dept. (time to install computer-related equipment). With this context, he chose option C, thinking that would be the best choice for the project and the company. In Scenario III, note personal contexts influence choices. The Technical Support person looks for optimizing equipment for all his clients; his context includes the equipment features required by all projects he is currently supporting, previous experiences, etc.; it is not clear he is taking into consideration the urgency for the current project. The Call Center Project manager's context has knowledge about campaign effectiveness, competitors' actions, campaign messages, customers' requirements, etc.; for her, the equipment purchase should be trivial, an almost automatic activity, and differences in equipment costs are secondary. For any of the scenarios, the Board context is not clear: how important is the project for the company? How does it relate to other company efforts? How relevant are these procurement budgets?

It is seldom the case that only one goal governs what people do. Most work on organizations is characterized by multiple goals. Depending on the circumstances, some of these goals may be at odds with one another, producing goal conflicts (Dekker 2002). The same rationale can be applied to people's context. What is important is to reduce the context mismatch, achieving some level of commonality of contexts.

3. A Solution to the Problem

A solution to the described problem necessarily includes people to be aware of it. It is useless to provide technology if people do not believe there is such a problem: they simply will not use the systems. A second requirement is a collaborative attitude from workers, in particular, some appreciation concerning what others do for the company success. We can then consider technology.

To provide a complete technological solution to the problem, five main requirements should be considered: to provide a way for defining a decision implementation plan – the sequence of activities necessary to be performed in order to guarantee the decision; to directly associate decisions to their implementation activities; to follow-up these activities; to support the interaction among decision makers and performers; and to provide information about the actions being undertaken to all those who have a role in the complete process or who will be affected by the decisions being made.

These requirements were initially addressed in an environment called SUPRE (Post-Meeting Supporting System) (Mendes 2003). SUPRE calls for a combination of supporting tools based on workflow technology and discussion support. SUPRE functionalities and how tools are combined to support them are described in the sections below.

3.1. Planning the decision implementation steps

Workflow has been used to represent processes and to provide a control of its execution (Jablonski and Bussler 1996). By modeling the process, it provides both users and process players with a general view, yet abstract in some cases, of the activities involved to achieve job completion (Smith and Fingar 2003). It provides managers with the evolution of the work by controlling process execution, so they can take action in the presence of an unexpected behavior (van der Aalst and van Hee 2002). WfMSs (Workflow Management Systems) have been used mainly in production processes. A production process is a repeatedly occurring one with little variation from its expected flow. When the variation can be predicted, the process designer represents it in the form of optional paths generated by decisions during the process.

In our solution we make use of the process model and the workflow technology in order to represent the implementation steps, which materialize a decision. As discussed by Borges, Pino and Valle (2005), a proposal can be submitted together with the process description supporting its implementation. Decision makers can also generate the process model to represent how the job should be done. Alternatively, the implementation team can provide the process model under request from the decision makers. The decision implementation model is a way to achieve a common context and to support interaction, through a shared workspace among the people involved in the decision (Gutwin, Roseman and Greenberg 1996). The different contexts in this situation are the one concerning the decision makers and the one affecting the decision implementors.

Figure 1 shows an example of an initial process model representing the steps and the people in charge to purchase a product in response to a request from the Project Manager. We

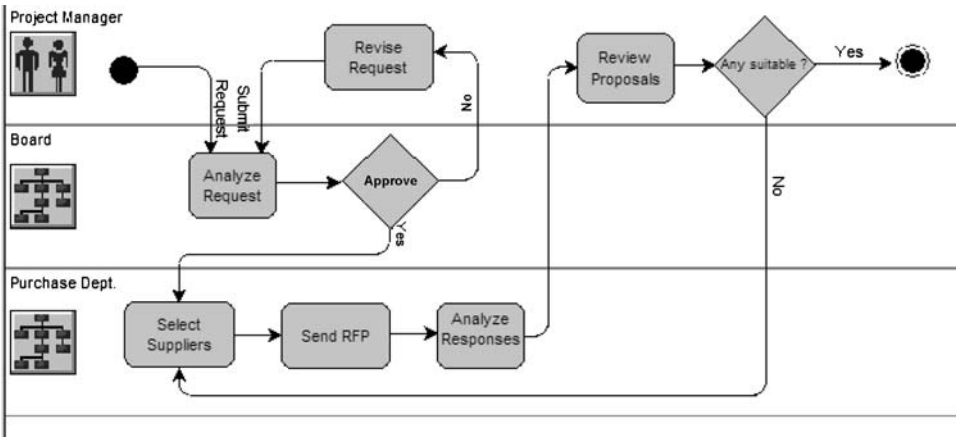

Figure 1. Initial process for purchasing equipment.

can note that in this model, the Technical Dept. is not involved because the Board assumed it has been done by the Project Manager before requesting the purchase of the equipments. Also, there is almost no interaction among the three involved groups.

The advantages of this approach are twofold. First, the implementation plan is a starting point for the negotiation, in case one does not agree with the plan. The plan can be annotated and modified in response to the issues raised by involved people. Second, all divisions related to the decision have a clear view of the entire implementation plan and their responsibility in it. Besides, decision makers can learn from mistakes in the past and include the necessary adjustment in future decisions. In some companies, the plan could also serve as the input for process enactment, which will provide implementation follow-up (Borges, Pino and Valle 2005).

We claim the implementation process model is a better way to bridge the gap between decision makers and implementers than the traditional forms: textual messages or informal communication, e.g. by the phone. Besides, it provides persistent memory and awareness to people not directly involved in the interaction.

In the Trucco company case, an implementation plan such as the one depicted in Figure 2 could have been designed and have its execution controlled by a WfMS. Instead of passing the decision implementation only to the Purchasing Dept., the Board would activate this implementation plan. Based on previous experiences, the plan predicts at least some of the scenarios, preventing some undesirable outcomes, such as Scenario I. The same would happen with Scenario II, unless agreed by Project Manager. As for Scenario III, the plan would support the discussion about the four proposals.

In SUPRE, the main functionalities of a workflow management system (Lotus Workflow (2003)) provide the possibilities for defining decision implementation processes. A process modeling tool – Lotus Workflow Architect – is used by decision makers in order to define the decision implementation steps from scratch, according to the decision needs and context.

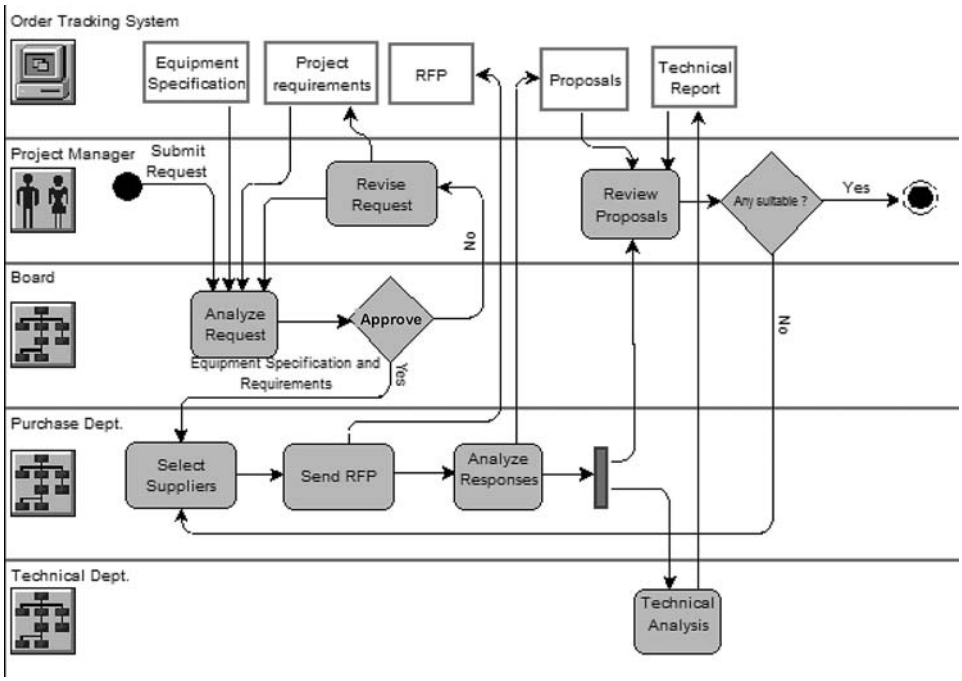

Figure 2. The equipment purchase implementation plan revisited.

The initial implementation plan is described using the Lotus Workflow Architect with the aid of pre-defined processes: the *process beans*. Those pre-defined processes are drawn based on the analysis of typical decision plans within the domain of the organization. In our case, the purchase process could have been designed as a result of previous purchase operations. In any case, the environment allows the use of the entire process or part of it. It also allows, of course, the design of a completely new process.

SUPRE also collects patterns for generic post-meeting activities such as: elaborating the meeting record; search for information; elaborating a document or report; validate information with someone or somewhere; disseminate an information, etc. Process beans can be adapted and combined for each particular decision context, aiding the implementation planning activity. An example of the Lotus Architect environment augmented by a set of process beans is shown in Figure 3.

3.2. Following the decision implementation plan

As shown in our example, the decision reflects the interest of persons, groups and the organization. Generally, those who implement decisions are different from those who made

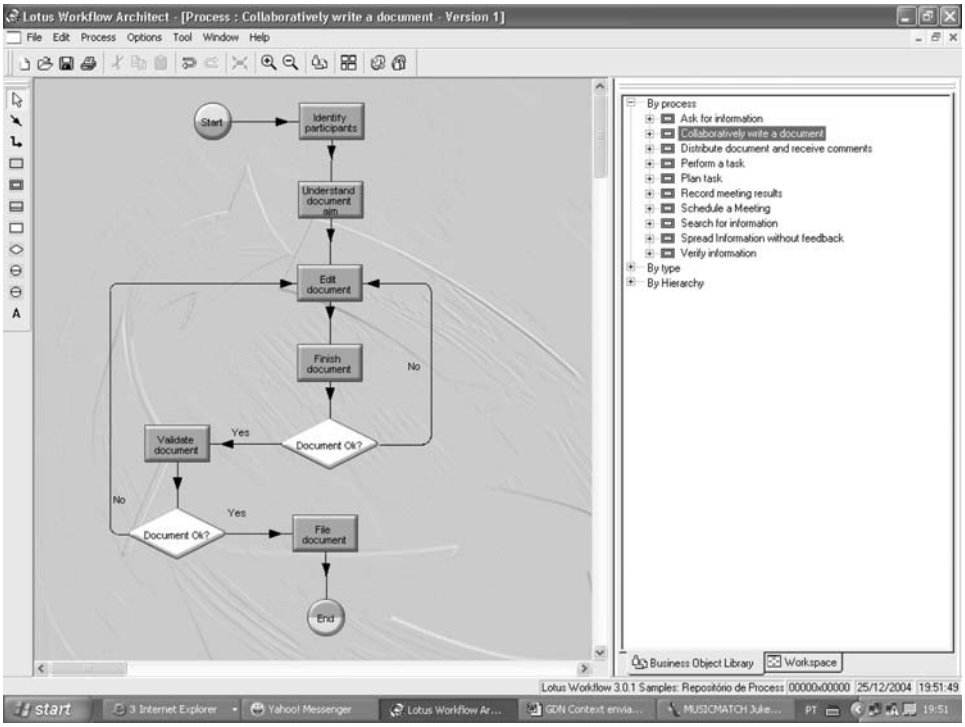

Figure 3. The Lotus workflow architect augmented by process beans.

the decision and this may cause decisions not to be implemented as planned. This lack of continuity may take decisions to be forgotten while being performed or even before they are implemented. In practice this often happens with simple decisions, e.g., disseminating information to a group.

After a decision has been made and assigned to a responsible person for its execution, the link between the decision and the implementation activities derived from it is frequently lost. The implementation becomes dependant on the organizational structure that will perform it and the rationale of why those activities have been executed – i.e., its context – is lost.

SUPRE allows the establishment of an explicit link between decisions and their implementation plans. Figure 4 presents the SUPRE user interface. It presents the results of a meeting as a list of decisions. Also, each decision is associated to an implementation plan. As described in the previous section, each decision implementation plan is a defined process in a workflow management system, and these processes can be started for enactment by the workflow engine.

Associating decisions to their implementation plans and later to its enactment, allows complete decision tracking. Additionally, it is possible to evaluate the enactment providing feedback of the decision status for those who made the decision. All this visibility helps

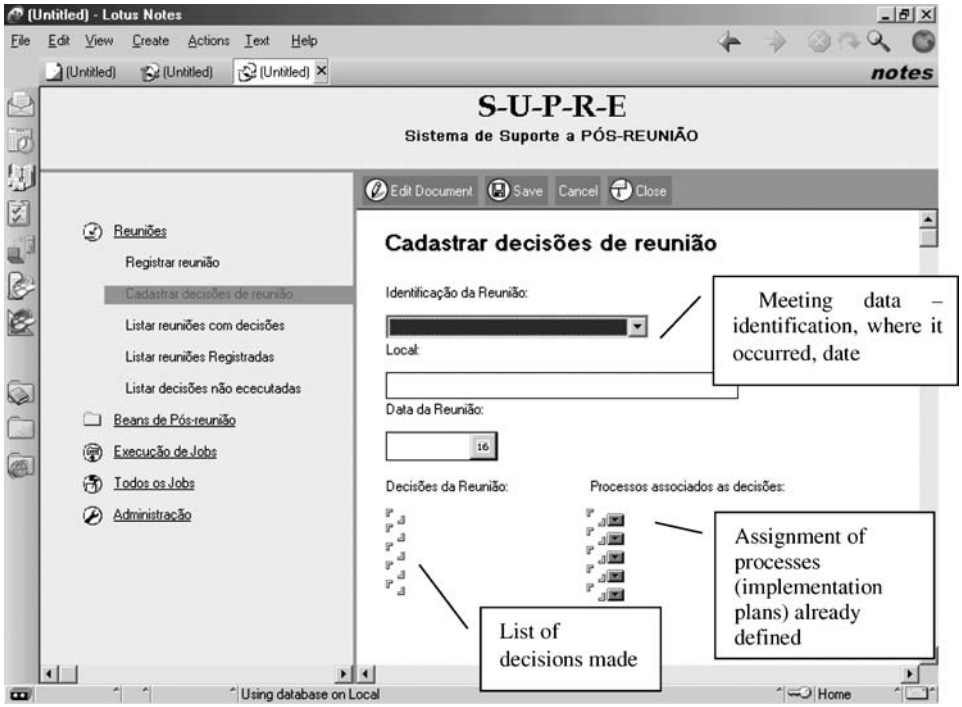

Figure 4. Associating decisions to processes.

to provide the necessary common context to decision makers, decision performers and the organization as a whole (Figure 5).

3.3. Supporting the interaction among participants

Throughout the decision and follow-up activities, participants will have guiding information and visibility to make them aware of the overall context of each decision. However, a large part of the common context relies on the discussions performed among participants at various points of this process. Participants interact and discuss during the decision process itself, while building and validating the implementation plan and later, after the decisions are implemented, to provide feedback on the decision results, the effectiveness of the decision and its implementation plan or even opportunities for improving the process. How do involved people argument around these options? How do they document that?

Again, a shared workspace is our preferred solution. In its current version, SUPRE can use Lotus Notes predefined discussion forums where participants establish topics and can argument on these topics. The advantage of having both the process design and the discussion forum under the same environment is that associations between elements of these tools can be easily made. Besides, the organizational structure used to represent the

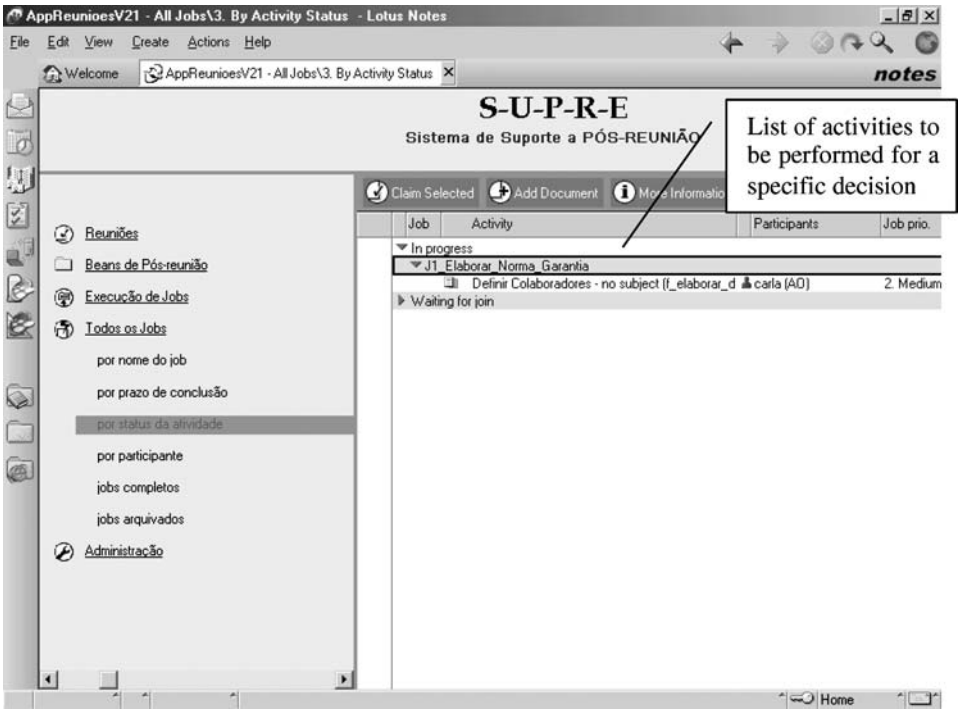

Figure 5. Following decision steps.

roles in the process design is the same used for the definition of members of the discussion group.

However, other discussion support environments that use different discussion metaphors and graphical visualization could also be used as the underlying communication model, although not directly connected to SUPRE. One of these alternatives is the IBIS-based discussion forum (Kunz and Rittel 1970) used in several implementations (Borges et al. 1999; Guerrero and Pino 2002). Although the IBIS model does not support the decision itself, it documents the discussion in such a way the decision process becomes a straightforward activity. There are several IBIS-based tools. The one we used to illustrate our example was the QuestMap tool (Compendium Institute 2004).

The case example described in Section 2 shows that four initial options are possible. With additional information we can perhaps discard some or all of them, at the same time we create new ones, such as the variant generated by the Technical Support Dept. Figure 6 reproduces the discussion diagram generated by QuestMap. Initially, there are four options represented by the four proposals. The fifth option was suggested by the Purchasing Dept. in view of the unsatisfactory results obtained in the first round. Finally there is the sixth option raised by the Technical Dept. All options have advantages and disadvantages, as shown by the QuestMap diagram in Figure 6. With this information at hand, the Board can decide faster and wisely, based on organizational policy.

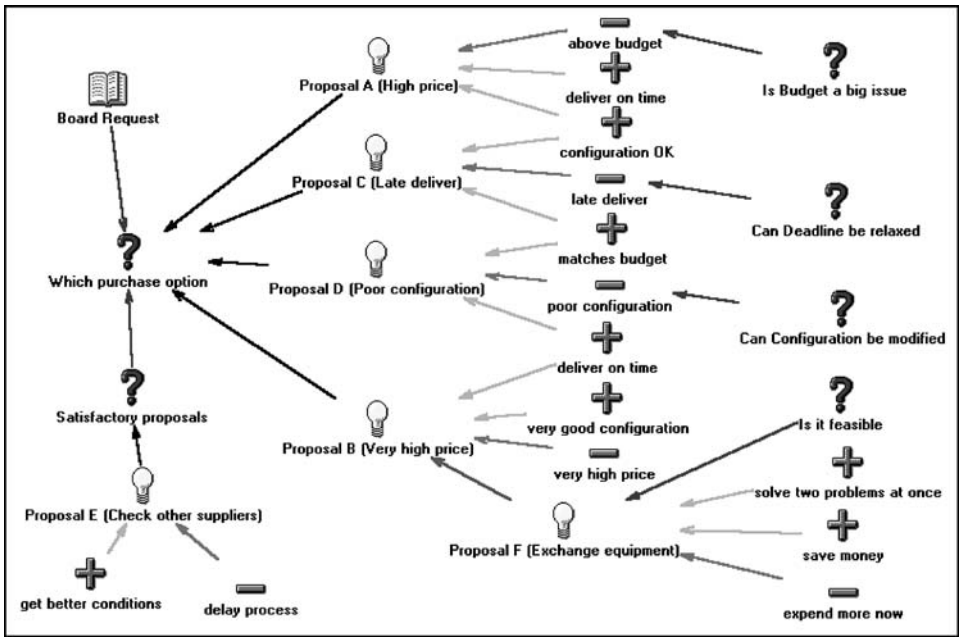

Figure 6. The discussion around the purchase options.

4. Discussion

The previous sections have described some situations where there is a clear gap between the environment where the decision process takes place and the environment where the decision is enforced and implemented. Lack of good communication is thought to be the main cause for this gap, but a number of other reasons can be also associated with this chasm:

- The decision makers were not really addressing the right problem;
- The decision makers were confident they had decided something which satisfied the needs by the end of the meeting, but this decision was not detailed or clear enough to be called a real solution;
- The decision makers have the false belief that only policy is important and that the details are someone else's problem;

The reasons listed above show that not all decision problems in organizations could be solved with good communication. In some, communication might play an important role on placing these problems in evidence, but their solution should come from management procedures. Although we recognize the veracity of these situations, our work focuses on the problems occurring whenever people are willing to cooperate to their solution, but they do not have the means or the adequate support to address them.

The approach presented in Section 4 – based on process modeling and discussion support – is a possible solution to fill this gap. The first question to be answered is what impacts these two technologies would produce in the decision life cycle. We try to demonstrate the advantages of our approach, but some disadvantages can be foreseen. This section presents a discussion on the trade-offs of our approach.

Process modeling of an implementation plan is not an easy task. It is unrealistic to assume that members of a Board of Directors would be able to generate such model from scratch. Although intuitive, the process model requires some expertise both on the modeling techniques and on the domain, i.e., on decision implementation issues. Two solutions are suggested to overcome this problem. First, all proposals should carry an implementation plan, prepared in advance jointly by the proponent and the implementation teams. Second, a library of typical implementation processes could be built based on previous experiences from similar decisions. In the latter case, the process stored in the library may not exactly fit the decision, but it can be used as a starting point towards the actual process. An interesting approach, based on a library of process beans has been proposed by Borges, Pino and Valle (2005). Besides storing complete processes, this library also stores sub-processes, called process beans, which can be assembled together to form a new process.

A library of typical implementation processes may also work as an organizational memory (OM). As in the case of many libraries, an OM is difficult to start, but, given time, it may become an important source of knowledge, where much (many) informal knowledge (procedural contexts) is (are) captured and stored. This long-term advantage may pay off the initial efforts and possible delays caused by the introduction of a new procedure.

Cultural barriers also raise an issue; people naturally prefer the easy way. Support from managers and pilot projects are part of the suggested prescription. Based on ethnographic observations, we identified another obstacle. Decisions are not always as rational as one would wish. In many cases, the rationale behind a decision is not explicit. In our case, e.g., the Call Center Manager may have the power to persuade the Board to approve Proposal A, because she does not want additional problems (uncertainties, complications): she has had enough already. Or, on the contrary, she may insidiously favor Proposal C because the project is late anyway and she may use the delay on the equipment purchase as an excuse for the project failure.

The discussion support technology also raises some interesting issues. The argumentation model reproduced in Figure 6 gives us a clear view of the options and their advantages and disadvantages. On the other hand, would not it be easier and quicker to discuss the options over the phone? Again, the advantage of having a retrievable memory is clearcut. In the Call Center case, the impasse would be sent back to the Board. The discussion map provides a good way of presenting the current situation without additional effort. It also serves as a documentation to justify decisions and to avoid discussion over the same topics, as it has never occurred in the past.

Several IBIS-based systems have been built and used to support discussion (Borges et al. 1999; Guerrero and Pino 2002; Compendium Institute 2004). Although the discussion map represents the essence of the discussion it has at least two drawbacks. First, it is not easy to impose the required discipline to discussion participants. People often mix the three

elements (question, position and arguments) in the same statement. This indicates that an intensive training on the model is suggested before starting a real discussion. In some cases, they only want to comment on one element and not add a new element. In our example, the decision made by the Purchasing Dept. about the delivery deadline was not explicitly represented. In order to give room for these requirements, some systems have modified the original IBIS model (Borges et al. 1999).

The second problem relates to the dynamics of the discussion. The resulting discussion map does not show how and why some elements have been added. For example, Proposal E resulted from the unexpected outcome generated by Proposals A-D, while Proposal F resulted from the later involvement of the Technical Dept. By the way, the attempt of the Technical Dept. to find a common solution to two problems is also implicit. This suggests that the discussion stages have to be associated to the activities of the implementation process, providing context to its evolution.

From the contextual point of view, notice our solutions try to build a large shared context to all involved actors. Both at the group level and inter-group level, a shared context allows coherent decisions. Instead of attempting to diminish the number of decisions the implementors make, our approach tries to enable implementors to make the right decisions.

Finally, a discussion is needed on the solution acceptance in organizational settings. Davis (1993) has proposed the TAM model (Technology Acceptance Model) as a tool to forecast and evaluate user acceptance of information technology. TAM asserts that actual system use (AU) is caused by behavioral intentions (BI), a measure of the strength of one's intentions to perform a specific behavior. BI, in turn, is determined by two attitudes: perceived usefulness (U) of the technology for getting the job done and perceived ease of use (E), the degree to which using the technology will be free of effort. An increase in E produces an increase in U. The model also proposes external variables; these are system design characteristics affecting people's perceptions of usefulness and ease of use.

Our solution can increase U in at least three ways. First of all, workers may find advantageous to have their work documented: promotions and positive job evaluations can then be done on some objective basis. Secondly, if they have been punished for misunderstandings in the past (as mentioned in Section 3), they are probably willing to use tools which will reduce the probability of new incidents. Third, people may also find advantageous not to be left out of discussions: they may want to participate in the implementation decisions.

The solution can also have a high value for E: discussions already done are not repeated again with the system. The process library is also a very useful resource to do tasks quickly. Of course, we are assuming the solution has high quality implementation with good user interfaces.

Briggs et al. (1999) have adapted TAM to the study of transition: the period of time that starts when some person in the organization expresses interest in using a new technology and that ends when a community of users has become self-sustaining. This model is called TTM (Technology Transition Model). Like TAM, TTM states that actual system use is a function of behavioral intentions; it asserts, however, that BI is a multiplicative function of *perceived net value* (V) and *perceived frequency of net value* (F).

V has a magnitude and sign. It encompasses a user's subjective assessment of how the new technology will change his life. It has several dimensions (usefulness, affective value,

economic value, political value, social value, etc.). F reflects how frequently users expect to derive the net value they perceive (daily, twice a year, etc.).

If we use TTM to study our solution, we find several reasons to have a positive V. The same favorable arguments given for TAM may now be categorized in the various V dimensions. On the other hand, if the system is difficult to use, or only a few people within the company use it (none of them being executives), then the final balance may be negative. This hints management must be convinced the solution is a good one and be willing to at least partially use it.

F in our case will be fairly high. The system should be used with most group decisions, and thus, its benefits should be derived and increased with repeated use.

5. Related Work

The inspiration for analyzing unexpected decision outcomes in organizations originated from the works on human error investigation (Dekker 2002). According to these studies, human errors are not the sole cause of mishap, but the symptom of deeper trouble in the way organizations manage their decisions. Examining these problems, we notice what seems to be the ultimate cause of the problem, is actually hiding the real causes. Instead, one should consider the big picture, i.e. the organization that supports and drives the activities at the sharp end. Translating these views to decisions would mean to analyze the decision cycle as a whole, from the making to the final implementation.

Costa, Antunes and Dias (2000b) discuss how to integrate the meeting results in the organizational work. They propose a framework based on the *genre* concept to represent the post-meeting processes or follow-up activities. Using the genre concept, they identified typical meeting outcomes like: "plan for action"; "postpone decision": "approve document", "asking for information" and many others. The identification of those genres was the result of the observation of meetings during four years. This framework was applied to the implementation of systems for associating genres to meeting agendas and publishing this information.

Greenberg and Roseman (1998) presented a list of gaps that exist in group interaction. One of the reported gaps was "*the gap between different phases of a collaborative activity, where people need to move between different work tasks; one example is the movement between pre-, during-, and post-meeting activities, where people move between meeting preparation, the actual meeting, and meeting cleanup*". They also discussed how the "Room metaphor" deals with those gaps.

The use of process definition to turn knowledge into an explicit model is not new (Araujo and Borges 2001). This knowledge comprises not only the process decomposition into activities and its execution flow, but also other organizational aspects involved in the process such as: individuals, groups, organizational entities, roles and responsibilities. Process modeling has been used to represent the way organizations run their business (Ould 1995; Smith and Fingar 2002). Thus, a process model is well known to these organizations or very intuitive to those, which have not adopted it yet.

It is not enough to model the decision process; it is also necessary to support its enactment. Workflow technology is the standard solution for controlling the execution of processes. Workflow management systems (WMS) can be defined as systems that offer active support based on an explicit process model (Jørgensen 2001). However, processes usually evolve on a different schedule than the documentation that describes them. The use of a WfMS to control the execution of changing processes requires special characteristics to deal with process changes (Ellis and Keddara 2000).

The use of IBIS-like tools for supporting discussion has been extensively discussed in the literature (Conklin 2004). Although the initial IBIS model was proposed by Kunz and Rittel (1970) anchored on the ideas of Tolmin (1959), Conklin was the first researcher who supported the model using a hypertext-based tool (Conklin and Begeman 1998). IBIS has been since then the main argumentation model for supporting discussions. Its use, however, depends very much on solid training and discipline from participants (Conklin et al. 2001). The model seems to be more appropriate to present the results than to support the discussion itself, as people get confused in classifying their contributions in one of the three object categories. The graphical tools, such as Questmap and Compendium are good examples of IBIS implementation (Compendium Institute 2004).

The investigation on how context can be explicitly shared and collaboratively managed is wide open. The literature shows that the CSCW community has started to consider the concept of context in groupware applications (Schmidt, Gross and Billinghurst 2004). For example, the perspective of using context for improving teamwork focuses on distributed and mobile work interactions. Several proposals have been reported on distributed architectures for providing team members with necessary information depending on their context. Context in this case corresponds mainly to location, time and physical information such as the device being used – palmtops, desktops and the like. The idea is that, depending on this information (that comprises the context), different sets of data, information and knowledge about the work being conducted will be provided to each user.

Alarcon, Collazos and Guerrero (2004) describe a distributed architecture based on context-aware agents that can coordinate team work whether they are connected (working on a desktop or through handheld devices) or not (when team members get unconnected for some reason). The context-aware agents should know enough about the current context of a user in order to determine what information should be transferred, retrieved and synchronized with other agents at each new context or situation.

Muñoz et al. (2004) describe a case study conducted in a hospital in order to characterize the requirements for context-aware collaboration in this setting. They identified the main contextual information as: people location; the devices being used, the timing of delivered messages, the participants' role and the artifacts usually manipulated – hospital beds, readings from hospital devices, lab analysis reports etc. They also propose a multi-agent based architecture for building a context-aware environment.

Fischer et al. (2004) describe the possibilities for supporting collaboration and distributed cognition among design communities in context-aware pervasive computing environments. They identified some perspectives for context-aware applications in this setting like helping applications to better capture and interpret the situations while users interact with it; to provide relevant information ('say the right thing at the right time in the right way'); and

how to make systems that let users articulate their intentions and needs (their context) over a work situation.

The above mentioned research work clearly discusses how it is possible to design and build context-aware collaborative applications – applications to automatically adapt according to the discovered context. Thinking about context from a different perspective, Schjorring (2004) suggests a different approach for turning cooperative actors (and not applications) context-aware. He argues that the idea of making applications decide its context constrains the possibilities of users' interpretation. His work proposes a methodological framework for discovering what context is in specific situations and designing context-aware applications that advance context-awareness among cooperative actors, improving their work productivity and quality. This view on providing awareness of context has a strong relation to our research target which is to provide means for facilitating collaborative knowledge management and organizational learning.

Indeed, the possibilities for making participants aware of the interaction context have been the objectives of the research work on group awareness. We have seen many efforts in order to define what is awareness information, how it can be presented through interface mechanisms and finally on how it can be filtered depending on individual and group characteristics. Past and recent research work (Brézillon et al. 2004; Rosa, Borges and Santoro 2003; Araujo et al. 2004; Schjorring 2004) follows the discussion on the relationship between context and awareness, giving focus on what would be relevant context information in group interactions and on how a groupware designer can provide a tool with awareness mechanisms for displaying contextual information.

6. Conclusions

A solution to the gap between decisions and their implementations has been presented. It represents a cooperative approach involving technology, which supports people to achieve the common goal of obtaining rightly implemented decisions for the Organization. As such, it needs people willing to collaborate with other employees.

The solution involves using process modeling, shared workspaces and discussion tools. These tools may be used in conjunction with other tools intended to support other parts of the decision meetings cycle, such as meeting preparation and decision making support itself.

A number of issues remain open. While the discussion map eases documentation, there is also a danger of information overload for those who have to relate to this material afterwards. Besides, there is also the issue of who should submit the implementation plan in the first place. Sometimes, new options arise when the implementation is in progress. An important functionality of the WfMS would be the support for changes emerging during running processes.

The approach needs to be tested in real settings. We must find an appropriate environment to start a pilot project and observe benefits and drawbacks of the proposed solution. What type of evaluation will take place? We can qualitatively measure results as a first step. As we mentioned above, many of the benefits will be obtained only after a period of intensive use.

In this work we adopted an optimistic approach in the sense we assumed that people are willing to accept a formal definition of their working processes. This may not be true, depending on the organizational culture. Reluctance to process formalization can severely restrict our solution; this is another issue that needs further investigation.

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