Using Storytelling to Record Requirements: Elements for an Effective Requirements Elicitation Approach

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Abstract — Existing requirements elicitation approaches have proven insufficient to record complete, consistent, and correct requirements. Studies conducted have shown that 40% of defects in software projects are due to incorrect recorded requirements. Therefore, some innovative approaches have been developed to deal with the lack of addressing the above-mentioned issues including video-based methods. Recent approaches using Storytelling to elicit requirements started to emerge in the field of requirement engineering. However, few experiences have been conducted to investigate which elements of the Storytelling technique are needed to conduct elicitation activities, and how effective Storytelling is in supporting, improving, and complementing existing techniques for the requirements elicitation phase.

In this paper, we report on an experiment involving twenty-five domain experts from various industrial companies to collect requirements using a Storytelling technique for a particular ticket machine case. In particular, we investigate the effectiveness of using a Storytelling technique compared to a traditional brainstorming technique. We then sketch out the experimental design of the case study; outline various observations, results, and finally we lay out important findings about telling stories in the context of collecting requirements.

I. INTRODUCTION

Eliciting clear, complete, and correct requirements is still a challenge and a difficult undertaking in requirements engineering [1]. Crucial information related to the requirements is often ignored, and partially or not recorded at all during requirements elicitation. Recently, a few innovative approaches have emerged to address some of these issues, including multimedia and video-based methods such as VBRE [2], Storytelling framework such as Athena [3], and specific studies such as the Investigation of Storytelling as a Requirements Elicitation Method for Medical Devices [4].

In the industry, the common process of eliciting requirements involves requirements workshops, focus groups such as JAD, brainstorming sessions, and interviews with one or many stakeholders [12]. The recorded notes, issues, questions, pinpoints, and stakeholders’ needs are translated into requirements. The different stakeholders, including end users, clients, project managers, designers, subcontractors, suppliers, and funding bodies have different levels and types of investments and interests [13]. They may not even share a common language or project knowledge [1]. Consequently, and in particular in the early phases of the projects, stakeholders may have different understandings, different interpretations, and share little project knowledge. However, as projects progress, the degree of shared knowledge evolves, yet it is still hard to come to a unique, shared and overall big picture of the project between all stakeholders. Engineers documenting the requirements may misinterpret, partially document, or omit important statements. Forcing stakeholders to keep to specific notations might irritate the stakeholders and distort the requirements. Therefore, the produced requirements may be incomplete, inconsistent, or incorrect.

Most of the existing requirements elicitation approaches are clearly lacking capabilities to support gathering complete and detailed requirements in a natural flow. This is because these approaches essentially do not focus on making the user tell what he feels like telling, rather constraints the user with a particular flow, such as in interview-based and questionnaire-based methods. Approaches such as unstructured interviews provide a better degree of freedom for the customer representatives as confirmed in [14]. It is important to mention that by “unstructured interviews” in this case means any kind of unstructured interaction between the developers and the user representatives [14]. Rather than having a concrete and focused set of questions chosen in advance, the interviewer
brings general questions to help the user talk about the problem domain. Further exploration of alternative methods for requirements elicitation that addresses these issues is needed. In particular, there is a need to experiment with approaches that are more known to be natural to human beings, which enforces sharing values, developing trust and commitment, and generating emotional connections as outlined in [5]. However, we are interested in an approach that not only includes the previously outlined aspects but also enables full communication and knowledge transfer within a requirements engineering context, where stakeholders can use their own language as a tool to convey needs and requests.

We are considering Storytelling as one interesting candidate approach that fulfills the above mentioned requirements. And our hypothesis is that Storytelling is a more effective method in eliciting requirements than traditional methods.

We investigate the usage of the Storytelling technique in eliciting requirements and its effectiveness. The effectiveness of the method is defined as the ability to produce clear, complete, and detailed requirements. For this purpose, we conducted an empirical study and made observations and evaluated the results, finally we laid out important findings about telling stories in the context of collecting requirements.

In section II, we describe the elements of Storytelling for requirements engineering. In section III, we describe related work. In section IV, we illustrate the scope and objective of the study, and then we describe the hypothesis, which we aim to investigate by the empirical study. Next, we outline the research strategy and the experimental setup. In section V, we interpret the qualitative results. Finally, we conclude and discuss the future steps in section VI.

II. ELEMENTS OF STORYTELLING FOR REQUIREMENTS ENGINEERING

Storytelling as a technique was used for knowledge management [6, 7, 8]. Stories, as a tool, have been used to pass along knowledge for thousands of years. There are stories to everything, and our brains are built to listen to them [9]. Studies in psychology have revealed that human beings learn best from stories [9]. Rinzler in [10] emphasizes on the fact that listening to a story causes the listener to experience everything heard, as if being a part of all the action. Listeners relate to each event and fill in any details that might be left out. Moreover, listeners are able to evaluate and remember each piece of information, because it is part of a logical and realistic whole that one validates against their own experience.

If we learn best from stories, we can find a similarity between elements of stories and elements of a requirements engineering story. Obviously, telling one’s experience and needs in the form of a story is more relaxing and flexible than using standard and ready-made questions to gather requirements. While exploring many useful ways of representing requirements for engineers, structured analysis and existing modern methods have become too abstract and have moved far away from how people ordinarily learn and communicate, such as in telling stories. Storytelling is a logical process that everyone understands intuitively. Relating a story to what the system does to an understandable narrated story is more compelling, and leads immediately to improving the process of gathering information and structuring requirements. Stories bring life to details in requirements, which are otherwise tedious to follow or to document and consequently might be lost.

According to Rinzler [10] each story includes particular elements. In the following, we outline the analogy to a requirements story and try to find its effectiveness in the conducted experiment.

Fig. 1 Elements of a Story which may be mapped to elements of requirements stories as well

A. Conflict

The basic problem to solve is the central conflict to resolve in the requirements process. Such a conflict can exist between stakeholder needs or between technical constraints and stakeholder needs, or other types of constraints, e.g. such as results from the system’s application domain.

B. Theme

The theme is the central concept underlying the solution in the document. In requirements engineering, it can be mapped to the project goal.
C. Setting

A setting is the place and time of the story. In requirements engineering, it is the broader context of the problem being solved. This includes, among others, general information about the technology environment, business, industry and economic conditions.

D. Plot

In a story, the events happen in a certain order and the outcome of each affects the later ones. In requirements engineering, it’s the series of processes that occur in the current and future system.

E. Characters

Any entity that is capable of action can be a character. There are many types of characters in requirements engineering: people, groups of people, machines, or programs.

F. Point of view

It can be very useful to take different points of view pertaining to a specific character, as one describes different processes, or the same process. The main goal is to provide a complete view that practically describes everything that happens and what everyone needs.

III. Related Work

A. Storytelling for Requirements Definition, Anchored Scenarios and Waypoint Tracking

This work [11] presents a methodology for the development and application of increasingly focused system guidelines using readily understood stories. The author argues that the main novel aspect in this research is the discipline in the determination of sample situations that best illustrate the real-world functionality, and thereby guide associated well-specified system behaviors. It studied reviews of domain characteristics which are cast into key constraints and common check-point elements. Well-understood stories, more general scenarios and then more abstract Use cases are derived. Standardized stories and scene-elements are tagged and stored into a repository for use in later projects. The course of systems development and final behaviors are envisioned, and are purposely framed by identifying way-point markers that anchor the path of execution and provide common measures for tracking status and weighing course corrections. The method is valuable in securing project approval, in clarifying core behaviors and boundaries, in guiding diverse collaborators, and in measuring success in the eyes of executive leadership.

B. Athena: A collaborative approach to requirements elicitation

In this work, the authors describe a solution to overcome problems including viewpoint, mental model and expectation differences among users and analysts. Athena [3], an approach founded on collective knowledge to progressively build the system requirements from a narrative of user stories to the definition of Use Cases. Athena is a collaborative approach to elicit requirements. It is based on group storytelling, where stakeholders tell stories about current and past systems that support a given activity. The stories are merged to form a single story. Stories are then transformed into scenarios, and from scenarios to Use Cases. The solution consists of a knowledge model based on stories about the system, a collective construction method, and a tool to support interactions. Experimental analyses have been conducted to show the effectiveness of the proposed approach and are reported in [3].

C. Investigation of Storytelling as a Requirements Elicitation Method for Medical Devices

The authors present a study exploring the Storytelling as an elicitation method for medical device requirements [4]. In particular, issues related to the definition of the requirement for the medical device usability, design of healthcare systems and context-in-use are addressed. The authors stress the fact that standards require the use of user research techniques, yet patient privacy standards prevent designers from observing users in context. The inability to observe users in their work environment impedes understanding the context-of-use. Since understanding context-of-use is required to ensure usability, further exploration into alternative methods for requirements gathering is needed. This study explored the Storytelling as an elicitation method for medical device requirements, by comparing the information elicited from nurses during requirements gathering for an infusion pump by two methods: focus groups followed by interviews (Group #1) and focus groups followed by Storytelling sessions (Group #2). Results suggest further exploration of Storytelling is warranted as Group #2 contributed similar quantity and breadth of information in significantly less time. Results also indicate potential support for the efficacy of
Storytelling within the healthcare domain as Group #2 participants contributed more distinct context-of-use information with an emphasis on the social context. Contributions of this study include a plan for mixed-method data analysis, a protocol for conducting a Storytelling session, and a framework for defining requirements within the healthcare domain.

IV. OBJECTIVE AND SCOPE OF STUDY

A small scale experiment was conducted to gain insights on the practice of telling stories related to requirements elicitation context. This study is an attempt to identify how effective Storytelling is in eliciting requirements and which factors are likely to influence the output and quality of the requirements. We measure effectiveness in terms of time needed versus resulting requirements, satisfaction of the stakeholders, degree of detail of the requirements, and completeness of the requirements. We had the opportunity to gather twenty five participants from different industrial companies and academic institutions (among others Siemens, Sophist Group, universities,...) who were concerned with requirements development for software and system development in their own domains. They were willing to learn new ways in dealing with requirements management, in particular to experiment with Storytelling.

A. Research strategy

In order to confirm our hypothesis we need to set up an experiment which is an empirical case study that compares the effectiveness of Storytelling to standard approaches, such as brainstorming and questions answer. The effectiveness is measured by how detailed, clear, and complete are the requirements. The following are the steps to conduct the experiment: formulate the hypothesis, observing the situation, abstracting observations into data, and analyzing the data. Finally, we draw conclusions with respect to the tested hypothesis

B. Hypothesis

Our hypothesis is that Storytelling is a more effective approach in eliciting requirements than traditional approaches based on systematic structured techniques. In particular, we claim that in using Storytelling technique, we are able to reveal critical information, tacit knowledge, as well as more details that are not likely to surface using standard brainstorming approaches. However, we do not advocate replacing existing methods with the Storytelling technique; rather we claim that it can complement existing approaches. In particular, Storytelling is a method for eliciting requirements from stakeholders. It must be combined with a method for requirements documentation, in order to transform the free-text requirements resulting from Storytelling into a more formal specification.

C. Setup

From the twenty-five domain experts taking part in the experiment, two groups each of twelve participants were formed to conduct the assigned task of eliciting requirements for a particular ticket machine case study. As an early experiment exploring the context of using Storytelling, the case study of the ticket machine was chosen for its relative simplicity compared to heavy and complex industrial examples, where the lack of time and means were the main obstacles for not being considered. The setup is summarized in Tables I-a and I-b and illustrated in Figure 2. The S-group uses a Storytelling technique while T-group uses the traditional brainstorming technique for requirements collection and discovery. The T-group represents the control group for the experiment. To minimize the risk of selection bias, we followed a random process of selecting the subjects, i.e. the group members. In addition, all members are qualified experts and practitioners in requirements and software engineering.

Both groups were asked to produce requirements and use cases in the first place. Therefore, the comparison between the results of the two groups is based on similar artifacts. In the produced Mind-Maps the requirements are represented using branches, and the use cases are represented using the sub-branches.

Table I-a. Summary of the case study of the S-group

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<th>S-group: Using Storytelling</th>
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<td>Within the provided time-frame the S-group uses Storytelling to collect and discover the maximum number of requirements in forms of short stories revealing personal experiences with the ticket machine. The stories included narrated real experiences, the good as well as bad ones, and anecdotes. Important recommendations were made to the group to consider outlining issues, discuss different stories and express user needs and requirements. The stories are told in the German language.</td>
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- Benutzer (User): represents a standard user of a ticket machine. Tells own experience including new ideas and wishes from the point of view of a user.
- Zugbegleiter (train attendant): tells stories in his role as a support for train customers to deal with common issues.
- Manager: tells stories from a manager point of view
- Wartung (Maintainer): the technical maintenance in the train
- Moderator: ensures that time and roles are respected by group members
- Teufels Advokat: criticizes the told stories and ensure they are complete and include particular cases and exceptions. He is never happy with a story and adds always “yes, but ...”
- Indexer: documents all told stories by all users. The written form can be a mind-map, a table, or free form

**Table I-b. Summary of the case study of T-group**

**T-group: Brainstorming (Control Group)**

Similar in the construction of S-group, the different members were assigned roles and are asked to conduct a brainstorming session to elicit requirements for the ticket machine case study. The different roles helped the participants to think about issues and outline main needs in terms of their respective responsibilities.

**Roles:**
The same roles were used for group I although unnecessary

**Time:** 45 min to complete the task

**Place:** in the same room, relatively big enough for both groups. Ideal would have been two separate rooms.

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**Table II-a. Summary of the observation of S-group**

**S-group: Storytelling**

- The group has shown coherence and has generated emotional connections between the group members.
- Some were raising questions. There was no explicit request for answers however.
- Some were emotional in telling their own bad-luck experience and suggesting solutions.
- Some were confirming others and adding a few elements.
- Group members were presenting alternative solutions to issues raised by others.
- Rare situations using the ticket machine were classified as exceptions.
- Group members were interrupting each other to complement or to mention a similar story.
- Group members had some fun in telling their own stories, this was clear from their laughs which happened often, and the way they were narrating their personal experiences and anecdotes

**Table II-b: Summary of the observation of T-group**

**T-group: Brainstorming (Control Group)**

- There was no sign of group dynamics as in S-group
- Questions and answers were sporadic
- Group members did not show any emotions
- Solutions of general type were shortly discussed
- Group members were most of the time quiet, which could mean they were thinking about what to ask and what to say. This suggests a non spontaneous behavior as with storytelling.
- Group members were thinking in terms of solutions and discussed less the problems
- Group members used ellipses to describe topics, in a brainstorming fashion
- Group members seemed they are trying to look for solutions for the problem of using the ticket machine more than formulating issues and problems.
- Group members did not show the active initiative to provide details, rather waited for questions to be asked by the group members or by the moderator

The general observations about both groups show a clear tendency of the groups. The Storytelling group was more dynamic, showed clearly more emotional signs than the brainstorming group, members showed more interaction with each other, gave more stories than solutions, and more anecdotes than brainstorming. This group produced by far much more content than the first group, which essentially conducted brainstorming activities. The second group produced less content (topics, questions, alternatives, various short stories, etc) and was thinking in terms of
solutions described in use cases than stories and anecdotes like in the first group. Quantitatively seen, the first group produced almost three times more requirements than the first group. The first group acted as a "control group", the second group acted as a "treatment group".

E. Results

From the stories told in the S-group, requirements and Use cases were extracted and put on a Mind-Map form for later analysis and comparison of the results of the two groups as depicted in Fig.4. From the brainstorming group, also a list of requirements and Use cases were written down in a Mind-Map form as shown in “Fig. 3”. The choice in using Mind-Map representation was a suggestion which came from both groups. Other different representations using tables or free form were also outlined; however these outline forms do not provide clear visual way for a direct comparison.

An initial analysis of the produced use cases shows a comparable quality of output. However, and according the definition we stated in the effectiveness in section II, Storytelling fulfilled the requirements and provided more elements to be more effective than brainstorming. Indeed, the S-group produced a higher number of use cases covering all of the ticket machine requirements the group members could think of. In addition, more specific details were revealed which were not observed in the results of the brainstorming group. Moreover, the use cases were clearly stated and related issues were solved during the time-frame allocated for the case study.

It is to notice that the main threat of the validity of the conclusion is the quality of the subjects, that is, the members of the group conducting the experiment. Different people with different expertise may provide qualitatively different results. In our experiment we used a random process in choosing the subjects.

It is to notice that the stories were told and documented in the German language. Therefore the Mind-Maps produced are in German as well. That said, the language is not considered an issue as this does not impact on the final results and could be a topic for a later investigation research area.

Fig. 2: Mind-map representing the results of T-group: using brainstorming to collect requirements

Fig. 3: Mind-map representing the results of the S-group: using Storytelling to collect requirements
The summary of the quantitative results are summarized in the chart in “Fig. 4”.

V. INTERPRETATION (QUALITATIVE RESULTS)

The Storytelling group members, in telling the individual short stories, the participants were building the ultimate (defined as final, one, big, and complete) story without noticing. The Indexer at the end was summarizing the individual stories into one big story while examining the output (what he personally was writing down, while users were telling their stories). The ultimate story needed the collaboration of all participants; hence Storytelling in this case is a collaborative activity. The group dynamics influenced the construction of stories told by the members (communication, emotional connections). The quality of the story influences the quality and the number of the discovered requirements. An important factor that could have influenced the results is the impact of the available time to tell the stories. The subjective opinion would suggest that in more relaxing conditions without any time constraints, the result would be better qualitatively. Moreover, although there is some confusion concerning Storytelling and brainstorming, it is quite clear that these are two different techniques to elicit requirements. However, brainstorming and Storytelling can play a complementary role. Traditional brainstorming sessions do not lead necessarily to better quality requirements or to discover more requirements than in using Storytelling.

VI. CONCLUSION & OUTLOOK

Storytelling is a powerful tool in knowledge capturing and transfer, as Storytelling is a natural and straightforward behavior for human beings wishing to communicate and transfer knowledge. In particular, we argue that Storytelling is a more effective tool than brainstorming for eliciting requirements and including the tacit knowledge as part of the elicitation process. This has the advantage of providing detailed and more complete requirements than traditional approaches. The main goal of this case study was to investigate how effective Storytelling can be in eliciting and
developing requirements. We verified our hypothesis using a small scale experiment. The quality and the degree of detail of the requirements developed using a Storytelling approach was by far greater than those developed using traditional approaches such as brainstorming. However, although the result confirmed our hypothesis, we do not claim to generalize the conclusion, rather the experiment provides a first encouraging insight into using Storytelling as a practical and effective tool in eliciting requirements and complementing existing approaches and tools. Finally, we plan to report on a similar experiment within an industrial context where Storytelling was used as a tool for requirements elicitation. Moreover, we plan a further replication of the case study within Siemens running industrial projects.

References