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ANALYZING APPROACHES TO COLLECTIVE KNOWLEDGE RECALL

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Abstract. People and organizations frequently need to recall past events that, for some reason, were not documented when they occurred. The successful reconstitution of past events depends on several variables, such as how long ago the event occurred, and whether key people are still available to tell what they know. Although it is sometimes difficult to restore all known events, an adequate recall process can get closer. This paper examines three knowledge recall methods and compares them in a set of controlled experiments. The group storytelling approach is used in two of the methods, one of which is supported by a groupware. The paper also evaluates the benefits and the drawbacks of using the group storytelling technology.

Keywords: Collective knowledge, group storytelling, knowledge management, cognitive engineering

1 INTRODUCTION

Knowledge is the most valuable asset in an organization [1]. The appropriate management of this knowledge can make all the difference to some organizations [2]. People and organizations frequently need to recall past episodes that, for some reason, were not adequately documented when they occurred. The recalling of relevant knowledge must rely on the people, rarely a single individual, who witnessed the events or participated in them. However, this is not a straightforward task. Incomplete information caused by lapses in memory and the lack of key facts are commonplace in the recalling process.

A description of an episode can be defined as a set of events and their relationships. An episode description falls into one of the three categories: the true version, the known version and the reported version. While reaching the true version depends on external facts, such as the set of events known and the proper establishment of the relationships, we claim that difference between the reported and known version depends on the recalling process, if, of course, all participants are willing to cooperate. The more people there are to contribute, the higher the likelihood of completeness and accuracy, i.e., the closer the reported version is to the known version. On the other hand, the more people there are, the greater the potential for controversy.

This paper extends prior research by analyzing, through experiments, the beneficial effects that group work can provide to collective knowledge recall. We compare the three main methods for knowledge recall: individual interviews, group dynamics in face-to-face settings, and group dynamics supported by a CMC tool. For the second and third method, we employ a technique that was developed to support the collective reconstruction of past events, which is known as group storytelling [3, 4, 5, 6]. This study builds from the hypothesis that groups that use the group storytelling approach perform better than groups that use individual interviews. We also examine the influence of a CMC tool on the group storytelling approach.

Telling stories is a natural way of transmitting tacit knowledge among individuals, groups, and organizations. When a story is told, the author's intention is to transmit knowledge to the listener. Stories are great vehicles for wrapping together many elements of knowledge such as: explicit and tacit knowledge, information and emotion, the core and the context [7]. Stories are a very powerful way to represent complex, multi-dimensional concepts. While a certain amount of knowledge can be reflected as information, stories hold the key to unlocking the vital knowledge, which remains beyond the reach of codified information [8].

Several approaches exist in the literature for the collective reconstruction of stories [9, 10, 11, 12, 13]. Some are based on interviews performed by a facilitator. Others use group dynamics in order to benefit from the group synergy, although there is some controversy as to whether groups perform better than individuals due to the process losses inherent in face-to-face settings [14]. Researchers have recently begun to examine the effects of computer-mediated communication on group dynamics and have concluded that process losses can be overcome to some extent [15].

To perform the comparison we need a real situation experienced by a group of individuals who agree to serve as storytellers. In our experiments, the stories were picked from commercial motion pictures and were unknown by all the participants. Each film was divided into parts, which were selectively shown to the participants so that nobody had the entire view of the story. The task was to rebuild the story with their partial knowledge of the events, using any of the three methods for knowledge recall.

Although the experiment made use of feature films, the results can be generalized to real stories because part of the development is very similar. People have a partial view of the events and they will only be able to reconstruct the entire story by grouping their pieces together. If our hypothesis holds, we believe the group storytelling approach can be used to recall past decisions and project stories in organizations [5].

The paper is divided as follows: Section 2 reviews the advantages and the drawbacks of collective knowledge recall. Section 3 describes the group storytelling approach, and Section 4 shows the supporting technology. Section 5 describes the planning and the implementation of the experiments, and Section 6 discusses the results. Section 7 concludes the paper.

2 COLLECTIVE KNOWLEDGE RECALL

The importance of the knowledge component has motivated companies to develop practices to facilitate its administration. As a result, knowledge management has been adopted in wide scale, supporting the definition of procedures, practices and technological tools that aim at capturing, storing and disseminating the knowledge in the organization.

Knowledge exists in both the mind of employees and in documents. Many organizations assign high priority to documentation, but not all important knowledge is stored in documents [16]. The experience of the organization members, their ideas and decisions are also part of the organization knowledge. Nonaka and Takeuchi define these elements as tacit knowledge [17]. It consists of technical abilities: mental models, faiths and ingrained perspectives not subjected to the easy manifestation. It is opposite to the explicit knowledge, which is simple to disseminate and share.

When the knowledge is tacit (i.e., it is in the mind of the employees), the knowledge recall process is complex and will depend on a positive and collaborative attitude from the knowledge holders. One of the main challenges is to capture and to maintain the tacit knowledge because it is not logical and strictly documented. For tacit knowledge to be communicated it must be converted into elements that anyone can understand [16]. One possible approach is the transformation of tacit into explicit knowledge.

When we want to recall an episode that has occurred in the past and which has been witnessed by a group of people, we should count on their testimony to try to

reconstitute the episode. It usually happens, however, that a participant alone is unable to tell the full story because s(he) has only a partial knowledge of the full event. Only when grouped together the set of events can start to make sense. This is achieved by some knowledge exchange and combination. We call this part of the process socialization. Although this is not enough to guarantee the full reconstitution of the episode – some events may not have been witnessed or some witness may not be available, the collective knowledge recall generated by the socialization is better than a set of events reported.

The reporting of an episode can have four versions: the version stored in the minds of the people who witnessed or participated in all or some of the events; the version reported by these people, i.e., the externalization of their tacit knowledge; the version known by these people, i.e., the set of knowledge the participants possess; and the real or true description of the events – probably non-existent. These four versions are illustrated in Figure 1.

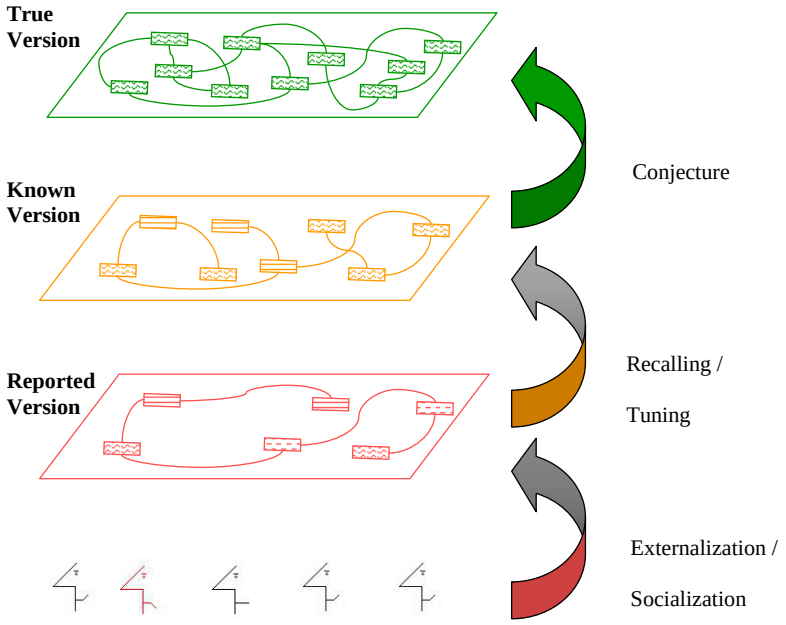

Fig. 1. The four versions of an episode

The reported version is generated when the participants externalize their knowledge about the events they have witnessed. This process is called externalization because they translate their tacit knowledge into formal knowledge [17]. However, during this process they can forget and disregard events they think are not relevant, making the reported version different from the known version. There are also cases where faulty memory, subjective perception, partial or erroneous knowledge may distort the report [18]. The goal of the tuning/recalling process is to approximate

the reported version to the known version. The closer is the reported to the known version, the better is the recalling process. The "true version" consists of all events that formed the episode organized in a coherent way. In real situations, the "true version" does not usually exist, because of missing information. Events, motives and emotions are examples of missing information. To generate a "true version" from an incomplete known version one should conjecture, speculate about missing information. The conjecture process, though very relevant, is out of the scope of this paper.

At this point we can identify two knowledge recalling methods. The first is guided by a person playing the editor role. The editor interviews all participants, understands their views and stores the knowledge extracted during the interviews in a repository, which will be later used to reconstitute the story. A second method, called group storytelling, is also guided by an editor, but the reports are available to all participants. The advantage of the group storytelling method is that the exposure of knowledge to all participants may stimulate the recalling process. These two methods are illustrated in Figure 2 a), b).

The knowledge generated by a group storytelling process is usually richer than that generated by the separated individual interviews [19]. A group storytelling process discloses different points of view, is stimulating and dynamic, and creates synergy among participants. To sum up, the group storytelling method is expected to disclose more knowledge than the sum of individual interviews. The probability of completeness and precision will be greater if more people contribute.

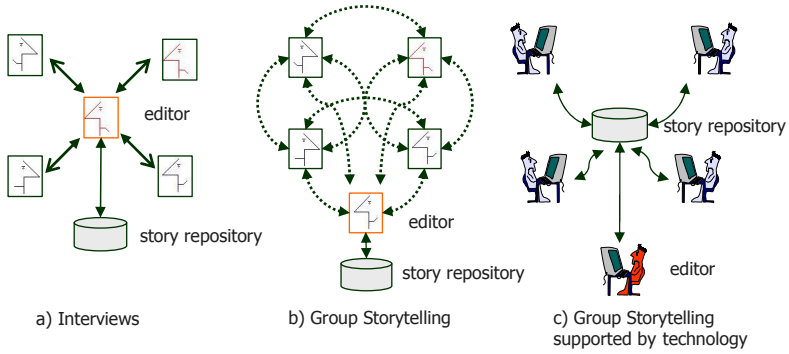

Fig. 2. Knowledge recalling methods

On the other hand, there is also more potential for controversy if there is a great number of contributions. This is particularly true when group members have to recall facts from the past in which they had a partial role; for instance, the documentation of a finished project or the reporting of an incident.

The knowledge generated at the end of a collective recall process results from the combination of the skills acquired by each participant during the task execution. The knowledge can contain many more valuable details if more than one person par-

ticipate in its creation since an activity normally involves more than one individual. However, just as any other group work, the collective capture of knowledge presents some difficulties that do not exist in individual work. In general, these difficulties have social or cultural causes, such as resistance to sharing knowledge, relationship difficulties, conflicts, constraints, etc.

The group storytelling process can have the support of technology. Using an appropriate technology, participants can be geographically distributed, work asynchronously and can also use a repository as an extension of their memory. While these features can be beneficial, they may also generate problems as the socialization process is guided by the system. Figure 2 c) illustrates the group storytelling approach supported by a technology.

Bloom's Taxonomy of Cognitive Domains	*Instantiation of the Taxonomy to Group Storytelling*
KNOWLEDGE Recall of previous knowledge	Be able to recall the relevant facts from what they watched or witnessed
COMPREHENSION Understanding knowledge. Explaining and translating one form into another	Be able to represent their stories in the template provided. Translate from one form to another (images to words)
APPLICATION The use of knowledge to identify and solve new problems	Use stories to reach conclusions or to identify gaps between stories or misunderstandings of presented stories
ANALYSIS The identification of others' knowledge and the relationship between different pieces of knowledge	Filter the relevant part of other stories and establish a network of stories to form a single story or a group of stories
SYNTHESIS Rearranging previous knowledge into new patterns or structures	Rearrange or rewrite their own stories in response to others' questions or remarks
EVALUATION Determining how useful or valuable the knowledge is for a given purpose (suitability)	Evaluate stories and decide the value of a story to the main stories
GROUP SYNERGY Assessing and combining knowledge from others to create new knowledge	Recall new stories after presentation of other members' stories. Filling gaps between stories

Table 1. Bloom's Taxonomy applied to collective knowledge construction using a group storytelling approach

To assess the participant's understanding of the result generated by collective knowledge recall, we can make use of Bloom's taxonomy [20]. This taxonomy has been widely used in educational environments to help to evaluate the apprentice's understanding of the concept being taught. We believe that with some adaptation, the taxonomy can also be used to represent the level of understanding of the

knowledge recall process. The taxonomy is reproduced in the first column of Table 1. We added an extra row to represent the group synergy. In the second column we evaluated the collective knowledge construction when using a group storytelling approach.

3 GROUP STORYTELLING

"A story can be defined as a narration of a chain of events that is told or written in prose or verse. The term narration comes from the Latin narrere, meaning to pass on knowledge" [4]. Storytelling can be considered to be as old as the human being, even considering that at the beginning of the human race, stories were of the most rudimentary form, such as the Rosetta Stone. The Egyptians registered their stories in illustrations. Indians have used oral storytelling as the main technique for knowledge propagation through the generations. The invention of the printing press made story dissemination widely available to many people at once, as copying material became much simpler [5].

Before a story can serve as knowledge transfer, it must be constructed or assembled. The assembly of a real story is the process of recalling knowledge from past events that have occurred. This can be an individual or a group task depending on whether the story fragments are remembered by one or more individuals. In the latter case, members of a group contribute to creating a story collectively, synchronously or asynchronously, in the same place or in a different place. This technique is called group storytelling.

The idea of using a group storytelling mechanism is not a simple one. It depends on the existence of a knowledge management culture as well as that of a collaborative culture. It can also require technological support.

There are several ways of registering a story. Among them are texts, photos, audio, video, or a combination of them. "Video and audio help bring ideas to life by adding more non-text clues, including body language, graphic illustrations, and sound effects or music. This helps activate many more parts of the brain than text alone, increasing most people's ability to pay attention and to recall what they have heard. It also draws in people who are not as comfortable in purely text-based communications" [8]. However, these technologies require richer production as well as skills that people generally do not have, like the definition of a good script, a good voice, a good characterization, and high quality pictures [3].

The group storytelling approach has been used in some works. Schäfer, Valle and Prinz [6] applied the group storytelling to create team awareness. The story in this case was a collection of annotated photos. They developed the PhotoStory application to generate and maintain a story through a sequel of pictures with subtitles. Participants should first set up a storyline. Then, they feed the story elements with annotated digital pictures. In their work, however, they aimed to create a story, which is different from the focus of our paper that aims at the recalling process.

Acosta et al. [21] used the group storytelling approach to support the externalization of tacit knowledge. They have developed the StoryMapper, a tool that uses conceptual maps to represent knowledge. The group members may synchronously or asynchronously contribute to the development of a story. They have also concluded that the approach brings some benefits to the knowledge recall.

Lawrence and Thomas [22] presented an interesting study on the social dynamics of storytelling. They analyzed how power, risk, and collaboration influence storytelling. They concluded that simply grouping stories on a particular topic partially simulates in-person collaboration and also provides ways for groups to comment, discuss, debate and build combined stories.

4 THE TELLSTORY GROUPWARE

The growth of cooperative work in organizations has stimulated the development of groupware, a type of support tool used by teams. It facilitates several activities that are traditionally performed in group work, such as coordination, communication, awareness and level of collaboration. In their research, Perret, Borges, and Santoro [5] argue that a consolidated system that gives support to the collaborative construction of stories does not yet exist in the literature.

There are some Computer-Supported Collaborative Learning environments that stimulate collective knowledge building, and there are also some Collaborative Authoring Tools. Based on some of the characteristics of these systems and the analysis of narratives and journalistic texts, Perret [23] developed the first version of a groupware application called TellStory.

TellStory is actually a family of web applications that support the group storytelling metaphor. There are currently two variations of the original implementation. There is one that put emphasis in collecting contextual information [24]. The most recent version has implemented categories of fragments and different forms of associations between pairs of fragments [25]. Two other variations are under development; one that supports collective knowledge about system requirements; and another focusing on the system maintenance requests. All versions have been implemented on the Zope platform [26].

The tool allows a group to tell a story through the contributions of each one of the members. Any registered member of TellStory can create a story and invite new participants. An individual can participate in the story by performing one of the following roles:

moderator: the creator of the story and the person responsible for the coordination of the actions inside of the story;

user: contributor to the story;

teller: the person that will write the final text;

reviewer: the person who endorses the story built by the teller; and,

commentator: the person responsible for the identification of tacit knowledge externalization of the story.

More than one person can assume the same role, and each role can be assumed by several people. The user role is common to all registered members.

After entering the system the user is presented to summary of his participation. There is a list of stories that the user participates or has requested an authorization to the story owner. The user can also see all the stories under some stage of construction. The user has also access to the list of all stories registered in the system and can request an authorization to participate. Finally, the user can create a new story and register it in the system. This summary is reproduced in Figure 3.

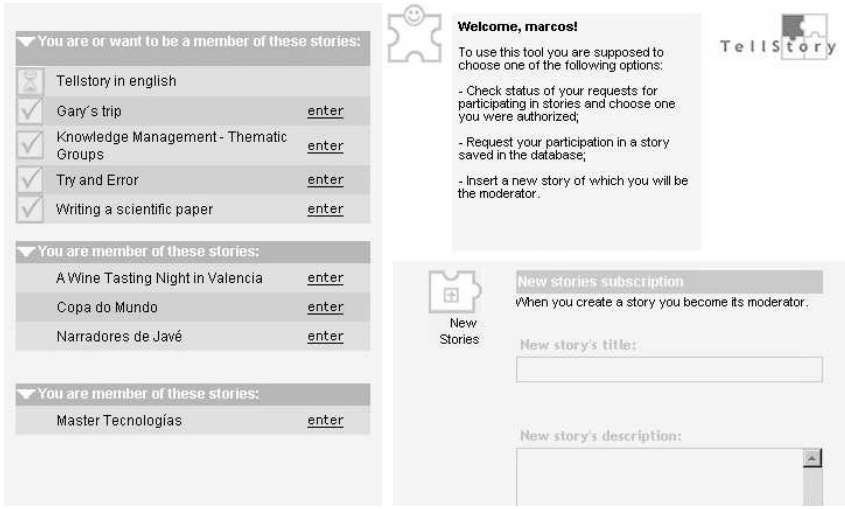

Fig. 3. A summary of all stories is presented to the user after he logs in the system. The system presents the list of all available stories and allows the user to create a new story

According to Holloway, a story is a sequence of events that are tied to each other by a full conductive thread of meaning, built by a causality relationship between a fact and its successor [27]. TellStory takes advantage of that definition to facilitate the construction of the story by a group. Each user can insert an event which he/she remembers (Figure 4), that is, a fact that happened.

The possible actions throughout the construction of the story are: inclusion, edition, exclusion, union, and fragmentation of events. The union of events occurs when two events can be considered as a single one; the fragmentation of an event occurs when an event is divided into two. These can be performed whenever necessary. The criteria that indicate whether a fact is an event, a sub-event, or a collection of events do not need to be explicitly defined by the participants. This makes the tool a flexible environment, where people can express themselves freely.

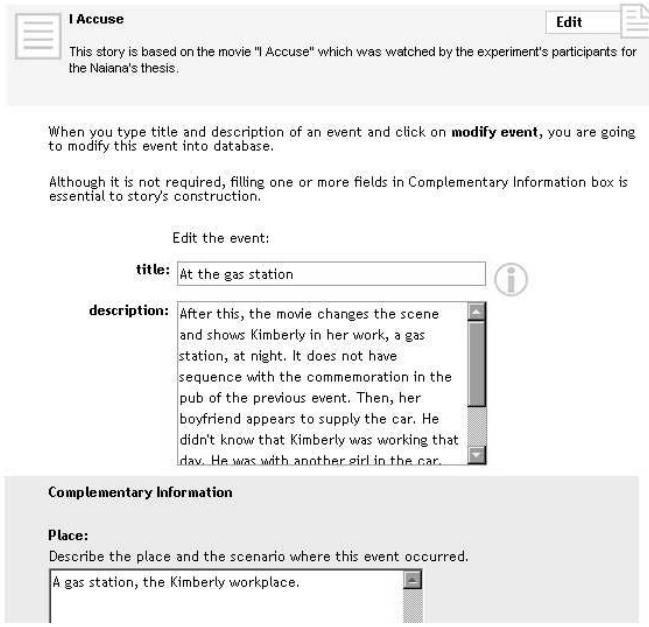

Fig. 4. Inserting/editing an event. The story is made up of events that are inserted by each participant. Besides the event title and description, the participant can also add some descriptors such as place, characters involved, etc.

The events can be introduced in random order because they can be treated later, during coordination activities. At this point, they organize the events, discuss them, and vote to decide which order will be chosen. Figure 5 shows the flow of events: to the right, the events appear in a column in the corresponding order. If a modification of the events in the story occurs, the numbering of the events changes.

Once the users have input the events, they can discuss them with each other through comments in a forum format. They can eventually make decisions on certain subjects through voting that is organized by the moderator. One example of subject discussion is event truthfulness. If there is no consensus about the existence of a certain fact, the tool allows the story to have two versions, one that considers the hypothesis of the event to have happened and the other that considers it not to have happened. However, the duplicity of versions should only be used if there is not a majority consensus on decisions related to a subject.

One of the most important benefits of TellStory is that it offers the possibility of using a template to address the elaboration of the story through the typical features of a narrative structure. For example, the template shows the users that an event should always have a cause and effect relationship with its successor or predecessor, according to the causality principle. The template also has a module in which the users can define and configure the characters, an activity which greatly

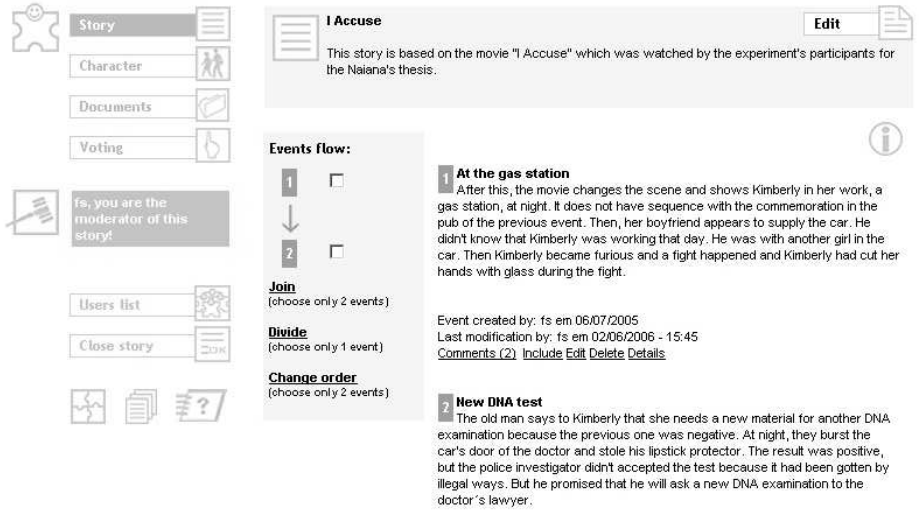

Fig. 5. Flow of a story. The participants decide on the chronological position of the event in relation to those already in the story when inserting the event. They can also change the position later on.

aids externalization. The template works as a guide for the tellers, stimulating their memories and helping them to better structure their thoughts. When the group understands and the story already provides a sufficient flow of events, the moderator can conclude the task. At this point, the teller gathers the events and writes a final text based on the sequence. The reviewer corrects casual mistakes and has the authority to make any changes to arrange the logic of the final text. Finally, the commentator searches for tacit elements that can be identified in the story, which are registered in a module that is included in the final text.

5 PLANNING AND PERFORMING THE EXPERIMENTS

The goal of the experiment was to compare different alternatives for knowledge recall and to evaluate the benefits of a supporting technology for the group storytelling technique. The results should provide a preliminarily evaluation of issues that we judged important to the design of a knowledge recall procedure. To achieve this, we compared the results obtained with each approach. The first insight was whether the group storytelling approach generates more commitment from the participants than the interview approach. We assigned some questions in the questionnaire related to the participants' satisfaction with the dynamics of the interaction. We compared the answers from the same group and also the answers from different groups using different approaches.

The second insight was the results obtained by each approach in terms of completeness and detailing level of the stories generated. We looked into the contents of

each story and analyzed how far or close they were to the real story. We also looked into the stories generated from the same movie and checked for the differences. We were particularly interested in examining the knowledge produced by the combination of individual knowledge from different participants. In other words, we intend to assess the combination phase in Nonaka's knowledge transfer spiral [17]. We also analyzed the level of interaction among participants using the Bloom's taxonomy described in Table 1.

Perret used the need for recalling a documentation of a complex organizational process that took place in an organization in Rio de Janeiro to test the TellStory tool [23]. This experiment, however, would not serve our purpose; we needed the same story to be recalled using different techniques and by different groups of people.

We opted to use two story recall techniques: one based on interviews and another based on the group storytelling approach. The first one is very common in organizations and consists of an interviewer asking questions to an interlocutor and compiling the answers to generate the story. In the group storytelling approach, members of a group contribute to the recall of a story collectively. The group storytelling technique was carried out with and without a supporting technology. The supporting technology adopted was the web tool, TellStory [23], presented in the previous section.

5.1 First Experiment

The first experiment involved 8 participants and 2 facilitators, divided into two groups of four participants and one facilitator, named group A and B. The facilitator was responsible for coordinating the techniques of stories recall. S(he) did not watch the films and did not know their stories. All participants had previous experience with the interviews and storytelling approaches. They were also trained in the TellStory application in previous uncontrolled experiments. This situation was intentional and aimed at reducing the learning effects.

The task assigned to each group was the recall of the story told in the feature films (which had not been seen by the participants) using partial knowledge of their events. Each film was divided into parts ranging from five to twenty minutes, which were selectively shown to the participants so that nobody had the entire view of the story. These parts had been previously selected by the coordinator of the experiment in order to create as much discussion as possible. Figure 6 shows the parts of the film watched by each one of the participants.

The experiment was divided into four parts. In Parts 1 and 2, groups A and B watched the same pieces of movie 1, but used different techniques to recall the story of the movie (group A used interviews; group B used the group storytelling technique without the tool). In Parts 3 and 4, the same groups watched the same pieces of another film. Both groups used the group storytelling technique, but group B used the TellStory tool, which they had been trained to use before the experiment. Table 2 presents a summary of the experiment.

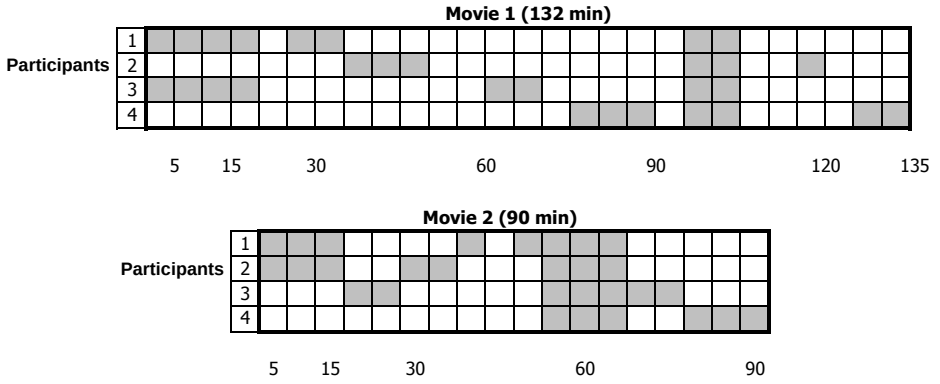

Fig. 6. Parts of the movies watched by participants. Some parts were watched by all, some by none; and some by a sub-group of the participants.

	View movie 1	View movie 2	Interview	Group storytelling	Group storytelling + TellStory	
Part 1	X		X			Group A
Part 2	X			X		Group B
Part 3		X		X		Group A
Part 4		X			X	Group B

Table 2. Parts of the experiment – planning each evaluation

Each part lasts one week. In Part 1, the members of the Group A were interviewed once by the facilitator for about one hour each. The facilitator spent approximately 3 hours to edit his version of the story. In Part 2, the Group B had 3 meetings of about one hour and a final meeting that lasted two hours, when they prepared their report. Part 3 was similar to Part 2. Part 4 was not monitored in full. We are not sure how much time each member used the system.

Each part of the experiment was divided into the following activities:

1. Watch the pieces of the film without talking to other participants about it.
2. Participate in the movie's story recall using one of the techniques.
3. Elaborate the final writing of the movie's story.
4. Answer the experiment evaluation questionnaire.

All the participants, including the facilitator, answered the questionnaire. Its objective was to generate a qualitative analysis of the differences between the techniques, to evaluate the benefits of a supporting technology, and to identify the difficulties that occurred during the experiment.

5.2 Second Experiment

The second experiment used five volunteers, different from those of the first experiment. One of the participants acted as a facilitator and did not watch the films. Again, the five participants had previous experience with storytelling and the TellStory tool. Two movies were shown and fragments of the movie were assigned to participants according to the tables shown in Figure 7. With this experiment we intended to reduce the differences related to group formation. We used the same group in both experiments.

After watching the selected pieces of the first movie, they started working on the TellStory tool to represent their fragments. They have used the tool asynchronously for four days, and during this period, thirty-five events and forty-nine comments were reported. Considering the simplicity of the story, this relatively high number of events demonstrates their interest in collaborating. The high number of comments, mostly questions, can be interpreted as a real attempt to solve their high level of uncertainty about the story. As can be seen in Figure 7, almost half of the movie was not shown to any participant.

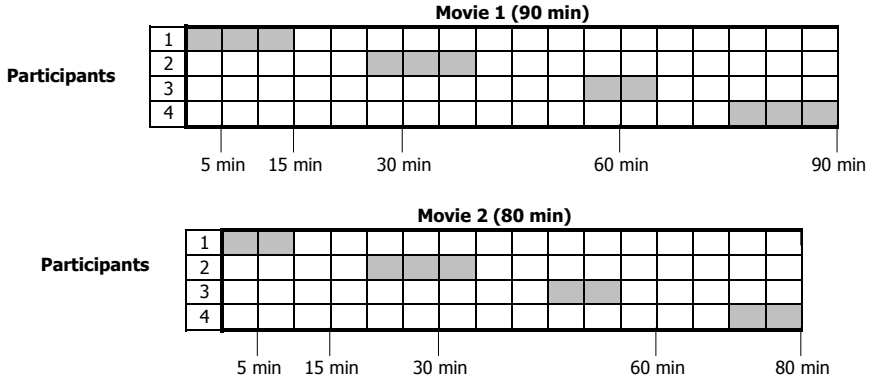

Fig. 7. Parts of the movies watched by the participants. Each participant watched a different part.

The same group of participants watched the fragments of the second movie. Two days after, they had a face-to-face meeting to recall the story. The meeting lasted for almost three hours, during which a report was generated. They were allowed to use all typical tools to support face-to-face interactions, such as paper sheets, whiteboards and voice recording. The discussion during these three hours was intense and, as expected, oriented to fill their gaps and understanding what pieces would complement each other.

The stories generated in all experiments were submitted to external evaluation. We asked three people who did not participate in the experiment and did not know the movies to read the reports and provide a report on their understanding about the contents.

6 FINDINGS

In this section, we present the results of the experiments based on the analysis of stories generated at each part, the observations made during the application of the techniques, and the answers of the evaluation questionnaires.

The stories generated by the groups were evaluated using the following criteria:

- Completeness: how complete the story generated by each group was; whether or not the group had covered all the important facts. The knowledge and the comprehension aspects of Bloom's taxonomy have influenced this criterion.
- Level of detail: if the story was presented as a summary of facts, or whether it had details. The knowledge and the synthesis aspects of Bloom's taxonomy have influenced this criterion.
- The structure and the persistence of the knowledge generated: if the knowledge about the story was kept at the tacit level or if it was formalized.
- The interconnection between story fragments: if the story was composed of loose fragments or if these fragments were well connected. The application and the analysis are the main aspects of Bloom's taxonomy that have oriented this evaluation criterion.

In addition, we took into account the geographic distribution of the participants and the possibility of asynchronous work. In the questionnaire, we asked the participants how difficult they found the use of each technique.

6.1 Interviews versus Group Storytelling

Based on the analysis of the stories produced, the group storytelling technique generated better results than the interviews. This was credited to the synergy created among the participants that stimulated the contributions and group discussions. The contribution of each participant had a positive effect on the others, by making them remember relevant facts, recall forgotten information, argue conflicting points of view, and complement the story.

The story that was generated using the group storytelling technique presented greater completeness and a higher level of detail. Besides describing the main scenes, many details were reported. In the technique based on interviews, the story that was generated had several problems: lack of some of the main scenes, a low level of detail, several assumptions made by the facilitator, and several open questions that could not be answered by the facilitator. In the technique based on interviews, the moderator is responsible for putting together the story's fragments. This may distort the story because the moderator did not watch the film and s/he does not have enough knowledge to make her/his own deductions.

One of the disadvantages of both the techniques is that the participants need to get together in the same place at the same time. This is undesirable particularly when the participants are geographically distributed. In both cases, the use of verbal

communication caused parts to be lost. Even when a written report was produced, some participants filtered the information before reporting their views. This can lead to the omission of relevant facts in the final text. This reinforces the importance of formally registering all interactions.

According to the questionnaire's answers, the participants encountered difficulties when applying the techniques. At the interviews, some participants felt constrained; in the group storytelling technique, some participants felt uncomfortable in the presence of other people.

In both the group storytelling and interview techniques, incomplete events occurred, due to lapses in memory and to the lack of necessary information. However, they were more frequent in the interviews, when the participants did not interact in a group.

Another issue is the importance of the facilitator. Both techniques greatly depend on the facilitator's performance. However, in real situations, facilitators are well-trained people who usually follow a set of guidelines, including a strategy for extracting the best from participants. For example, although we had adopted the same technique in Parts 2 and 3 of the experiment, the strategy adopted was different, resulting in stories with very different characteristics and qualities.

6.2 Group Storytelling with the TellStory

Many problems were solved when the group storytelling technique was used with the support of TellStory. With the TellStory tool, all the contributions were persistent. The participants were able to organize their knowledge access the contributions made by other participants, access the tool at any point from anywhere. To sum up, they followed the story recall dynamics proposed by the tool [23], achieving some of the expected advantages.

Nevertheless, other problems appeared. The TellStory promoted less interaction among the participants and there was little intervention from the moderator due to the limitations of the tool. These limitations negatively affected the contribution of the group. Problems such as lack of awareness mechanisms, lack of coordination tools, and poor communication mechanisms were reported by the participants.

Although it produced important gains in time and energy, the asynchronous interaction did not motivate the participants' commitment. Because they logged on at different times and did not meet, the use of the tool requires a high level of compromise from group members. A synchronous interaction induces participants to reserve a fixed amount of time for the task, while the asynchronous interaction tends to assign low priority to the task. We believe that a mix of the two types of interactions would be more appropriate. In other words, to start with synchronous sessions followed by asynchronous interactions.

In the first experiment, the story generated by the TellStory presented the same completeness and level of detail generated by the group storytelling approach without the tool. However, the scenes were not as ordered, which indicates some limitations of the tool. In the second experiment the story generated using the TellStory

presented more details. The movies had a similar length and were chosen based on what we considered a similar level of detail and complexity. The participants were the same. The similarity criteria was an attempt to credit the differences to the method, but we cannot assure this.

The results confirmed that group storytelling is a very strong technique for recalling stories. However, the advantages generated by the supporting technology are not yet clear. The experiments also served to indicate further improvement in TellStory:

- to be as transparent as possible so that people do not apply filters and feel confident in contributing;
- to provide mechanisms of awareness, coordination, and communication;
- to promote a reliable and motivating environment.

According to the questionnaire's answers, all the participants positively evaluated the dynamic proposed by the tool as being very useful for a story recall. They also reported that a face-to-face interface is richer and more stimulating. When this technique is not used, nonverbal information, such as facial expressions, gestures, voice intonation, and body movements are lost. Thus, the context, the individual perception of the contributions, and the channel of communications are also lost. The lack of direct interaction, a characteristic of the TellStory tool, made some participants less active, reducing their registered contributions. The future re-design of TellStory should provide face-to-face communication beside other media, such as video conferencing, audio, and graphic tools.

It is recommended that the story recall occurs as early as possible to avoid the missing of details. On the other hand, the experiment indicated the need for better teamwork support. The story recall should also motivate participants by providing benefits of some kind at the cultural and social level.

In Table 3, we present a summary of the features of each technique based on the observations made during the execution of the techniques, the resulting stories, and the answers to the questionnaires. The quality of the stories conclusion was generated by comparing the resulting story with the pieces of the story shown to participants. We noted more missing parts in the stories generated by interviews than the stories generated by the group storytelling. We asked people who did not know the movies and did not participate in the experiments to judge the quality of the documentation, i.e., from which document it was easier to understand the story and identify the missing parts. This analysis has showed a clear superiority of the stories generated by the TellStory and provided us with additional insights about how to judge the quality in future experiments.

6.3 Observations Made During the Experiments

The tellstory approach is new and requires a disciplined attitude by the participants. We noted a tendency to advance towards the full story as a tentative to acquire the

Aspect	Interviews	Group storytelling	Group storytelling with TellStory
Quality of stories	Organized, but poor and incomplete stories	Richer, more complete better organized stories	Rich, complete, but disordered stories
Interaction among participants	There is no interaction between the participants	Synergy of the participants	Participants' synergy, but the qualities of the face-to-face interactions are lost
Documentation	Disorganized and not persistent knowledge	Disorganized and not persistent knowledge	Organized and persistent knowledge
Role played by the moderator/ facilitator	The moderator is responsible for relating the film segments	The moderator questions or suggests the connection of the film segments	The moderator questions or suggests the connection of the film segments. S(he) also monitors the participation in the task.
Group location	In typical interviews, the pair interviewer-interviewed should be in the same place, at the same time	The group must be in the same place, at the same time	It allows access at any moment from anywhere
Expressiveness of participants	Constraints on interviews	Uncomfortable in the presence of other people	Inhibition about writing their remarks and beliefs

Table 3. Qualitative results obtained by observations from the stories

full meaning of their experiences. Many comments can be classified as conjecture, i.e. they were aimed at exploring the unknown part of the story. The facilitators had to make an effort to keep the context within the known story. On the other hand, this can be seen as a constructive attitude as participants do not know what is the known part of the story until they get no answers from their inquiries. Therefore, unanswered comments are valuable as they indicate obscure parts of the story that need to be recovered from other participants or left for the conjecture step. To address this issue in the new version of TellStory we created a fragment classified as a "gap". It describes what participants think is missing in the story.

The advantage of using selected scenes from movies is that we are able to judge the completeness of the story generated comparing what was shown with what was reported. We drew our conclusions about completeness and conjecture using this comparison. This would be difficult to achieve if we have used real events. We did not carry out a rigorous ethnography study, but that study would be useful to

analyze why a known event has not been reported by a participant or what has motivated him/her to add the event, e.g. another event or a comment from other participant.

Participants used a variable granularity of events and level of details in their description. Although the facilitator has the possibility of editing the fragments by splitting or joining events, this was considered an undesirable interference from the facilitator. The same did not occur when participants added comments to events reported by other participants. We observed a different attitude when participants were interviewed and the interviewer edited the story. It seems that when participants assume the authorship of the story, as it occurs in the group storytelling approach, they are more sensitive to this interference from the facilitator.

6.4 Limitations of the Experiments

The current findings have several limitations. Although these preliminary results provide useful insights to the collective knowledge recall, further experiments are necessary to confirm our hypotheses and the first rounds of findings. It is a consensus that group synergy has a positive effect on both the quality (completeness and accuracy) of the stories and the time spent to generate them. However, we have not confirmed the gains obtained with the groupware tool. This may have to do with the type of interaction, the functionality of the tool, or the set of experiments.

When groups are co-located in the same environment, the main advantage provided by the tool is the automatic documentation it generates. The face-to-face interaction, however, converge to a single story faster than the asynchronous interaction supported by the tool. The geography distribution of participants cannot be considered a constraint of the face-to-face interaction because it can be overcome by videoconferencing support.

The size of the groups can produce some effect on the results. On the experiments the groups were rather small (four people each). Large projects usually have many more participants. We believe this creates additional difficulties to face-to-face interactions, not only on the availability of all participants to get together at the same time, but also on the dynamics of the interaction itself. The asynchronous interaction can show some advantages in this situation.

The previous experience of participants working as a team can have some effects on the results. Teams that have worked together in task-oriented activities are expected to perform better than teams whose members have never worked together. In our experiments this was not an issue because the participants knew each other and had worked as a team in several tasks before the experiment. This situation can be assumed in most organizations. If, however, they work together for the first time, lack of trust can create additional barriers for groupware supported interaction [28].

7 CONCLUSIONS

Knowledge recall is an important activity in organizations because many projects and jobs are carried out without any documentation of their procedures or results [29]. Knowledge recall would serve to support the design of future similar activities, trying to avoid mistakes and to repeat successes. In order to provide such support, it is very important to recover the tacit knowledge adopted during these projects. Formal documentation usually leaves out this important type of knowledge.This paper presents two experiments aimed at examining two approaches for knowledge recall.

The group storytelling approach to knowledge recall was compared to the more traditional approach based on interviews performed by a facilitator who is also responsible for the final version of the story. We also compared the group storytelling approach with and without a computational support tool. The preliminary results show a clear advantage of the group storytelling method over the interview approach. When we compare the group storytelling approach with and without the tool, there are advantages and disadvantages in both modes. Further experiment should be done to confirm these initial findings.

We have used feature films to simulate stories that are not completely known by any participant. The use of movies allowed us to control the parts known by the participants and therefore evaluate what was missing in their reports. We also have cases where parts of the story existed, but they have been lost. This is usually the case when the organization cannot count on all participants to recall the knowledge.The tool still needs many improvements. Some of expected benefits have not been achieved because the tool does not support an appropriate functionality. The experiment was important to generate insights into the requirements of future versions of the tool. Besides implementing the new functionality, we intend to make the tool customizable to be able to adapt to different knowledge recall situations.

Currently, the relationship between fragments is only temporal. A new version of TellStory [25] will include the possibility of establishing other relationships between fragments, such as causal, inconsistent or contradictory, and strengthening, as proposed by Vale, Prinz and Borges [3]. Another type of connection between fragments is the gap connection, that indicates a missing fragment that may or may not exist, i.e., whether or not it is part of the known version.

One important target of our research is to use this approach for recalling the events that precede incidents that occur in organizations. To do this, the mechanisms of perception, communication, and coordination of the TellStory tool are being improved. Some new features are also being incorporated. The dynamic and the structure of stories proposed by Perret are also being adapted to the context of accidents and emergency situations [25, 30].

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