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# Evidence-Based Timelines for Project Retrospectives — A Method for Assessing Requirements Engineering in Context

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**Abstract**—Effective requirements engineering (RE) can support efficient development of successful products. However, assessing and improving how RE supports its context, i.e. the development life cycle, is non-trivial since many different roles and factors are involved over a long period of time. Project retrospectives may support project teams in reflecting on how requirements are agreed upon and communicated throughout a project. However, time is rarely taken for group reflection after project completion. Furthermore, project events may be recalled differently due to memory bias. We propose supporting project retrospective meetings by providing prepared evidence-based timelines visualizing the project history. The method was designed and evaluated in collaboration with a large telecommunications company using action research with the goal of assessing RE within the full development life-cycle. The initial evaluation results show that the method may support project retrospectives through fact-based memory recall and by enabling efficient and factual group discussions of RE in the context of the project life-cycle. In addition, some areas for improvement of the method have been identified, e.g. strengthened focus on expected outcome and clearer visual separation of evidence types.

**Keywords**—project retrospective; agile requirements engineering; action research; process improvement; visualization

## I. INTRODUCTION

Requirements engineering (RE) is an important part of the development process that can support other software engineering processes, e.g. project planning and testing [7], and ultimately enhance product quality and customer satisfaction [7]. However, assessing and improving RE in the context of the entire project life cycle is challenging due to the complexity of multiple roles and activities involved over a long period of time, especially for large-scale development [20]. Process improvements can be identified through retrospective analysis [13], [14] and project retrospectives (a.k.a. lessons-learned or post-mortem reviews) aid identifying good practices and improvements [1], [6], [9], [18]. However, project retrospectives are rarely performed and project details are quickly forgotten as people are allocated to new projects [1], [11]. In addition, *memory bias* may affect recall of a memory and its contents, which may prohibit learning from project retrospectives [26]. Furthermore, reflection on purely experience-based memory recall carries a high risk of drawing incorrect conclusions

[11] and may result in emotional venting sessions rather than in constructive fact-based discussions [6], [10].

We propose using evidence-based timelines for supporting reflection on project history by providing facts (evidence) of project events, and not only rely on subjective opinions. The method is designed to enable project teams to assess the impact of RE decision making and requirements communication on the development life cycle. Improvements beyond single tasks and roles may be identified by group reflection on the project history from the multiple viewpoints of several roles. The method has been designed in close collaboration with a partner company with the aim to assess and enable improvements of RE within their agile development process. The design of evidence-based timelines for supporting project retrospectives has been described in [2]. In this paper, the retrospective meeting is presented and we report on an empirical evaluation of the method that was performed at the case company using action research. Evidence-based timelines were constructed for three completed development projects and retrospective meetings were held with key project members. Data has been collected on the participants' view of the method using a focus group discussion and a questionnaire.

The case company is described in Section II. The retrospective method is described in general terms in Section III, and in the case company context in Section IV. The evaluation method is described in Section V, while the results are presented and discussed in Section VI. The limitations of the evaluation are discussed in Section VII. Finally, the paper is concluded in Section VIII.

## II. CASE COMPANY

The projects included in the evaluation are projects at a company with around 4,000 employees that develops software in the telecommunications domain using an agile development process. All new functionality is prioritized in a product backlog and developed, in order of priority, in separate projects per feature that integrate software into software release projects. The synchronization with these release projects is managed at product toll gates through gradual commitment of the features.

A feature project life cycle has a lead time of 9 weeks to 2 years and includes handovers between different units and teams; from request through design, development in cross-

functional teams, system integration and system testing, and finally customer acceptance. Typically around 200-250 features are integrated into a main software release project.

Different roles are involved in a feature project. The ones relevant to this evaluation are: product manager, project sponsor, project manager, project architect, developers and testers. The product manager acts as a customer proxy and is responsible for requirements and scope decisions. The project sponsor is responsible for ensuring sufficient resources to execute the project. The feature architect ensures that the developers implement a good architecture, which adheres to company strategy and guidelines. The developers and testers are responsible for iteratively detailing the requirements in collaboration with the product manager, and develop and verify software that meets those requirements. In addition, there are roles at the system level, i.e. architects, integration, testing, that are not members of the feature project but with which the feature interacts.

### III. EVIDENCE-BASED RETROSPECTIVES

Our method entails using prepared project timelines as a starting point for retrospective meetings. The history of a project is visualized in a timeline by displaying time-stamped evidence of project events gathered from various systems. The timelines may, thus, provide memory prompts that enable reflecting on past events. At the retrospective meeting multiple roles involved throughout the project share their experiences of project events and through collaborative reflection good practices, unresolved issues and improvements may be identified. Kerth describes a timeline method where the timeline is produced at the meeting by the participants [14]. Our method enhances on this by providing evidence-based timelines as input to the meeting.

#### A. Preparations Including Timeline Design

The timelines are constructed based on four parts: goals, aspects, evidence, and visualization. *Goals* are defined for the retrospectives to focus on strategic improvement areas. Based on these goals, the *aspects* to visualize in timelines are defined with an eye to what data can be extracted. Both goals and aspects can be defined for continuous reflection (and, thus enable long-term comparison) or to assess issues specific for a certain project. Multiple retrospectives can be aligned by defining common goals and aspects and thereby provide an improvement focus within an organization or for sub-projects within a larger project. When the set of aspects to include are defined, *evidence* is collected for the project in the form of time-stamped data extracted from various systems. The project history is *visualized* by displaying this evidence along a timeline, which is used at the retrospective meeting as a basis for discussion and analysis.

#### B. Retrospective Meeting

The retrospective meeting is designed for participants who represent key roles throughout the project life cycle

(similar to project history day [6]). These roles may invite others with experience relevant to the retrospective goals and aspects. The meeting was designed according to guidelines for project retrospectives [14] and focus groups [22]. For example, the importance of the role and skills of the moderators in facilitating an open group discussion were considered. This role is responsible for leading and supporting a focused and constructive discussion at the meeting. In addition, the moderator should ensure that the discussions are not monopolized by a few people. The number of participants was aimed at four to eight project members and at least one, preferably two, moderators. The method was designed for a meeting time of 60-90 minutes. In addition, time is needed to prepare the room and to afterwards collect the data posted on the walls.

At the meeting, the goals of the retrospective and the overall timeline including the *aspects* are presented to focus the participants and orient them concerning the visualized data. As an opening exercise, the participants are asked to consider what information may be missing or incorrect for one of the timeline aspects. This acts as an ice breaker and encourages the participants to actively use the timeline for referring to and adding information to.

Next the moderator leads an open discussion based on a set of *focus questions* defined in line with the retrospective goals to support focusing the discussion. A set of *prompting questions* suggested by Kerth [14] can also be used for reinvigorating the discussions. By using the focus questions as a check list the facilitators can allow a free discussion within those boundaries. Depending on group dynamics, more structure might be required to ensure that everyone is actively participating. For example, participants could be asked to silently reflect on specific questions and then share their thoughts in turn. The participants should be encouraged to add clarifications, corrections and additional information to the timeline. In this way, the meeting produces an updated and jointly agreed picture of the project history as one of its outcomes. The final part of the meeting consists of jointly summarizing the findings and lessons learnt. For this, the headings from Kerth's timeline exercise [14] are used, i.e. things that worked well, were learnt, need improving, are still puzzling, need to be discussed further.

#### C. After the Meeting

A meeting summary including the findings is produced by the moderators. In addition, the timeline is updated to reflect the agreed picture of project history including added and corrected events. This material is distributed to all participants who can comment on misunderstandings and add additional reflections made after the meeting.

### IV. EXAMPLE: METHOD IN CASE CONTEXT

The method was customized to enable assessing the impact of RE activities within development projects at the case company by defining a retrospective goal, and focus questions and aspects to cover this goal. This was done

through regular meetings with company representatives over a period of 1-2 months. A guide describing our method in the case company context is available on-line [3].

The company’s main retrospective *goal* was to assess and improve RE decision making and RE communication throughout development. *Focus questions* on scope, communication and planning were defined to cover this goal. Six *aspects* were identified, namely (1) project state, (2) decision points connected to scope planning, (3) business value, (4) development cost and planning, (5) artefacts, and (6) role assignments. Due to limited time the artefact aspect was not included in this first evaluation.

*Evidence* was gathered mainly from databases used for project planning and tracking, and for scope management. The time-stamped data was then *visualized* per aspect by using the timeline functionality of MS Visio. A set of the available icons were selected to visualize different types of events, e.g. state, decisions, informational. The set was limited to five basic event types in order to keep the visualization simple and avoid overloading the participants with symbols. The selected types were: project phase, time period, role assignment, decision and informative comment, see Figure 1. Dates for events are notated as day / month. The visualization of each aspect is described below. In the given examples, all dates and names have been anonymized.

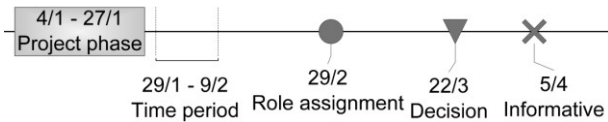


Figure 1. Event icons used to visualize timeline events.

**The aspect of people** visualizes events related to roles, functional area and development site. For example, Figure 2 shows that Liza was assigned the role of system architect and that the product manager (reqs responsible) was unavailable (out of office) the first week of July. In addition, the change of sponsor and project manager in July was due to vacation stand-ins. Grey text indicates information provided by participants.

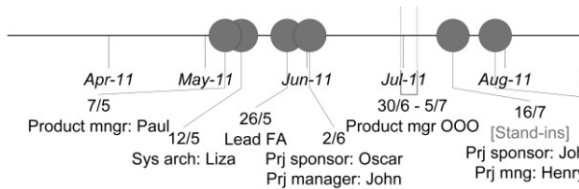


Figure 2. An example from visualizing the aspect of people.

**The aspect of state** visualizes project phases and state-related project events. For example, Figure 3 shows that the project was in the initial prioritization phase during April and most of May, during which time the target software release was suggested to be 3, 4 or 5. System impact analysis was initiated 20<sup>th</sup> May.

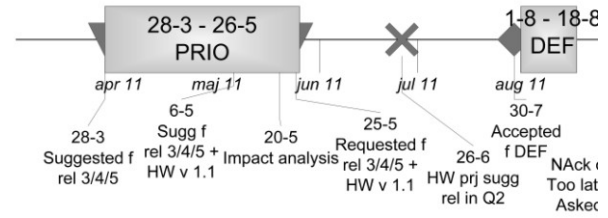


Figure 3. An example from visualizing the aspect of state.

**The aspect of decisions** includes formal decisions and informative events related to decisions. Figure 4 shows that the feature was missing stakeholder information (28/4), which is then decided on (6/5) and later (20/5) system architects recommend the feature for implementation.

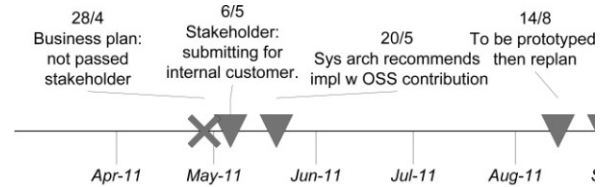


Figure 4. An example from the aspect of decisions.

**The aspect of value** visualizes events related to business value. In Figure 5 the origin of the feature (i.e. technical roadmap) is shown and also that it is required for dependent products. On 30/4 a stakeholder is added (the stakeholder requested by the decision event of 28/4) and a few weeks later (13/5) the business value is decided, indicating that the feature was then included in the product backlog.

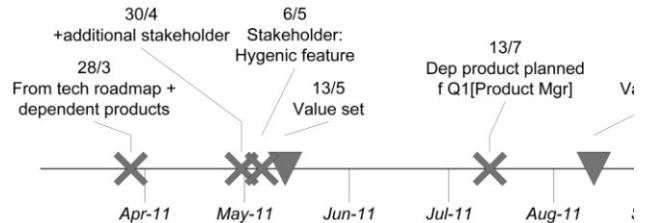


Figure 5. An example from the aspect of value.

**The aspect of cost** visualizes events related to development cost and planning. Figure 6 shows two estimates made for feature definition cost (in May) and for delivery date (in August).

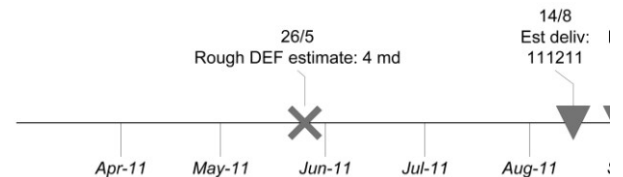


Figure 6. An example from the aspect of cost.

## V. RESEARCH METHOD

The evaluation of our method was carried out using a qualitative research approach, namely action research [22] with a combination of qualitative and quantitative data collection. The purpose of action research is to influence

some aspect within the research focus with the aim to improve a practice, the understanding of it and the situation in which it takes place [22]. We selected action research over the purely observational research method of case studies [23] to evaluate our method in a live industrial context. The idea was to validate the method by applying it and investigating if the method was applicable to assessing and improving how RE supports the development life-cycle. Action research consists of four steps [22]: (1) plan how current practice can be improved, (2) implement the plan, (3) observe the effects and (4) reflect on the performance.

The method was validated concerning the following three main aspects: (RQ1) extent of support provided by the method for gaining new insights, (RQ2) extent of support provided by evidence-based timelines, e.g. for memory recall, and (RQ3) cost effectiveness of the method for project members. For the initial evaluation, three completed projects were selected (step 1) and timelines were generated for these and retrospective meetings held with project representatives (step 2). The participants experience of the method was gathered through a focus group discussion and through a questionnaire (step 3) sent out a few days after the meeting. The participant feedback was analyzed and discussed within the group of researchers and with a company representative (step 4) and will result in adjustments and improvements to the method before additional evaluations are performed.

#### A. Selected Projects

Three feature projects (see TABLE I.) that had developed new functionality and delivered software to a release project within the past few months were selected for the evaluation. For each project evidence-based timelines were constructed. The retrospective meetings were attended by the managing roles of the feature projects, i.e. product manager, project manager, software line manager, and project architect. Developers and testers involved in the projects also attended. At each meeting there were 4-9 project members and 2-3 moderators. All retrospective meetings were held at the company's offices and scheduled for 1.5 hours each.

TABLE I. FEATURE PROJECTS INCLUDED IN EVALUATION

ID	Lead time (months)	No of developers in project	No of retrospective participants	Evidence extraction & visualization (h)
1	28	1	4	5
2	13	1-2	9	5
3	14	4-5	6	9

#### B. Focus Group Discussion

The participants' experience of the method was captured via a focus group discussion [22] held directly after the retrospective meeting. Open-ended questions designed by

the researchers were used to gauge the extent of new insight (RQ1), the role of the prepared timeline (RQ2) and the effectiveness of the method (RQ3), including improvement suggestions. The meetings were audio recorded and notes were taken by the moderators.

#### C. Questionnaire Design

A questionnaire was designed to capture the views of the retrospective participants. This complemented the focus group discussion by providing a way for the participants to individually and privately reflect and share their opinions on the retrospective method. Questions on the aspects that the method was designed to support were reviewed in several iterations within the group of researchers and with the company representatives. The extent of support for group reflection and learning (RQ1), support provided by the timeline (RQ2) (e.g. for memory recall, fact-based discussions, agreeing on events and identifying connections between events) were investigated. For these the respondents were asked to grade the support with *not at all*, *somewhat*, *fairly much* and *very much*. Furthermore, questions on the visualized data were included, i.e. if more or less or just the right amount of data for each aspects was desirable, or if other data should be included. In addition, demographic data on the respondent's role and length of experience was gathered. The questionnaire is available on-line [3].

#### D. After the Focus Group Discussion

The moderators summarized the focus group discussion around the method (in addition to documenting the retrospective meeting and updating the timeline). This summary was distributed to the participants together with the questionnaire allowing them to provide corrections and additional reflections.

## VI. RESULTS & DISCUSSION

The evaluation results are presented herein according to facet; new insights (RQ1), timeline support and amount of visualized evidence (RQ2), cost of performing retrospectives (RQ3), and improvement suggestions. For each aspect the responses from the focus group and the relevant questionnaire results are reported, and the results discussed.

The respondents represent all roles present at the retrospective meetings, i.e. product manager (requirements responsible), project manager, line manager, architect, developer and tester. The respondents' experience in current roles varies from 3 months to 10 years (4 years for the majority) and in total ranges from 5 to 27 years (evenly distributed over respondents). The questionnaire responses on new insights and timeline support are summarized in Figures 7 to 9. The more detailed responses (shown in Fig. 7) have been summarized (in Fig. 8) into two categories: *low* support (combination of *not at all* and *somewhat*) and *high* support (combination of *fairly much* and *very much*).

#### A. New Insights and Learning (RQ1)

In the focus group several participants stated that they had gained and learnt from the retrospective. A project

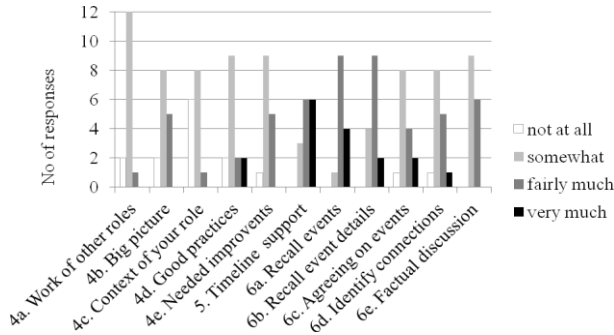


Figure 7. No of responses on questionnaire questions 4, 5 and 6; new learning at retrospective meeting and support provided by the timeline.

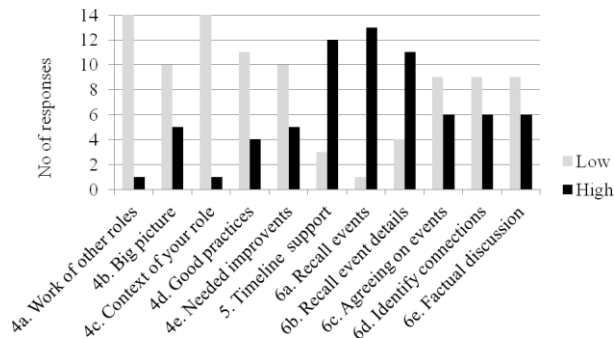


Figure 8. Response on new learning (question 4) and support by timeline (questions 5 and 6) grouped by high and low degree of support.

sponsor said that he now realized that the recently introduced company strategy would have had an impact on the feature’s scoping decisions. One tester gained new insight into the overall process, in particular the early requirements phases and said: “For me, it is very positive to see the entire picture. I have wondered about that many times, to see where there are bottlenecks.” A project manager said that this kind of retrospective could improve and motivate people when starting a new project.

The questionnaire responses indicate that the participants did gain new insights and learning, but only to a low degree. For the 15 respondents, these questions (4a-4e) got 10-14 responses in the low category (see Figure 8). Concerning insights into the overall life cycle (4b), the responses indicate a slightly higher degree of new insights.

**Discussion** The low questionnaire rating on new insights is surprising since this facet was mentioned by several focus group participants. This may be explained by a high degree of pre-insight (participants had very long total experience), with variations for different roles. Furthermore, the range of responses for insight into good practices (4d, see Figure 7) from *not at all* to *very much* might also be due to differences between roles. But, this may also indicate differences in how people learn from this kind of retrospectives.

## B. Timeline Support for Meeting (RQ2)

Several participants expressed that compared to experience-based retrospectives the provided timeline supported reflection of the entire life cycle including early scope planning. One participant said: “It would have been harder to discuss the project without the prepared timeline. The graphical presentation gets you to start thinking.” A product manager, and some developers and testers appreciated seeing a compilation of the big picture including the project phases which they are not actively involved in, i.e. development versus initial requirements phase. Similarly, one participant said that the method supported extending individual perspectives. Furthermore, several participants from different projects said that the timeline supported memory recall and that preparing it before the meeting was preferable. One participant said: “It helps us to remember what happened. It would’ve been difficult to start talking based on nothing. It’s a long time since we did this.”

Of the 15 respondents, 12 perceived that the timeline provided a high degree of support to the retrospective meeting (see figure 9, question 5). In particular, the timeline was graded as providing a high degree of support for memory recall of project events (6a) by 13 respondents and for recall of details of events (6b) by 11 respondents. However, concerning the support for agreeing on events (6c) and identifying connections between events (6d) the opinions range from *not at all* to *very much* (see Figure 7) with 6 respondents grading the support as high, while 9 grade it as low (see Figure 8). There is a difference in the response on the degree to which the timeline supports an objective discussion at the retrospective meeting (6e). This support (6e) was rated by 9 respondents as *somewhat*, and by 6 respondents as *fairly much* (see Figure 7).

**Discussion** The results indicate that the timeline and its overview enabled a discussion of the whole life cycle including RE decisions made through-out and supports the project retrospective meeting to a high degree. The evidence-based timelines may act as integrators at the meetings and thereby create an environment productive to constructive reflection and sharing, similarly to the usage of whiteboards and post-its [8]. Our evaluation confirms previous findings that timelines are beneficial in providing a common background that motivates team members without previous information about the full development cycle [24] into deeper analysis, thereby supporting reflection and observations of patterns at the project level [17]. The high rating of support for memory recall confirms Krogstie’s

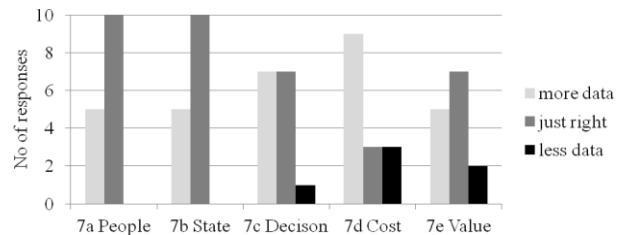


Figure 9. No of questionnaire responses on the desired amount of data for each aspect of the timeline.

findings that using historical data at retrospectives supports prompting memory and aids in reflecting on project processes [15]. For *agreement* on events (question 6c) the variation and tendency of respondents to value timeline support of this as low might be explained by a pre-existing common view of project events caused by close collaboration between a majority of the roles present. An alternative explanation might be discerned by comparing this to results reported by Krogstie et al. that experience-based timelines reveal discrepancies in interpretations of events [16]. Furthermore, Baird et al. found that focusing on objective data may resolve conflicts more easily [1]. The combination of these two findings could indicate that the provided evidence may reduce the amount of disagreements by pre-resolving potential conflicts by presenting data accepted by participants. Furthermore, Collier et al. reported using simple timeline data in group analysis for identifying root causes of over- and underestimation of project cost [11]. In the light of this, the low questionnaire rating of support for identifying *connections between events* might indicate that the amount of data available or its visualization, or the meeting structure could be improved to further facilitate this. In addition, it remains to investigate if participant preparations can enhance identification of event connections.

### C. Improving Amount of Evidence in Timelines

On average, the questionnaire respondents stated that the amount of data to visualize in the timeline (see Figure 9, 7a-7e) should be increased, though the opinions varied between aspects and participants. There was one respondent that would have liked more data for all aspects, while another thought the amount was *just right* for all aspects. There were responses in all categories (more, less and just right) for the aspects decision (7c), cost (7d) and value (7e). The largest difference in response was for decisions (7 responses for more, 1 for less) and cost (9 responses for more, 3 for less).

The respondents also suggested some additional types of evidence. Visualizing more details on incurred cost (resources) and information on target product and hardware was each suggested by two respondents. In addition, one respondent suggested showing reasons for paused development, e.g. resource conflicts.

**Discussion** The responses on the amount of evidence to visualize highlights the importance of filtering data to avoid information overload [17] and structuring data to provide focus [15]. The moderators perceived that the aspects most actively used at the retrospectives were the aspects of people and state, and to a lesser degree cost and decisions, though the noted scoping decisions were all referred to and discussed. Considering this, it is surprising that so many respondents suggested more data for decisions and cost. For cost, this might be explained by the participant's unfamiliarity with the visualized data for accumulated cost. For decisions, the types of decisions and possible increased visual separation them need to be further investigated.

### D. Cost of Evidence-Based Timeline Retrospectives (RQ3)

One participant noted that the value of the method varies: "If the project has just run over a few weeks there is probably less information and value for this method."

Extracting and visualizing evidence in timelines took between 5 to 9 hours per project (see TABLE I. Feature project 3 took the longest to prepare, most likely due to this project being the first one for which evidence was extracted and visualized. In addition, this was the largest project included. The extracted data was collected and sorted in MS Excel according to aspect and timestamp. The data was then visualized per aspect in an MS Visio timeline. Each timeline was printed on four sheets of A3 paper and displayed on the meeting room wall. The printing and posting of the timeline took around one hour per project.

**Discussion** Preparing evidence-based timelines is a manual repetitive task and a candidate for tool support. An interesting avenue to explore is the interactive tool support for visualizing large amounts of time-stamped data used to support criminal investigators performing the task of finding patterns and evidence in data from confiscated computers more efficiently and accurately [19]. However, the manual work in constructing the timelines also familiarized the researcher with the project history and was a good preparation which enabled the researcher to better follow the discussions at the retrospective meeting. In addition, during timeline preparation interesting connections were identified that could then be queried at the meeting. The preparations for each feature (done by one person) took approximately the same amount of time as was spent on each retrospective meeting (6 to 14 man hours). This is not much compared to the overall project cost (man months), but needs to be motivated by a positive experience at the retrospectives resulting in learning and improvements.

### E. Improvement Suggestions

One participant suggested that the timeline could be used continuously to visualize progress and not just for retrospectives. This was the only improvement suggestion given at the meetings (which ran out of time at this point). However, a number of suggestions were collected through the questionnaire. On the questions on improvements to the meeting set-up and structure 7 of 15 respondents answered that these were good without suggesting any improvements, while the other 8 participants proposed improvements. Respondents from all three feature projects commented on *time management*. The respondents suggested lengthening the meeting time, increasing the moderating or having two meetings with a summary for people to reflect on before the second meeting. However, one respondent said that the moderator's preparations had enabled the group to quickly get started and another respondent expressed that the time needed would decrease as they got used to the method. Two respondents suggested *strengthening the focus* and clarifying the *expected outcome* of the retrospective, while another suggested *structuring the discussion* more around

the timeline. *Project member preparation* through timeline review before the meeting was suggested by two respondents as improving meeting efficiency, while a third respondent suggested retrospective meetings closer in time to project completion. In addition, one respondent stressed *ensuring representation of all relevant roles* at the meeting (for one project, no testers could attend). There were a couple of suggestions for improving the learning over time. One respondent suggested *extending the method into iteration retrospectives* for which the timeline would then be gradually extended and insights could be implemented in the ongoing project work. Another respondent commented on the importance of *considering the delta* between project retrospectives and long-term progress of the organization.

**Discussion** The results on low degree of new insight at the retrospectives (see Section VI.A) in combination with suggestions to strengthen the focus and clarify expected outcome indicate that the concluding part of the meeting needs improving. Furthermore, as the timeline concept becomes familiar participants could prepare by reviewing the timeline beforehand. In addition, it is vital that all relevant roles are available to facilitate a productive meeting. Potential improvements include incorporating the timeline concept into iteration retrospectives, thereby gradually constructing project history over time and gradually improving on work practices. This will also require identifying ways to efficiently focus on the delta and additional aspects added since the previous retrospective. Visualization of project evolution has been reported by Treude et al. and Ripley et al. as an approach that may support understanding relationships between multiple concerns or aspects [25] and allow for steering ongoing projects and learning from completed ones [21].

## VII. LIMITATIONS

For this evaluation, as for every study, there are limitations to discuss and address. The threats to description and interpretation validity and steps taken to mitigate them are reported herein, and the generalisability of the results is discussed. The limitations are described based on guidelines for flexible designs provided by Robson [22]. In addition, the proposed retrospective method also has limitations that need to be considered when applying the method and when interpreting the results of the method. For example, the data available for extractions from existing systems and archives may be insufficient or even incorrect, which may lead to presenting misleading evidence at the retrospectives.

### A. Description Validity

The two main threats to description validity is the risk of participants not freely expressing their views at the focus group and the risk of misinterpreting what is said at the meeting and what is meant by the questionnaire responses. To mitigate the risk of participants not freely sharing their opinions each feature project and retrospective participant was guaranteed company internal and external anonymity.

However, there is still a risk that the presence of other team members and in some cases their managers might prohibit a free expression of opinions. For the feedback on the retrospective method, we judge this risk as minor since the participants have no stake in the method itself. In addition, individual feedback was gathered through the questionnaires. Concerning the risk of misinterpretations, audio recordings were made of the retrospective meetings after confirmation by the participants and each retrospective meeting was carried out by two researchers who took extensive notes and collected drawings that were made by the participants. These notes and the recordings were used when making transcriptions of the meetings, which were agreed on by two researchers for each meeting. In addition, the transcriptions were sent to the participants to check that they correctly reflect what was said at the meeting.

### B. Interpretation Validity

Since the evaluation was performed by the same researchers as had designed the method there is a risk of imposing a preconceived positive view on the method on the retrospective participants. This was addressed by not drawing specific attention to the method evaluation, but rather emphasize that the retrospective meetings were part of an ongoing research study into how RE affects the development life cycle. (The participants were informed beforehand of the length of time required for the meeting and for responding to the questionnaire.) Furthermore, the questionnaire was designed to allow the respondents to grade the impact of the method on several different aspects.

### C. Generalisability

Internal generalisability within the case company was addressed by sampling three feature projects with varying lead time from different technical areas. However, the results are limited by being unable to include people from system verification and integration in the evaluation. These aspects will be investigated in future studies.

Considering external generalisability the results are limited to the case company. And for this initial evaluation, the results are further limited to the feature projects at the company which develop low-level software for specific customers. However, future research is planned to extend the units of analysis also to application-level feature projects within the case company and to projects at other companies.

## VIII. CONCLUSIONS & FUTURE WORK

Software development is affected by RE decision making [5] and the communication of requirements [4] within development projects. When RE is inefficient and weakly coordinated with development this may result in failure to deliver software on time with the quality and functionality needed to meet customer expectations [4], [5], [7]. The complexity of software development with many roles involved over a long period of times makes assessing and improving on RE a challenge both in research and in



practice, especially in a large-scale context [20]. We have designed a method for supporting project retrospectives with evidence-based timelines [2] in close collaboration with one of our long-term industry partners. The method has been designed to support project teams in reflecting and improving on how RE supports the development life cycle.

In this paper, we report on an evaluation of the project retrospective method performed as part of ongoing action research [22]. The method was applied to three industrial software development projects. The results indicate that the method supports project members in reflecting on the full project history and thereby widening their perspectives beyond the (limited) time period for which individual roles were involved. Examples of gained insights include how decisions on target hardware and products affected the scope, cost and lead time of the development, how close customer requirements communication enabled delivering the right functionality on time etc.. The results also indicate that the focus and expected outcome of the retrospectives need to be strengthened to better support identifying new insights and improvements. Furthermore, the visualization of evidence can be improved to enable retrospective participants to more clearly distinguish between different types of relevant events and relationships between them.

Based on this evaluation the method will be improved and the evaluation extended to cover other types of projects within the case company and projects at other companies. Future work also includes support for comparison analysis between multiple projects; parallel projects and consecutive projects applying the project retrospective method.

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