Context-Based Explanations for E-Collaboration

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INTRODUCTION

E-collaboration is generally defined in reference to ICT used by people in a common task (Kock, 2005; Kock, Davison, Ocker, & Wazlawick, 2001). However, when speaking of e-collaboration, people seems to put more the emphasis on "e-" than on "collaboration"; that is, on the ICT dimension of the concept that on the human dimension. Along the human dimension, e-collaboration requires to revisit previous concept of cooperation, conflict, negotiation, justification, explanation, etc. to account for the sharing of knowledge and information in the ICT dimension. We discuss in this article of explanation generation in this framework.

Any collaboration supposes that each participant understands how others make a decision and follows the series of steps of their reasoning to reach the decision. In a face-to-face collaboration, participants use a large part of contextual information to translate, interpret and understand others' utterances use contextual cues like mimics, voice modulation, movement of a hand, etc. In e-collaboration, it is necessary to retrieve this contextual information in other ways. Explanation generation relies heavily on contextual cues (Karsenty & Brézillon, 1995) and thus would play a role in e-collaboration more important than in face-to-face collaboration.

Fifteen years ago, Artificial Intelligence was considered as the science of explanation (Kodratoff, 1987). However, there are few concrete results to reuse now from that time. There are several reasons for that. The first point concerns expert systems themselves and their past failures (Brézillon & Pomerol, 1997):

- There was an exclusion of the human expert providing the knowledge for feeding the expert systems. When an expert generally provided something like "Well, in the context A, I will use this solution," the knowledge engineer retained the pair {problem, solution} and forgot the initial triple {problem, context, solution} provides by the expert. The reason was to generalize in order to cover a large class of similar problems when the expert was giving a local solution. Now we know that a system needs to acquire knowledge within its context of use.
- On the opposite side, the user was excluded from the noble part of the problem solving because all the expert knowledge was supposed to be in the machine: the machine was considered as the oracle and the user as a novice (Karsenty & Brézillon, 1995). Thus, explanations aimed to convince the user of the rationale used by the machine without respect to what the user knew or wanted to know. Now, we know that we need to develop a user-centered approach (Brézillon, 2003).
- Capturing the knowledge from the expert, it was supposed to put all the needed knowledge in the machine, prior the use of the system. However, one knows that the exception is rather the norm in expert diagnosis. Thus, the system was able to solve 80% of the most common problems, on which users did not need explanations. Now, we know that systems must be able to acquire incrementally knowledge with its context of use.
- Systems were unable to generate relevant explanations because they did not pay attention to what the user's question was really, in which context the question was asked. The request for an explanation was analyzed on the basis of the available information to the system.

Thus, the three key lessons learned are (1) KM stands for management of the knowledge in its context; (2) any collaboration (including e-collaboration) needs a user-centered approach; and (3) an intelligent system must incrementally acquires new knowledge and learns corresponding new practices.

Focusing on explanation generation, it appears that a context-based formalism for representing knowledge and reasoning allows to introduce the end-user in the loop of the system development and to generate new types of explanations.

With new findings about context available now, a new insight is possible on past problems abandoned previously by lack of a relevant solution at that time, like incremental knowledge acquisition, practice learning and explanation generation. Previously, they were considered as distinct problems. Now their integration in the task at hand of the user offers new options, especially for e-collaboration.

Hereafter, the article is organized in the following way. First, we comment briefly previous works on explanations in order to point out what is reusable. Second, we discuss explanation generation potentialities in a context-based formalism called contextual graphs. Finally, we show what explanations can bring in e-collaboration, maybe more than in face-to-face collaboration.

BACKGROUND

Explanations in Knowledge-Based Systems

The first research on explanations started with rule-based expert systems. Imitating a human reasoning, the presentation of the trace of the expert system reasoning (i.e., the sequence of fired rules) was supposed to be an explanation of the way in which the expert system reaches a conclusion. Rapidly, it was clear that it was not possible to explain heuristics provided by human experts without additional knowledge. It was then proposed to introduce a domain model. It was the second generation of expert systems, called the knowledge-based systems. This approach reached also its limits because it was difficult to know in advance all the needed knowledge and also because it was not always possible to have models of the domain. However, the main weakness was the lack of consideration for the user and what the user wanted as explanation. The user's role was limited to be a data gatherer for the system. A second observation was that the goal of explanations is not to make identical user's reasoning and the system reasoning, but only to make them compatible: the user must understand the system reasoning in terms of his own mental representation. For example, a driver and a garage mechanic can reason differently and reach the same diagnosis on the state of the car. The situation is similar in e-collaboration where specialists of different domains and different geographical areas must interact in order to design a complex object. A third observation is that the relevance of explanation generation depends essentially on the context use of the topic to explain (Abu-Hakima & Brezillon, 1994; Karsenty & Brezillon, 1995). We discuss this point later in the article.

Beyond the need to make context explicit, first in the reasoning to explain, and, second, in the explanation generation, the most challenging finding is that lines of reasoning and explanation must be distinguished, but considered jointly, the line of explanation being able to modify the line of reasoning (Abu-Hakima & Brézillon, 1994). Thus the key problem for providing relevant explanations is to find a uniform representation of elements of reasoning and of context.

Explanations and Contexts

A frequent confusion between representation and modeling of the knowledge and reasoning implies that explanations are provided in a given representation formalism, and their relevance depends on explanation expressiveness through this formalism. For example, ordinary linear differential equation formalism will never allow to express—and thus explaining—the self-oscillating behavior of a nonlinear system. Thus, the choice of representation formalism is a key factor for generating relevant explanations for the user and is of paramount importance in e-collaboration with different users and several tasks.

A second condition is to account for, make explicit, and model the context in which knowledge can be used and reasoning held. For example, a temperature of 24°C in winter in Paris (when temperature is normally around 0°C) is considered to be hot in Paris and cold in Rio de Janeiro (when temperature is rather around 35°C). Thus, the knowledge must considered within its context of use for providing relevant explanations, like to explain to a person living in Paris why a temperature of 24°C could be considered as cold in some other countries. (We will not discuss in this article the problem of affordance such as the use of an umbrella to walk or to protect from the sun and not the rain.)

There is now a consensus around the following definition "context is what constrains reasoning without intervening in it explicitly" (Brezillon & Pomerol, 1999), which applies also in e-collaboration (although

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