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// Project retrospectives can be powerful tools for project teams to collectively identify communication gaps and practices to improve for future projects. However, even if project members take the time for a retrospective, it can be hard to correctly remember and jointly discuss past events in a constructive way. Fact-based timelines that visualize a project's events offer a possible solution. //

CONSIDER THE LATEST project you worked on: Did the team take the time to collectively reflect on the experience once the project was completed? If so, was it a constructive group discussion or merely a feel-good event?

Project retrospectives, also called postmortem reviews or lessons learned, can be a powerful tool for organizational learning and process improvement.[1,2] But once a project is completed, it's often swiftly replaced by another. The participants rarely take the time to sit down together to discuss how it went,[3] much less what to do better and how in the future. As time passes, the details and sequence of events are soon forgotten, and our memories tend to focus on how we felt and what we experienced.[1]

When this happens, a project retrospective can turn into an emotional venting session rather than a constructive discussion on how to improve on practice.[2,4] Moreover, a retrospective that relies solely on peoples' experiences of events risks drawing incorrect conclusions because they're only considering part of the picture—typically, their own.[5] To address these issues and better support project members in remembering events and performing fact-based retrospectives, we developed the EBTR (evidence-based timeline retrospective) method.[6]

EBTR Overview

One way to improve project retrospectives is to provide participants with a timeline of project events. This visualization of the project's history serves as a memory prompt and a focal point for participants in collectively discussing those events. In EBTR, timelines containing evidence of project events are planned and prepared in advance. The displayed objective information, or evidence, is gathered from available project sources and includes the documents and repositories used for planning, requirements, issues reports, and so on. Team members then share perspectives around such timelines at a retrospective meeting and gain new insights into the entire
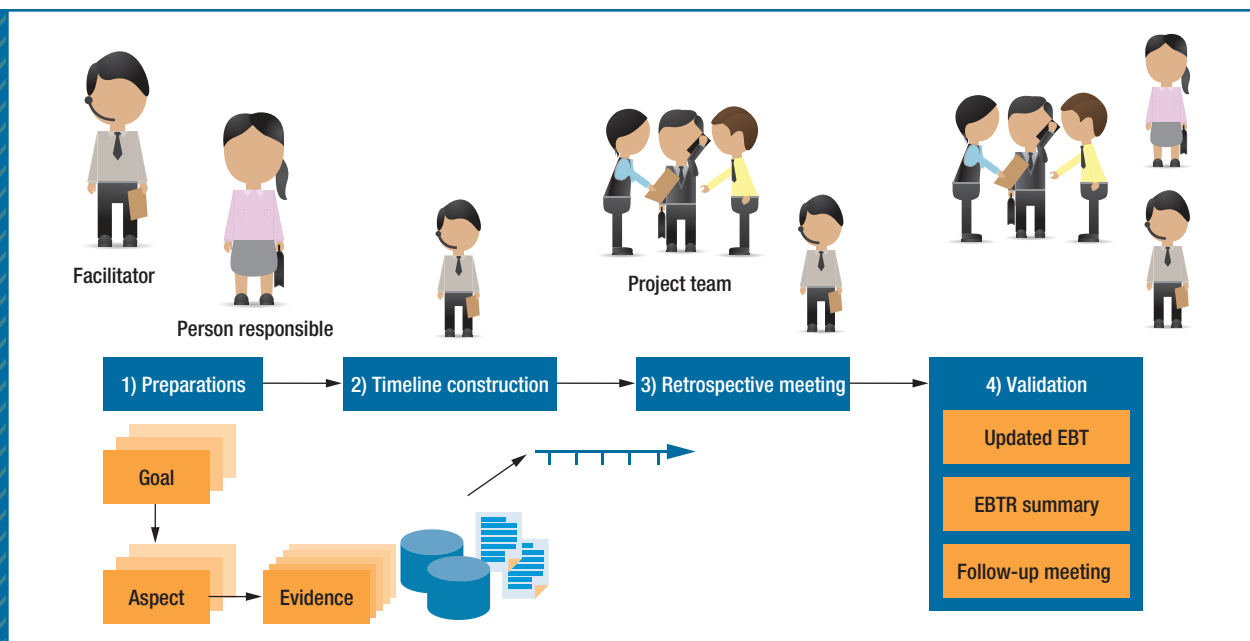
FIGURE 1. The four main steps in the evidence-based timeline retrospective (EBTR) method. The facilitator does all the preparation work, builds the timeline, and sums everything up at the end; participants are tasked solely with attending the meeting.

project life cycle. Project members can also identify good practices and improvements to practice.

An important factor when designing the EBTR method was to minimize the cost for participating teams. Consequently, project members only need to attend and actively participate in the retrospective meeting. A facilitator performs all the necessary preparations, including summing-up the outcome. The method is based on a timeline exercise that Norman Kerth described.[7] While Kerth's exercise relies on people's memory of events to construct timelines, the EBTR timelines consist of project data as evidence of a project's history. (We use the term *evidence* here differently than you would within, for example, evidence-based medicine and software engineering, where it refers to scientifically validated truth.)

EBTR consists of four main steps: preparations, timeline construction, retrospective meeting, and validation of the outcome, as illustrated in Figure 1. The method also has six variation points that can be used to tailor EBTR to a specific case. For example, leading structured or semi-structured discussions helps you cover a narrower or a wider range of topics.[6] Details about how to apply EBTR appear in the "Reflecting on Development Projects" section and online at http://serg.cs.lth.se/research/experiment_packages/ebtr/.

Step 1: Preparations
The "person responsible" for a process or its implementation can initiate an EBTR for a certain purpose and identify a facilitator to manage the work. Through discussions with this person responsible, the facilitator defines goals and aspects on which to focus the EBTR. The goals can target a specific area or a wider set of issues. Based on the defined goals and aspects, and the project

context, the facilitator derives a set of focus questions and determines the type and source of evidence to display in the timeline. The facilitator also uses these focus questions to guide the retrospective meeting in step 3.

Step 2: Timeline Construction
The facilitator extracts time-stamped evidence from its sources to display in the timeline. The timeline content and visualization are variation points tailored for each case, depending on the type and amount of available project information and data sources. The effort and tools required to manage the extracted evidence will vary—for example, small amounts of data from status reports can be collected and managed manually, but larger amounts, say, from issue management systems with hundreds of entries, will require a systematic approach and tool support. Even with

relatively modest datasets, drawing and updating the timeline manually quickly becomes cumbersome and time-consuming. For the timeline to be effective in supporting the retrospective meetings, the project history visualization must be clear, uncluttered, and easily interpreted without special training.

Step 3: Retrospective Meeting

The core EBTR activity is the retrospective meeting, in which the team gathers to reflect on the project. All key roles involved throughout the project's life cycle are invited, with the facilitator leading and moderating discussions to focus on intended goals and aspects. If a vital role-player can't attend, the facilitator might have a separate meeting with this person, but that option isn't ideal.

The meeting consists of an introduction, a warm-up exercise, a reflective discussion, and a summary of the meeting's outcome. The introductory part includes a walkthrough of the timeline and the applied visualization techniques. If it happens prior to the retrospective meeting, it saves time and properly prepares participants for the discussion part to come.

A warm-up exercise helps familiarize everyone with the timeline—one example is to ask each participant to mark his or her active involvement on the timeline and to add other people who worked on the project, revealing hand-over points and previous team members. The exercise also encourages participants to relate to and interact with the timeline, which is an important factor in making the timeline a trigger for the discussions that follow.

The project members reflect on events together by sharing experiences from their different viewpoints, guided both by the focus questions and the evidence provided in the timeline. The degree of discussion structure can vary, but a more structured format encourages all participants to actively participate. If the discussions dry up, a set of prompting questions can stimulate further reflections.

The next part of the meeting is spent identifying the main findings and suggesting improvements. The facilitator elicits these findings with a set of predefined categories, such as what we learned and what we should do differently. The facilitator documents these findings and the discussions in an EBTR summary.

Step 4: Validation

In this final step, the project members validate the retrospective's outcome. The extent of this validation can vary, but it should at least include distributing updated timelines and the EBTR summary to the full team for confirmations and corrections. Additional follow-up meetings can further communicate the outcome to project members and the process responsible for initiating the EBTR. Decisions about improvements such as new practices or enhancing existing processes are ideal topics at such follow-up meetings.

Reflecting on Development Projects

So far, we've applied the EBTR method in two case studies—telecommunications software and Web-based business applications. We met the specific retrospective goals for each case by tailoring the EBTR—for example, adapting the timelines as in Figure 2.[6]

Telecom Projects

We performed EBTR retrospectives for a large company in the telecommunications domain, specifically on three of its agile development projects that delivered to a larger product. The three projects had four to nine members each and a lead time of 13 to 28 months. The teams frequently held retrospectives for each iteration along the way but rarely conducted them for the whole project, which meant they risked losing sight of the overall picture and making ill-advised short-term decisions.[4] By performing EBTRs, the goal was to increase the engineers' insight into how requirements were defined and communicated in the overall context (step 1).

The facilitator (who was one of the researchers) had a lot of experience at the company and with its development process, but not with the specific projects. She generated timelines (step 2) by extracting large amounts of information from several sources, including the systems for issue management, scope management, and planning. The facilitator then stored the extracted data in MS Excel and constructed the timelines in MS Visio before printing them out

> Project members reflect on events together by sharing experiences from their different viewpoints.

FIGURE 2. Evidence-based timelines. (a) A sample timeline from one of three telecom projects used MS Excel and Visio, and (b) the IBIS project opted for a hand-drawn approach.

on large sheets of paper for displaying on the meeting room wall (see Figure 2a).

The timelines acted as a natural focal point and attracted people's attention as soon as they entered the room. The facilitator invited the project members to the 90-minute EBTR meetings (step 3), and once they arrived, gave an overview of the timelines and the information visualized in them. The project teams then reflected on the project through an open and semistructured discussion around the timelines.

The participants interacted with the timelines by pointing to events, identifying connections between events, and adding missing information, with the facilitator using the defined focus questions as a checklist

rather than as an agenda. In so doing, the groups covered a wide set of issues within the targeted area, ranging from delays in deciding to implement market-critical features to difficulties in planning technically complex features.

The IBIS Project

We also applied EBTR in a research project called IBIS (www. ibis-projekt.de), which developed a method[8] for supporting SMEs (small- and medium-sized enterprises) in designing intuitive-to-use software products. Academic researchers joined product managers, requirements engineers, developers, testers and software engineers from two SMEs, with a total of 11 people participating in the joint project. We

applied EBTR to a seven-month period of the project during which the IBIS method was evaluated; one of the participating researchers acted as the EBTR facilitator. Our goal (step 1) was to assess the IBIS method's application and the research–industry collaboration within the project concerning communication and workload.

The facilitator constructed the timeline (step 2) based on evidence in three areas—activities, events, and artifacts (such as planned versus actual delivery dates)—provided in questionnaires filled out by software engineers throughout the project. The facilitator visualized this evidence using a timeline drawn with a flipchart and color-coded cards (see Figure 2b).

At the four-hour retrospective meeting (step 3), the participants sat around the timeline, which was placed on a large table. The facilitator opened the meeting with a short introduction of the goals, the agenda, and the timeline, including its visualization scheme, and then led a structured discussion, topic by topic, using the focus questions. The participants considered the questions individually and noted their reflections on Post-It notes. Each participant then presented his or her notes and added them to the timeline. The group commented on the presented notes and discussed possible reasons and connections to other issues.

Benefits of EBTR
Through these cases studies, we discovered several benefits of applying EBTR.

Fueling Reflective Discussions
The evidence-based timelines helped people remember and triggered discussions about past events. One participant said, "It reminds you of what actually happened." Another stated, "It would have been difficult to just start talking based on nothing. It was a long time since we did this." Physical interaction with the timeline stimulated the participants and kept them active throughout the meeting, as they pointed to discussed events or added ones that were missing. The participants also jointly visualized their degree of activity by adding their own activity line to the timeline. By keeping people alert and interested, valuable reflections were made in a short and focused period of time.

Providing a Project Overview
The participants liked that they could "see at a glance what we have

achieved in the project." This is one of the strengths of the approach compared to retrospectives without evidence-based timelines. A participant said, when comparing it to previous retrospectives, "You get a much better overview with this timeline." One manager even suggested

> Evidence-based timelines helped people remember and triggered discussions about past events.

that the timeline approach could be used to visualize and communicate progress throughout the project.

Identifying Connections
By pointing to an event in the timeline, participants could consider potential causes or effects by looking at the previous or following events. For example, for the IBIS project, late scope changes were found to be caused by a lack of communication at the project's start. By uncovering this connection, the IBIS method was improved to avoid such problems.

Seeing the Big Picture
The timelines and group reflections provided an extended perspective of the participants' work as part of a larger context. For example, one participant became aware of the entire effort spent and the outcomes achieved in the project through the EBTR retrospective. The developers and testers in particular appreciated seeing the big picture, including project activities in which they weren't actively involved: "It's interesting to see a compilation of the big picture. As a developer, I don't see

even half of this." Such insight can prevent communication gaps in the future and improve coordination of different activities.

Identifying Improvements
The participants gained new insights into work practices and how things such as company strategy could impact a project's scoping and detailed requirements. EBTR helped them summarize their experiences and identify improvements, which in turn served as motivation. As one project manager said, "It's a good reminder that can help us when we start on the next bigger project." For IBIS, the EBTR summary even provided valuable feedback to customers and was included in the final project report to funders.

Lessons Learned
Seeing some of EBTR's benefits first hand, we learned how to best perform future EBTRs through case studies.

Introduce the Timeline Prior to the Retrospective
The participants in the telecom projects initially found it hard to understand and use the timelines. They quickly caught on, but it meant a slow start to the retrospective meetings.

Retrospectives launch more quickly if the participants receive a 10-minute introduction prior to the meeting. For example, the timeline concept can be presented at a project or team

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meeting, with actual timelines distributed in advance of the retrospective itself. This has the added advantages of motivating project members to participate and introducing them to the facilitator. Both of these factors can support a more open and constructive retrospective discussion.

Organize the Meeting Room around the Timeline

At the first retrospective meeting, timelines were posted in a corner of the room that wasn't immediately visible to participants, who placed themselves around a table at the other end of the room. This physical distance and placement made it hard to focus discussions on the timeline and prevented participants from directly interacting with the timeline.

At subsequent retrospective meetings, we consciously organized the room to encourage participants to interact with the timeline, choosing a central location for posting the timeline and placing chairs around it. The result was more open and free flowing discussions.

Keep the Retrospective Short and Focused

We've varied the length of our retrospectives between 75 minutes and three hours, and found that a longer meeting doesn't lead to more insights or findings. It's also hard to keep a constructive discussion going for more than 60 minutes—everyone gets tired and finds it hard to concentrate. However, 60 minutes isn't long enough to conclude and summarize the meeting.

The meeting time can be optimized by keeping the discussion focused on the goals and aspects defined for the EBTR. The facilitator plays a key role in this and should have good knowledge of the domain and the applied development processes. The focus questions help keep the discussions within the topic area, but the time spent on each question should be monitored and kept within a rough time budget. This will ensure time at the end for summarizing findings. The facilitator can also decrease the discussion time by selecting a subset of topics or presenting the topic area rather than detailed focus questions.

Tailor EBTR to the Purpose and the Project

One flavor of EBTR doesn't necessarily suit all projects and

organizations, so before performing the retrospectives, we had to tailor the methods for each project context.

In the preparation step, the purpose of applying the method affects the definition of goals, aspects, and evidence. We can achieve a wide and general assessment goal by reflecting on a broader picture supported by a wide range of evidence. This was the case for the telecom projects, in which increased insight into requirements within the development process was the target. That said, reflecting on less evidence will facilitate a more focused discussion and enable meeting a more specific EBTR goal—the specific EBTR goal of evaluating the IBIS method is an example of this.

The discussion structure at the retrospective meeting can also be tailored to match the EBTR goal's width: a more structured discussion around the focus questions will narrow the reflections to a specific goal, whereas using the questions more as a checklist will lead to discussions of a wider set of topics and more reflections on the big picture.

The facilitator's relationship to the project is another variation point to consider. For IBIS, a project member acted as the EBTR facilitator. As such, she had insight into the project's specific events and history, which turned out to be well matched to the EBTR goal of assessing specific issues. But if the EBTR goal is a wider assessment of an area, we recommend using a facilitator with no previous relationship to the project—doing so will encourage wider discussions and reflections of the bigger picture.

Don't Overload the Timeline
It was a challenge to visualize the project data in a clear and uncluttered way. For the IBIS project, we used cards and Post-It notes on a flipchart to display the moderate amounts of data. Initially, this approach worked well, but as the meeting progressed, the flipchart timeline became hard to read as the amount of cards and Post-It notes increased. From this, we learned that the initial timeline is best prepared digitally and then printed. Additional events and information can then be added in the form of cards or Post-It notes during the retrospective.

In contrast, the huge amounts of data for the telecom projects posed a challenge in the timeline construction itself. We choose a combination of MS Excel for storing and sorting the data and MS Visio for visualizing it, but we also found it necessary to separate different types of evidence, for example, by displaying information about people involved in the project on one timeline and the project planning information on another.

The response we've received from the retrospective participants encourages us to continue evolving and improving the EBTR method. One extension to investigate is how to apply EBTRs to larger projects that have more members than can attend a common retrospective meeting. This also requires more powerful tools for constructing timelines with huge amounts of data. Another avenue to explore is integrating the EBTR approach for agile and iterative development—for example, constructing the timeline for each sprint or iteration, and using it at iteration retrospectives. The project members would then become more familiar with the timelines as the project progresses, and the team could contemplate the wider picture for each iteration and ultimately reflect on the full project history.

We encourage practitioners to consider how EBTR can be tailored to their needs and projects. We believe that our reported experiences from applying the method can encourage development teams to learn and improve by reflecting on evidence-based timelines.

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