The Impact of Employee Participation on the Use of an Electronic Process Guide: A Longitudinal Case Study

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Abstract—Many software companies disseminate process knowledge through electronic process guides. A common problem with such guides is that they are not used. Through a case study, we investigated how participation in creating an electronic process guide, through process workshops, influenced the use of the guide. We studied developer and project manager usage with respect to three factors: frequency of use, used functionality, and reported advantages and disadvantages. We collected data from three rounds of interviews and 19 months of usage logs in a longitudinal study in a medium-size software company. Employees who participated in process workshops showed a higher degree of usage, used a larger number of functions, and expressed more advantages and disadvantages than those not involved. Our study suggests that employee participation has a long-term positive effect on electronic process guide usage.

Index Terms—Software engineering process, process implementation and change, process infrastructure, software process models, organizational management and coordination, software quality/SQA, human factors in software design.

1 Introduction

Descriptions of software development processes (process guides) have been seen as an important instrument for making software development more efficient and for delivering software of higher quality. In the software engineering literature, we find many examples of how companies have organized descriptions of development processes such as the process framework at IBM [8] and tailoring of processes at Motorola [20].

Curtis et al. [12] cite several reasons for describing software development processes, including to facilitate human understanding and communication and to support the improvement of processes. Kellner et al. [25] added that process guides can help users of processes to track their work and perform the process effectively. In all, process guides have many benefits for software process improvement. However, for the guides to yield their benefits, it is important that they are used; this is not always the case, as we will see in Section 2.

An argument that has been leveled against using process guides is that the mechanistic nature of structured development does not fit with a complex reality [9]. Parnas and Clements [33] acknowledged that process descriptions will not represent real-life complexity, but argued that they are useful nonetheless because an "ideal" process description can help to enable users of the process to bring the real process closer to the ideal. In spite of the problems with process guides, most companies do make them available on the company Intranet, what we will refer to as electronic process guides.

This paper addresses the issue of how to increase the usage of electronic process guides and whether involving employees in developing a process guide influences the usage over time. The remainder of the paper is organized as follows: Section 2 describes electronic process guides, studies on their usage, and methods for designing them. Section 3 describes our research question and method in detail. Section 4 presents results from a study of a satellite software company on a process guide usage. Section 5 contains a discussion of the findings. Section 6 concludes and provides suggestions for further work.

2 Electronic Process Guides

An electronic process guide [18], [25], [38] may be viewed as an online, structured, workflow-oriented [21], reference document for a particular process that exists to support participants in carrying out the intended process. An electronic process guide may include the following basic elements:

- Activities: descriptions of "how things are done," including an overview of the activities and details regarding each individual activity.
- Artifacts: details of the products created or modified by an activity, either as a final or intermediate result of the activity or as a temporary result created by one of the steps.
- Roles: details of the roles and actors involved in performing the activities.

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- Tools and Techniques: details of the tools and techniques used to support or automate the performance of an activity.

Meso and Jain [28] distinguish between process guides developed for specific purposes, "strong problem-solving approaches," and process guides for general purposes, "weak problem-solving approaches."

In the field of information systems, the term "system development methodologies" is used in a similar fashion. For example, Avison and Fitzgerald [3] defined this as "a collection of procedures, techniques, tools, and documentation aids which help systems developers in their efforts to implement a new information system."

In software engineering, there is a long tradition of work on software processes [11]. Many research groups have focused on software process modeling languages and process-centered software engineering environments [2].

2.1 Electronic Process Guide Usage

The potential of electronic process guides can only be realized when key capabilities are not only adopted, but also infused across the organization. This is complicated by the fact that there is considerable skepticism among software developers regarding the possibility of learning from and adhering to prescribed process models, which are often perceived as overly "structured" or as imposing too much "control" [10]. Therefore, we cannot expect such an infusion unless electronic process guides are perceived as useful and easy to use in daily practice and consistent with the existing values, past experience, and needs of software developers [44].

A study from the former Andersen Consulting [23] reports that "most practitioners told us they did not use methodologies." Among the available process descriptions, 63 percent were read only once and the remaining 37 percent were read on average once every 100 days. Some practitioners reported using electronic process guides as often as once a day, others as little as once a year.

Iivari and Maansaari [24] summarize studies of systems development method usage as follows: "Many organizations claim that they do not use any systems development method and, as far as they are used, methods are not used literally, but adapted."

One of the most extensively studied implementations of an electronic process guide in software engineering is the one at the small software development organization Alette, which has about 20 employees. Scott et al. [38] report the results of an eight-month study on the use of the electronic process guide at Alette: what it is used for, how it is used, and the effects of usage. A first study reports declining use over the period studied and the electronic process guide was used principally to support process improvement, mainly through providing templates and task lists for projects and by providing a discussion forum on templates. The electronic process guide was not used to guide projects because the process was seen as unsuitable and the electronic process guide was cumbersome to use. However, the study reports improvements in documentation, project estimation, planning, management, and customer relations as an effect of using the electronic process guide. Alette used the ISO 12207 standard as a basis for developing the electronic process guide and it was developed by a team of researchers. After the study, the electronic process guide was revised and an experience repository was added. A second study, by Scott and Jeffery [39], on the usage of the combined tools, reports that they are used extensively in the organization over the first six months. Some of the effects reported are time saving, the sharing of experience, easier and better management, and better understanding of other employees' job roles. A third study by Kurniawati and Jeffery [26], [37] conducted one year after introduction, reports that the electronic process guide and experience repository was used by 60 percent of potential users. The average use frequency was measured to two potential user accesses per day.

Another electronic process guide that has been studied is implemented at an anonymous company, "Company X." The company is a medium-size software house with 150 employees. The company's software process improvement group introduced an electronic process guide through department meetings, training, and direct support. In a survey conducted in this company to measure usage in relation to the factors proposed by the Technology Acceptance Model (TAM) [35], [44], Dybå et al. [18] found that perceived usefulness is a fundamental driver of both usage and use intention and, hence, that the prospects for infusing electronic process guides successfully will be severely undermined if they are not regarded as useful by the developers. However, Moe and Dybå report that, in a qualitative study [31], they found that few employees were actively using the electronic process guide. Of 19 people interviewed, they found that only one person said that they used it daily and three people said that they used it monthly. The rest reported using it less than once a month or not using it at all. Project managers were the most frequent users, while software developers used it less. Templates and checklists were regarded as the most useful features.

Von Wangenheim et al. [45] studied the introduction of electronic process guides in two companies in Brazil. The electronic process guides were developed through a collaborative process of elicitation using process workshops. They found that the "results of establishing electronic process guides were very positive, principally, observing improvements in the effective and efficient execution of the process(es), project planning, estimation, monitoring, and control, as well as an improved quality of products/services and improved customer relations and satisfaction."

2.2 Designing Electronic Process Guides

When companies choose to design their own development processes, one option is to assign the task to a group of expert "process engineers" as described by Becker-Kornstaedt [5]. One or more process engineers gather information about existing practice in a company by analyzing process artifacts (such as developed products and requirements documents), interviewing employees about their process, and observing how processes are conducted in the company. The process engineers analyze the material and develop the electronic process guide.

An alternative is to involve the employees more in designing the electronic process guide, for example, through workshops [1], [15]. In what follows, we first describe what is meant by involvement and participation and, then, explain how these ideas can be used for designing electronic process guides in workshops.

2.2.1 Employee Participation

Employee participation in organizational development is a part of the Scandinavian work tradition. It is also included as an important element in most works on improvement, from Total Quality Management [14] to the knowledge management tradition in Communities of Practice [46]. Further, participation is one of the most important foundations of organization development and change [15] and a critical factor for success in software process improvement [16].

User participation has been a central issue in research on system development, particularly in Scandinavia. Bjerknes and Bratteteig [6] cite three reasons why user participation in the design (of information systems) is important. We have the following:

- Improve the knowledge upon which systems are built.
- Enable people to develop realistic expectations, and reduce resistance to change.
- Increase workplace democracy by giving the members of an organization the opportunity to participate in decisions that are likely to affect their work.

Some studies have found that employee participation leads to organizational effectiveness, measured as a function of financial performance, turnover rate, and workforce morale [36], [43]. Another potential effect of participation is increased emotional attachment to the organization, which has many benefits. Employees have greater commitment to the organization, more motivation to perform, and increased desire for responsibility. They also care more about their work, which may lead to greater creativity and cooperative behavior, and higher productivity and service quality [19].

Participation can take many forms. Wilpert [47] defines participation as: "The totality of forms and intensities ... by which individuals, groups, and collectives secure their interests through self-determined choices among possible actions." This can range from formal institutions, such as work councils, to informal participation in day-to-day relations. Some insist that participation must be a group process, which is the form of participation discussed in this paper.

Riordan et al. [36] use a framework with four attributes to define employee involvement:

- Participative decision making. Employees have control over, or a say in, decisions that affect their work.
- Information sharing. Information about the organization, including its plans and goals, is made available to employees.
- Training. Employees receive appropriate training, which enables them to acquire the knowledge and develop the skills required for effective performance.
- Performance-based rewards. Employees perceive that incentives link their actions to outcomes within the organization.

Black and Gregersen [7] distinguish between five processes in decision processes: Employees can participate in

1. identifying problems or issues,
2. generating alternative solutions,
3. selecting a specific solution,
4. planning the implementation of a specific solution, and
5. evaluating the results of the implementation.

Several techniques are available for promoting participation. For example, search conferences [34], survey feedback [4], autonomous work groups [22], and quality circles [22], [27] are all predicated on the belief that increased participation will lead to better solutions and enhanced organizational problem-solving capability.

2.2.2 Defining Processes through Employee Participation

Process workshops aim at involving all relevant employee groups in defining the processes. However, before defining a process in a workshop, it is important to discuss how the work should be done, what the process will be used for, and how it will be implemented in an electronic process guide. This first step can be performed by arranging a search conference [34].

The search conference [34] is a method for participatory, strategic planning in turbulent and uncertain environments. All of the work is conducted in a self-managed team (also called autonomous work group [22]) that is responsible for the entire planning process. The search conference process is based on democratic participation, which gives those employees most affected by the change more control over the end result. The intended result of the conference is to produce the following: a committed group of knowledgeable people who have a deep understanding of the challenges confronting their organization, agreement about the ideals the strategy is supposed to serve, action plans that are aligned with those ideals, and a social method for participation. When designing an electronic process guide, the search conference is used to discuss the current situation regarding the working processes before looking to the future. Brainstorming is used to make sure that the whole group (managers and project managers and developers) generate ideas and to make it possible for the group to free themselves from old ways of thinking. An important result from the conference arranged before the process workshop is the decision about how to define the new processes based on the company's existing best practices.

After the initial search conference has been conducted, several process workshops [15], in the form of quality circles [27], are conducted for each main development process in the company.

A quality circle is composed of volunteers who arrange regular meetings to examine problems related to productivity and quality and to discuss work procedures [27]. The strength of quality circles is that they allow employees to deal with improvement issues that are not dealt with in the day-to-day

business of the organization. The quality circles used in process workshops are temporary and are created with a relative well-bounded mandate to be fulfilled. Once a subprocess has been accomplished, the circle is disbanded. This kind of quality circle is also known as "Task forces" [22].

A process workshop can last from half a day to several days, depending on the complexity of the process and the number of participants. The process workshop makes people discuss how they work, which fosters learning even before the electronic process guide is available in the company. It also ensures quality because the electronic process guide is developed by people who know how to do the work; it does not describe how consultants or senior staff imagine the development processes. After the workshop has been conducted, employees read the results critically from different viewpoints, such as software architect and project manager, and a participant is assigned the role of revising the result into a process description. A description of how a process workshop is conducted is given in Section 3.1.2.

3 Research Question, Context, and Method

From the discussion in Section 2, we would expect employee participation in electronic process guide design to lead to a higher degree of usage. The motivation for the work described in this paper is to understand how participation in creating an electronic process guide through process workshops influences the use of the electronic process guide among project participants in a medium-sized software company.

The central research question is: *How does the participation in process workshops influence the use of electronic process guides over time?*

In addressing this question, we focused on determining whether there is a difference over time between one group that participated in process workshops and another group that did not. We use three measures for use: 1) frequency of use, measured by the number of times the employees say they consult the process guide and the number of times the electronic process guide is actually consulted, 2) functionality, measured by what employees say about what aspects of the electronic process guide they consult, and 3) advantages and disadvantages of use, measured by what benefits or what employees say they find from using the electronic process guide. The reason for the last measure is that factors such as perceived usefulness, perceived ease of use, and perceived compatibility are factors that affect use in the TAM [13]. Believing that using the electronic process guide has benefits may influence usage positively, while believing that using the electronic process guide has disadvantages may influence the use negatively.

We were interested in examining whether workshop participants show different characteristics than nonparticipants regarding these three measures of use and, if so, how these differences evolve over time.

3.1 Research Context: The Company and the Electronic Process Guide

3.1.1 The Company

Kongsberg Spacetec (Spacetec) was founded in 1984 and is one of the leading producers of receiving stations for data from meteorological and Earth observation satellites. The company has worked with large development projects as both a prime contractor and a subcontractor. The size of their typical product development projects is 1,000-4,000 work hours. Customers range from universities to companies such as Lockheed Martin and Alcatel and to government institutions such as the European Space Agency and the Norwegian Meteorological Institute. Most of the software systems that are developed run on Unix and many of the remainder run on the Linux operating system.

The company possesses a stable and highly skilled staff, many with master's degrees in computer science, mathematics, or physics, and have what we can describe as an "engineering culture." The company has approximately 60 employees. Prior to 2003, the company had an extensive system for quality control that was in accordance with quality routines from the European Corp. for Space Standardization and ISO 9001. This system was cumbersome to use and did not emphasize aspects such as incremental and component development. As a part of being certified according to ISO 9001-2000, the company decided to develop a process-oriented system for quality control [30]. We worked with the company to define the processes for software development [15].

The company was selected for this study because they participated in a research project on software process improvement and were going to develop an electronic process guide.

3.1.2 Developing the Electronic Process Guide

In the period from October 2002 to January 2004, the company defined their electronic process guide, starting with a search conference and then holding several process workshops. One-third of the employees participated in one or more workshops. The workshop participants were selected by the quality department to represent a variety of roles, experience, and opinions. The workshops usually lasted half a day.

At the search conference, requirements for the electronic process guide were discussed. It was determined that the electronic process guide should be as simple as possible to access, easy to maintain, and kept up to date. The electronic process guide should provide

- descriptions of tasks for the most important roles in a project,
- checklists for each main process,
- templates for all documents to be produced,
- descriptions of best practice, and
- access to project tools (for example, a requirement and a bug-tracking system).

After the requirements were defined, seven process workshops were held to define the electronic process guide for product development, which was first divided into four

subprocesses: specification, elaboration, component construction, and system integration.

Each workshop started by defining subprocesses in the main process. Then, we defined activities and their sequence for each subprocess. We used the KJ process [40] (after Japanese ethnologist Jiro Kawakita) for brainstorming and documenting the result. The KJ process is a creative group technique to identify and organize the relations between seemingly unrelated ideas. Then, documents for input and output to the process were defined. These documents could be already existing templates, checklists, and good examples.

There were many discussions on technical issues and how to handle relations between departments in the company, for example, from the marketing department to the development department. Some decisions had to be taken by voting, but most discussions ended in consensus on a first draft process.

The outcome of the workshop was a document that provided an overall description of the activities, roles, input, and output of subprocesses, and how the subprocesses were related. In a follow-up meeting, the participants were assigned roles such as system architect, developer, and project manager to read the descriptions critically and improve upon the document. Finally, some participants were assigned the task of writing a complete description based on the workshop results and the follow-up comments. An example of the result of a process workshop can be found in Fig. 1.

3.1.3 The Implemented Electronic Process Guide

After the processes had been defined, the electronic process guide was implemented in a self-made tool and released on the Intranet. The company used 180 work hours in workshops and 1,049 work hours in total for development of the first version of the guide.

A number of project support tools were integrated with the electronic process guide, the most important of which were these: an action list tool with automatic e-mail alerts when the due date of an action is passed, a tool that provides a template work breakdown structure, a tool for following up risk and calculating project risk-level, a tool for writing requirements according to the company standard, a tool for documenting use cases, and a tool for documenting the minutes of meetings.

When starting a new project, the project manager automatically generates an instance of the electronic process guide for the project. This instance can easily be adjusted to the needs of the project and is usually done because the electronic process guide covers more than the project usually needs. The electronic process guide supports the whole life cycle of the project and each subprocess is given its own checklist. It is possible to tick off completed items on the checklist. When the checklist is updated, this also updates a project progress view because a checklist covers everything in the process description for a particular process. This progress view makes it easy to generate status reports. The project manager can use the electronic process guide in a project meeting for discussing the work to be done, who should do what, or project progress. The project participants (for example, designers, coders, testers, architects, and quality-assurance people) use the electronic process guide to access process descriptions, project documentation, templates, and checklist.

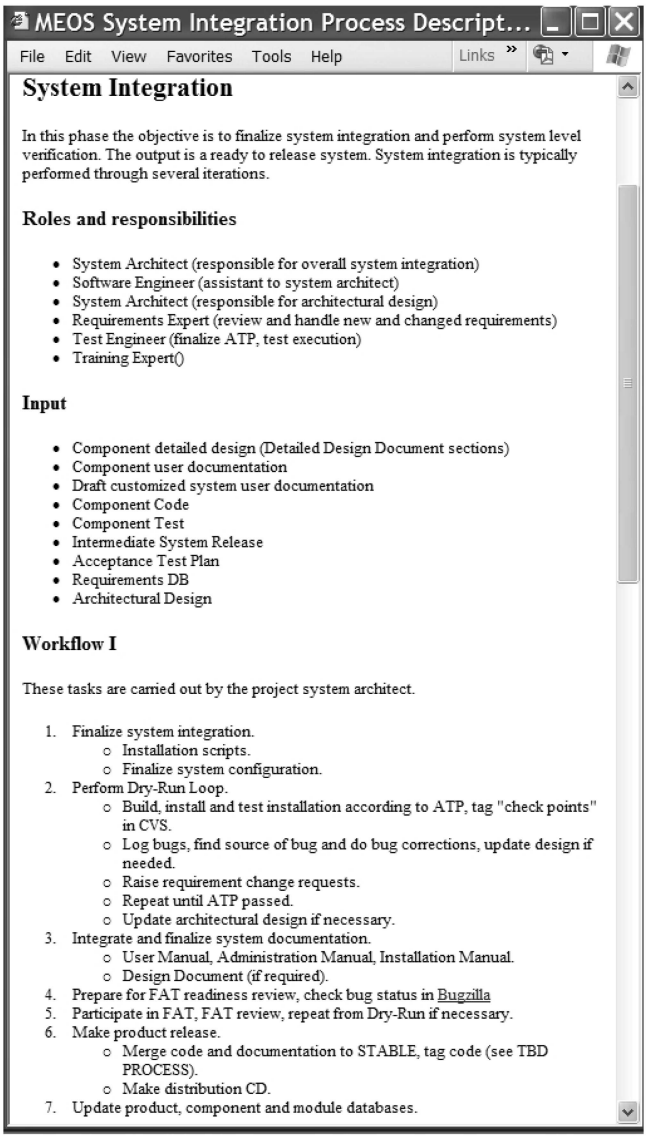

Fig. 1. A screenshot of the system integration process description on the company Intranet.

The implementation of the electronic process guide on the company Intranet started in November 2002, prototypes were tested in December 2002, and the first test with real projects was performed in January 2003. Other important milestones were

- March 2003. The electronic process guide was introduced as a mandatory tool for project managers on all new projects. Running projects were allowed to follow the existing processes and standards. Software developers could use the tool voluntarily.
- January 2004. Most projects were registered with an instance of the electronic process guide.

3.2 Research Method and Design

The work reported here is a case study [48] that followed the introduction of an electronic process guide at Spacetec.

TABLE 1
Characteristics of the Group Who Were Participating in Process Workshops (WS) and the Group Who Were Not Participating in Process Workshops (-WS)

Characteristics of the two groups	-WS	WS
Number of people	22	9
Percentage of project managers	56	55
Average number of years working with software development	8,1	12,9
Average number of years in the company	6,3	10,2
Percentage of people with BSc degrees	23	44
Percentage of people with MSc and PhD degrees	77	56

It is a single-case holistic study in that we studied one phenomenon in one company [48].

The electronic process guide studied had 31 employees as the primary user group. These employees were working either with software development or project management on software projects. We excluded people who were mainly working with administration or hardware development, as well as three people from the quality department, because they were directly involved in developing the tool.

Of the 31 employees in the primary user group, nine participated in one or two process workshops. The workshop participants were selected by the quality department at Spacetec to represent a variety of roles and opinions related to quality assurance. The two groups are described in Table 1. We see that the workshop group had people with longer experience in software development and who had worked in the company longer. They also had less formal education than the nonparticipants.

We used multiple data sources and applied triangulation in the analysis, as described below. In the analysis, we rely mainly on qualitative interviews [41] because these provide a rich picture of use. We also use quantitative measurements in the form of transaction log analysis [32]. We end this section by discussing threats to validity and how these were handled.

3.2.1 Data Sources

We investigated the use of the electronic process guide for the two groups through the data sources, which we now describe in further detail:

Interviews. In order to study how the electronic process guide was used in the company over time, we conducted three series of semistructured interviews in January 2004, August 2004, and January 2005. We asked the quality department in the company to select a set of people that was representative with respect to their opinions on the electronic process guide. Of the workshop participants, three had participated in two workshops and two had participated in one. The number of interviewees, their roles in the organization, and the number of process workshops they participated in are given in Table 2.

We interviewed eight employees each time we visited the company, four who had participated in the process workshops and four who had not. Because employees were unavailable, it was not possible to interview the same people all three times. Three workshop participants and three who did not participate in the workshop were interviewed every time. In addition, we interviewed two people who participated in workshops (one in the first round, another in the two last rounds) and two people who did not (one in the two first rounds and another in the last round).

TABLE 2
Interviewees Who Participated in Workshops (A-E) and Did Not Participate in Process Workshops (F-J) and Their Roles in the Organization

Interviewee	Interview rounds			Workshops	Company role
	1	2	3		
A		Y	Y	1	Project manager
B	Y	Y	Y	1	Developer
C	Y	Y	Y	2	Project manager
D	Y	Y	Y	2	Developer
E	Y			2	Developer
F	Y	Y		-WS	Project manager
G	Y	Y	Y	-WS	Project manager
H	Y	Y	Y	-WS	Developer
I	Y	Y	Y	-WS	Developer
J			Y	-WS	Developer

For workshop participants, we also state the number of workshops in which they participated.

All interviews in each round were done on the same day by the two authors in parallel. The interviews were recorded and transcribed in full.

Usage logs. For studying the use level from the logs, we used transaction log analysis. Transaction logs capture the interactions between online information retrieval systems and users [32]. The data from the logs were collected from the company Intranet Web server logs. Each hit on the electronic process guide during the whole period was logged. The pages were not cached outside the server and each page loaded only generated one hit, even though the pages can consist of multiple components (such as images). The pages visited consist of tools or process descriptions. The tools, for example, checklists, requirement lists, and action lists, are typically visited every time some of this information is changed or when a user needs to acquire an overview of tasks that have been planned. The explicit combination of computer names and real names, which gives the number of look-ups per person, was known only to the researchers and not to employees in the company. Sixty users generated 116,000 look-ups over a period of 19 months from August 2003 to February 2005. Thirty-one of these 60 belonged to the primary user group and were included in the final analysis. They visited 36 different pages and generated 63,000 look-ups.

3.2.2 Data Analysis

Interviews. All data from the interviews were imported into a tool for analyzing qualitative data, Nvivo.[1] We read all interviews and coded interesting expressions of opinions in

1. Nvivo is a tool for analyzing qualitative data available from QSR International, www.qsrinternational.com.

the text by assigning the expression to a category with similar expressions. We coded ("preform") expressions in the text into categories such as use frequency, which we defined as "daily," "weekly," "monthly," and "seldom." For other categories, we used "postform" or open coding, deriving the codes from the text. One example is the expression "you have one place to find information" and "the documentation you need in the project is available," both of which were coded into "everything in one place" (listed in Table 5). These coded pieces of text were again categorized with other expressions of benefits of the electronic process guide such as "easier to organize the work" and "better control" in a process that is referred to as axial coding [42].

The coding was done by the two authors independently. After having coded two-thirds of the material, we selected two interviews to compare coding. The reliability was computed as the number of agreements divided by the total number of agreements and disagreements [29]. For the two documents, the reliability scores were 0.14 and 0.43, which we considered too low. We decided to merge the independently coded material and discuss it in the belief that discussion would yield greater agreement. We then proceeded to code the remaining one-third of the interviews independently and computed a new reliability score for two new documents. This time, we got 0.45 and 0.6. We believe that the reason for the low reliability scores for the first two-thirds of the material was the high number of categories used in the coding. Each of the 3,285 lines of text could be assigned into one or more of 63 categories. However, in order to ensure agreement of the coding, we merged the independent coding again and went through all of the coded material together.

After the coding, we generated reports for our main groups of axial codes: *electronic process guide usage*, *what is used in the electronic process guide*, *benefits of electronic process guide usage*, and *disadvantages with electronic process guide usage*. For each of these reports, we structured the information according to interview time and process workshop participation in order to study the differences between these groups.

Usage logs. The daily usage logs were summed for each week and, to make the data more readable, we presented the data by number of look-ups per month. All of the data were imported into Microsoft Excel and were analyzed through plots over time for an average number of look-ups per person per month.

3.2.3 Threats to Validity

We briefly discuss the main threats to construct validity, internal and external validity, and to the reliability in this study:

Measuring use. In general, it is difficult to measure use, which is related to construct validity. Dybå et al. discuss challenges related to the conceptualization and operationalization of the use of methodology [17]. In that study, they did not find a strong relation between subjective and objective operationalizations of use. A problem with objective measures of use, like the logs we have used, is that it includes "direct and indirect usage, the nature of the involved tasks, situation-specific adaptations, and learning behaviors." To reduce the source bias, we included two data sources in our study and key informants reviewed the conclusions. There are two main threats to the internal validity of our study:

1. *A potential bias with respect to selecting the participants in the process workshops.* If the selected group is not representative of the population studied, internal validity is threatened. There are two relevant strategies for ensuring the internal validity of our case study: addressing rival explanations and explanation building. In Section 3.1, we present the process by which workshop participants were selected. We discuss the selection of participants as a rival theory in Section 5. Explanation building is used in Section 5, where findings from multiple sources are discussed in relation to related work on employee participation.
2. *The selection of the interviewees among the workshop participants and nonparticipants.* We plotted the usage graphs for the interviewees, which show a pattern similar to that for the whole populations given in Fig. 2. This suggests that the selections behave similarly to the whole groups, in the relevant respects.

The threat to external validity is addressed in this single-case study through the use of theory, which motivates the study, and is used for comparing results in the discussion.

As for reliability, we have described in detail how the study was performed in Section 3.2 and developed a case study database in Nvivo, which contains all transcribed interview material and the coding of the material.

4 Results

We investigate the three factors discussed earlier on electronic process guide usage: 1) use frequency, 2) used functionality, and 3) described advantages and disadvantages of use.

4.1 Electronic Process Guide Use Frequency

The use level varied between those participating and those not participating in the workshops, as may be seen from self-reported usage in Table 3 and the usage from the logs in Fig. 2.

The big general variations in the usage in the graphs can be explained by two factors, namely, vacations and the introduction of new tools to the electronic process guide. The people at Spacetec had a Christmas vacation in months 5 and 17, a summer vacation in month 12, and an Easter vacation in month 9. New tools were introduced in months 8 and 9.

If we look at the total number of look-ups per person for the whole period (there are 46 work weeks a year and each person worked, on average, 73 weeks during the 19-month period), the workshop group has an average of 39 look-ups per person/week or eight look-ups per person/day (each person generated, on average, 2,815 look-ups) and those that did not participate in workshops had an average of 23 look-ups per person/week or five look-ups per person/day (each person generated, on average, 1,704 look-ups). From the detailed logs, we found that one person in the

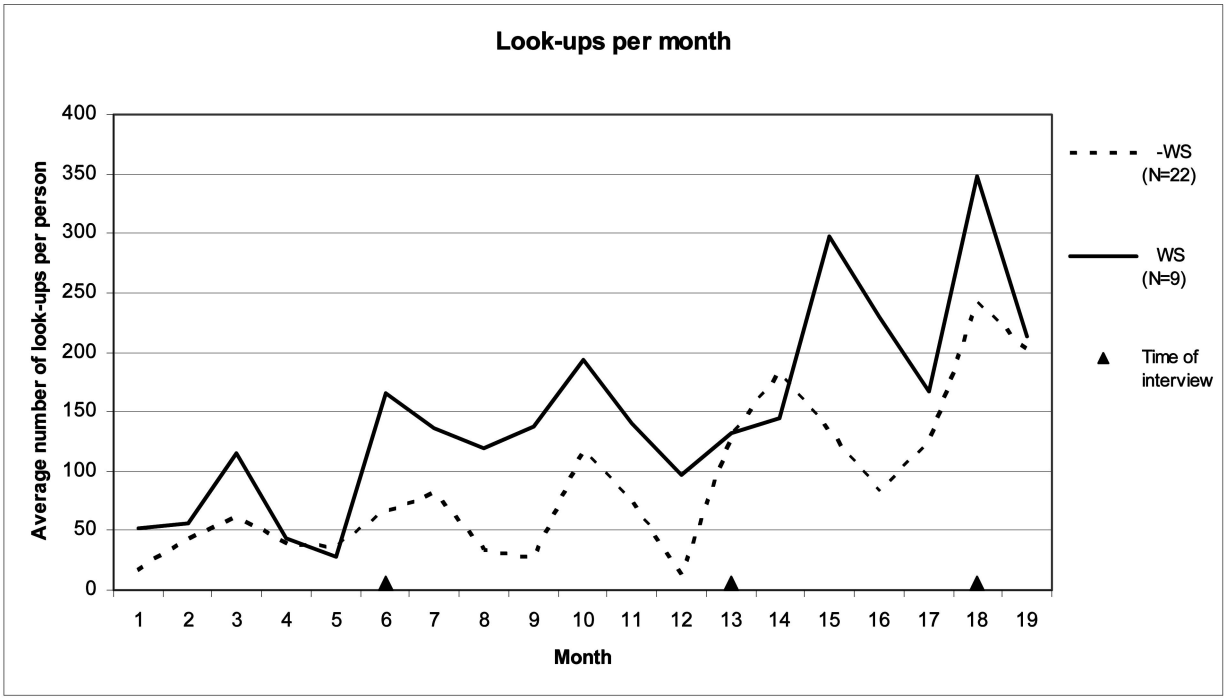

Fig. 2. Electronic process guide usage per month for workshop participants (WS) and nonparticipants (-WS). The usage is counted in number of look-ups per person per month. The interviews were performed in months 6, 13, and 18. Vacations were in months 5, 9, 12, and 17. This graph shows usage for the whole population.

workshop group generated considerably more look-ups than the others in his group, but, even if we remove him, the workshop group still generated more look-ups per person.

4.1.1 January 2004/Month 6

Of the four interviewees participating in the process workshop, two claimed they used it on a daily basis, one weekly, and one seldom. The person who claimed to use it seldom said, "Since I am working on a project that started before we began using the electronic process guide and this project is still running, I have not used it at all." Of the four people who had not attended the workshop, one used it daily, one weekly, one monthly, and the last seldom.

From the usage logs, it seems that the people who participated in workshops used the guide more than those who did not participate in the workshops (see Fig. 2). In month 5, the people in the no-workshop group used the guide a little more, on average, than did those in the other group. The reason for this was that a few people from this group worked during the Christmas holiday. The average number of look-ups per person for the last seven weeks before the interview (without the Christmas holiday) was 30 look-ups per week for the workshop group and 12 look-ups per week for the other group.

TABLE 3
The Self-Reported Use Frequency of the Electronic Process Guide of the Eight People Interviewed in Each Round (WS = Workshop Participants, -WS = Not Participating in Workshops)

Use Frequency	Jan 2004		Aug 2004		Jan 2005	
	WS	-WS	WS	-WS	WS	-WS
Daily	2	1	3	1	3	1
Weekly	1	1	1	1	1	1
Monthly	0	1	0	1	0	1
Seldom	1	1	0	1	0	1

4.1.2 August 2004/Month 13

In August 2004, three of the people who participated in the workshop used the electronic process guide daily and the other person used it weekly. One of the people using it daily said, "... I use it very often as a project manager, in weekly project meetings, we go through the checklists, and then, I make them (the project participants) check off what has been done."

Of the four people who had not participated in the workshop, the distribution was the same as in January 2004. One of the people using it seldom said, "I actually use it less than the last time we spoke. I think it is about once a month."

In August 2004, there is a clear tendency for the developers and project managers who participated in the workshops to use the electronic process guide more often than the other group, if we rely on the interview material. However, in month 13, the usage level taken from the logs was approximately the same for both groups Fig. 2: The average look-ups per person per week is 34 for the workshop group and 33 for the other group.

4.1.3 January 2005/Month 18

In January 2005, the picture from the interviews was exactly the same as in August 2004. Three workshop participants report daily usage and one weekly, while the nonparticipants

TABLE 4
The Self-Reported Usage of Different Functions in the Electronic Process Guide

Functionality	January 2004		August 2004		January 2005		Total		*Total*
	WS	-WS	WS	-WS	WS	-WS	WS	-WS	*All*
Checklists	4	2	4	3	3	3	11	8	*19*
Action list	4	0	3	1	4	3	11	4	*15*
Process descriptions	3	0	2	4	3	2	8	6	*14*
Project status	2	3	3	1	2	1	7	5	*12*
Project reports	2	1	2	0	2	1	6	2	*8*
Work packages	2	0	1	1	2	1	5	2	*7*
Project notes	0	0	1	0	2	1	3	1	*4*
Milestones	0	2	0	0	0	1	0	3	*3*
Requirements database	0	0	1	1	1	0	2	1	*3*
Risks	0	0	2	0	1	0	3	0	*3*
Templates	0	1	0	2	0	0	0	3	*3*
Generate documentation	0	0	1	1	0	0	1	1	*2*
Use case	0	0	1	0	0	0	1	0	*1*
SUM	*17*	*9*	*21*	*14*	*20*	*13*	*58*	*36*	*94*
COUNT	*6*	*5*	*11*	*8*	*9*	*8*	*11*	*11*	*12*

are spread over daily, weekly, monthly, and seldom. The usage log confirms this picture; the workshop participants have a higher number of electronic process guide look-ups than the nonparticipants.

The person who uses the electronic process guide seldom said, "I do not think I have used it since the last time .... We have finalized the project I was working on, it was the project manager who updated, and there was little to update at that point. For the last few months, I have been working after delivery, which I do not think the electronic process guide says anything about."

For month 18, the logs show more look-ups for the workshop group (see Fig. 2): The workshop group has an average of 89 look-ups per person per week and the other group has an average of 50 look-ups.

4.2 Electronic Process Guide Functionality Use

The functionality in the electronic process guide was used to varying degrees over time. In Table 4, we indicate how many of our interviewees said they were using the most popular functions. The "sum" at the bottom in Table 4 refers to the total number of functions used, while the "count" refers to the number of unique functions that were used. Thus, we measure both the "breadth" and degree of functionality usage.

When we analyzed the logs, we found that the tools generating most of the look-ups from both groups are the same ones that Table 4 shows to be the most popular. For the workshop participants, "checklists" got 3,500 look-ups and "action list" got 2,300 look-ups for the whole period. For the nonparticipants, the "checklists" got 2,500 look-ups and the "action list" got 2,100 look-ups.

4.2.1 January 2004/Month 6

In January 2004, the people who participated in the process workshops describe the usage of six functions in the electronic process guide (the "count" figure). They used the check lists, action lists, process descriptions, project status page, project reports, and work package lists.

The people who did not participate in the process workshops describe the usage of five functions: checklists, project status, project reports, milestones, and templates.

Several people mentioned using the electronic process guide to look at other projects: "I've been looking at two or three other projects to see what they are doing in practice .... I definitely have a better overview of the projects than I did before."

The descriptions of work processes were used to remember all steps in a project. Some made use of the templates, while the most popular functions were checklists and action lists.

The workshop participants used one more function than the nonworkshop participants and more of the workshop participants describe using the functions (17) than nonparticipants (9).

4.2.2 August 2004/Month 13

In August 2004, project managers could generate reports using a tool associated with the electronic process guide, which they previously had to do by hand. One of the managers reported that "it is a new way of reporting, earlier we used Excel ..., and then, we had to get the numbers semiautomatically, and everything was not up to date."

Both workshop participants and nonparticipants used more functions than in January 2004, 11 for the workshop participants and eight for the nonparticipants. More of the workshop participants used the functions: 21 versus 14 for nonparticipants. The most popular function was still the checklists.

4.2.3 January 2005/Month 18

For January 2005, workshop participants reported using slightly fewer functions, that is, nine, whereas nonparticipants reported using eight. The total figure for people who mentioned usage is still higher for workshop participants than nonparticipants: 20 versus 13. The action list is now the most popular function. A project manager describes this as "... a very nice tool to remember to get things done."

TABLE 5
Advantages of Using the Electronic Process Guide Reported in the Interviews

Advantages	January 2004		August 2004		January 2005		Total		*Total*
	WS	-WS	WS	-WS	WS	-WS	WS	-WS	*All*
Better overview	3	2	3	3	3	1	9	6	*15*
Everything in one place	3	2	2	0	3	1	8	3	*11*
Better control	1	1	3	2	2	0	6	3	*9*
Better reports	0	0	2	1	3	1	5	2	*7*
Easier to organize the work	1	0	1	1	2	1	4	2	*6*
Easier to remember steps in the process	1	0	1	1	1	1	3	2	*5*
Better project execution	1	0	0	2	2	0	3	2	*5*
Uniform way of working	1	1	2	0	0	0	3	1	*4*
Easier to tailor processes	1	0	1	0	2	0	4	0	*4*
Everyone insight in status	0	0	1	1	1	0	2	1	*3*
Better project information	0	0	1	1	0	1	1	2	*3*
More conscious on the process	0	1	0	1	1	0	1	2	*3*
SUM	*12*	*7*	*17*	*13*	*20*	*6*	*49*	*26*	*75*
COUNT	*8*	*5*	*10*	*9*	*10*	*6*	*12*	*11*	*12*

TABLE 6
Disadvantages of Using the Electronic Process Guide Reported in the Interviews

Disadvantages	January 2004		August 2004		January 2005		Total		*Total*
	WS	-WS	WS	-WS	WS	-WS	WS	-WS	*All*
Poor layout	2	3	1	1	1	2	4	6	*10*
Technical problems	2	0	4	0	3	0	9	0	*9*
Cumbersome to use	1	2	1	1	1	1	3	4	*7*
The process does not fit	1	0	1	1	2	2	4	3	*7*
Does not show genuine progress	0	0	2	0	3	1	5	1	*6*
Not tailored to small projects	1	0	1	1	1	1	3	2	*5*
More bureaucracy	1	2	0	0	1	0	2	2	*4*
The process does not support iterations	0	1	0	1	1	1	1	3	*4*
Double book-keeping	0	0	1	0	0	2	1	2	*3*
Too large	1	0	1	0	0	1	2	1	*3*
Unknown terms	0	1	0	0	0	1	0	2	*2*
Only available online	0	0	1	0	1	0	2	0	*2*
SUM	*9*	*9*	*13*	*5*	*14*	*12*	*36*	*26*	*62*
COUNT	*7*	*5*	*9*	*5*	*9*	*9*	*11*	*10*	*12*

4.3 Advantages and Disadvantages of the Electronic Process Guide

When asking about the advantages of using the electronic process guide, there was a difference between the two groups. The interviewees who attended the workshops listed several more advantages of using the guide than the other group. Typical advantages noted were better overview, all information being in one place, better control and reports from projects, ease of organizing work, and ease of remembering all steps in the process; see Table 5.

We also asked the interviewees what they saw as disadvantages of the electronic process guide. The main disadvantages given were related to the layout and technical quality of the electronic process guide; see Table 6.

4.3.1 January 2004/Month 6

The four interviewees who attended the process workshops mentioned 12 advantages in all, while the four who did not attend mentioned seven. The two groups mentioned the same number of disadvantages. A workshop participant described one advantage, that the electronic process guide made it easier to "remember everything that must be done in each phase .... It is very easy to forget that you should hold a delivery review board each time you have a delivery." Another person who attended the workshop talked about how the electronic process guide made it easier to share knowledge.

Another said that "it is important to have an overview of the project. You get a really good overview of the project status and where you need to make some effort. Earlier, it was more ad hoc. You only followed a print from a Gantt diagram generated in MS project. We used to work according to the waterfall principle, but now, you can do iterations and go back if you need to correct something. So far, it seems like a very good tool for keeping track of the project."

One person who had not attended the workshop said, "What is positive is that I can find everything I need in one place ... What you need to do is described well; you don't need to run around asking and looking for information among your colleagues."

Many of the disadvantages described were related to the layout of the electronic process guide: "I think the layout should have been improved ..., it is not critical, it works OK. It is functional."

A fear expressed by one workshop participant and two nonparticipants was that the defined process could lead to a more bureaucratic development process. A developer who did not participate in the workshop said, "I think it easily could be more bureaucratic. Calling in many people to meetings as soon as the software is stable seems a bit . . . I do not know how that will work, I do not really believe in it."

4.3.2 August 2004/Month 13

The people who attended the workshop mentioned a total of 17 advantages, the same as before. The people who did not attend the workshops reported 13, a large increase from before. Further, workshop participants mentioned 13 disadvantages, while the nonparticipants mentioned five.

Speaking of advantages, one of the workshop participants said, "It is a lot easier for people to work in a more structured way, since you have the guide, and can see what it means to have a role in each phase of the project. What is expected as output from a phase is obvious. When you have done what you need to do, you check off and then you move on."

One person who did not participate in the workshops commented, "The code produced is no better than before, but I believe that the risk for big misunderstandings is reduced, concerning what the system should do. Perhaps it is easier to get the same picture of the project."

A new disadvantage mentioned by two workshop participants at this stage was that the electronic process guide does not have the capacity to show incremental progress.

4.3.3 January 2005/Month 18

For January 2005, the workshop participants listed more advantages, 20 in all, whereas the nonparticipants listed six. As for disadvantages, the workshop participants listed 14 and the nonparticipants listed 12. Interestingly, the disadvantage "the process does not fit" was mentioned by two participants and two nonparticipants in January 2005.

With respect to the advantages, a workshop participant said that "you have a much better 'live' picture of what happens, and in that sense, you have a better overview."

With respect to disadvantages, four developers stated that the process described in the electronic process guide does not fit the project. One developer who participated in the workshops said that the process does not fit because they were working on "a special project, where we are porting a software from one platform to another, and then, we are not using standard phases." Another developer said that "a clear disadvantage is that one process has been forced on all projects with very little variation in steps and roles. Therefore, a tiny delivery project, where everything is already developed, and we just need a small integration, was given a project manager, and a person responsible for technical quality assurance was appointed. There were so many people involved that the job took three times longer."

5 Discussion

We examined the use of an electronic process guide in a medium-sized company by conducting three series of qualitative interviews and examining usage logs over 19 months.

The electronic process guide was actively used at Spacetec; for the whole period for which we have logs, each user looked up the guide eight (process workshop participants) and five (nonparticipants) times a day on average. In all, it seems that the company has introduced the electronic process guide successfully. In "Company X," Moe and Dybå [31] found one person, out of 19 interviewed, who used the electronic process guide daily. The Alette study [26] reports two daily accesses per potential user. The Andersen Consulting study [23] gives the impression of a low usage rate.

An interesting difference between the electronic process guide at Spacetec and the one at Alette is that the former is what Meso and Jain [28] refer to as a "strong" problem-solving approach because it is developed for a specific purpose, whereas the latter is more of a "weak" problem-solving approach because it is based on the ISO 12207 standard. Another difference between the two electronic process guides is that the Alette guide was developed by process engineers, whereas the Spacetec guide was defined mainly through process workshops.

We now discuss our research question: How does the participation in process workshops influence the use of electronic process guides over time? We organize the discussion according to the three topic areas presented in the results section: usage frequency, functionality in use, and advantages and disadvantages of the electronic process guide as viewed by the interviewees.

First, concerning electronic process guide usage, the level of use differs between the groups who participated in the workshops and those who did not. The self-reported usage frequency was higher for the workshop participants in January 2004, August 2004, and January 2005. This is confirmed by the usage logs, which show a higher degree of usage among the participants in the workshop in 14 of the 19 months where data was collected. The nonworkshop group had a slightly higher usage in four months (months 4, 5, 13, and 19), and the usage level was approximately equal in one month (month 14). Over the whole period, the workshop group had an average of 2,815 look-ups per person versus 1,704 look-ups for nonparticipants. On average, workshop participants accessed the electronic process guide approximately 65 percent more times than the nonparticipants over the total period for which we gathered usage logs. This suggests that participation in process workshops leads to a higher level of usage.

Second, the workshop participants used more functions and they used functions more often at all three times that we conducted interviews. In total, the workshop participants reported using 58 functions, whereas nonparticipants reported using 36 (Table 4). This suggests that workshop participants used a broader range of functionality than did nonparticipants.

Third, the interviewees who participated in the process workshops state more advantages (49 in all) than the ones who did not participate (26 in all). The workshop participants noted more advantages than did the nonparticipants at all three interview times. For disadvantages

reported, the picture is the same overall. Workshop participants reported 36 disadvantages in total, whereas nonparticipants reported 26. The number of disadvantages reported was the same in the first interview round, higher for the workshop participants in the second, and approximately the same in the third. It is interesting that the number of disadvantages noted by the workshop participants increased over time (nine to 14), whereas the nonparticipants noted the most disadvantages in the first interview (nine in January 2004) and the last (12 in January 2005). By examining reported advantages and disadvantages, we may conclude that employees who participated in process workshops noted more advantages but also more disadvantages. This is probably because workshop participants also reported a greater usage of the electronic process guide and, therefore, reported disadvantages found through use. For example, they are the only ones who reported "technical problems" and are in a clear majority in reporting the disadvantage "does not show genuine progress." The only person to report about "unknown terms" in the process descriptions did not participate in the workshops.

In summary, we found three indications of increased usage and awareness of the electronic process guide in the group that participated in process workshops. What can explain this higher degree of usage?

Riordan et al. [36] list four types of involvement: participative decision making, information sharing, training, and performance-based rewards. What separates the workshop group from the nonworkshop group is that they participated in the decision making as to what the actual work processes should be in the company and they received information on how the processes and project management system would work at an earlier stage. Training was modest for the electronic process guide and given at the same level to both groups. There were no explicit performance-based rewards related to the usage of the electronic process guide.

The main difference between the two groups was the participative decision making. We believe that the information that was shared early in the workshop participant group could be compensated for quickly by training and usage for the nonworkshop group. The reason for this belief is that workshop participants only participated in developing parts of the processes that were described in the final electronic process guide and, therefore, only had limited detailed insight.

In the process workshops, employees were involved in several decision making processes [7]. They identified problems related to the existing development process, generated alternative solutions, participated in selecting a solution, and planned how the solution should be implemented. Some were also able to evaluate the electronic process guide by providing feedback during the interviews. Studies have shown that participation in planning is related to performance and participation in generating alternatives, planning, and evaluating results is related to work satisfaction [7]. Other studies have found that employee participation leads to organizational effectiveness, measured through financial performance, turnover rate, and workforce morale [36], [43].

Could it be that participative decision making had such a large impact on the usage of the resultant electronic process guide that it was sustained for 19 months? We have not been able to identify studies on the impact over time, but it seems clear from the literature on involvement and participation that this can have an impact and, in this case, an impact on the usage level. In a quantitative study of electronic process guide usage at "Company X," Dybå et al. [18] found that higher levels of organizational support were associated with higher perceptions of usefulness. Perceived usefulness was, in turn, strong and highly determinant of both current usage of the electronic process guide and intention to use it in the future. In a qualitative study in the same company, Moe and Dybå [31] found that only a few people reported such participation and this explains some of the low level of use in this company.

One reason for the continuous higher level of usage among the workshop participants might be that low usage makes the employees see fewer advantages of the electronic process guide, which acts as a barrier to use. By contrast, high usage seems to make the employees see more advantages, which motivates increased use.

We have not found other studies that measure the effect of participation over time. In our case, the participation in process workshops can be seen as the most important type of organizational support, where employees engaged in discussion with the quality department. However, we would expect the workshop effect to fall off over time.

Could there be other explanations of the difference between the two groups than the participation in designing the electronic process guide? Could it be that the increased usage is due only to a natural variation because of the phases of the projects the employees participate in? The electronic process guide gives the most support in the first and last phases of a software project and less during implementation, so the current project phase will affect the level of usage of the project participants. Because of the length of our study (19 months), we do not think this can explain such a difference because most projects will have gone through several phases during this time interval.

A further alternative explanation could be that the employees who were selected for the process workshops were more motivated to use the guide in the first place so that participation was not the real cause of the increased usage. However, the company selected participants in order to represent a variety of roles and opinions, so there was no intentional selection bias that could favor the workshop group with respect to motivation to participate and use the guide.

Project managers were more likely to use the electronic process guide, but, in Table 1, we see that there was the same percentage of project managers in the two groups. Another rival explanation could be that the people who were more experienced in the company or with software development would use the electronic process guide less as they already would have established practices for how things are done. However, we see in Table 1 that the contrary is the case; the workshop group has more experience with software development and has, on average, about four years more of experience from the company.

6 Conclusion

Electronic process guides have been seen as an important instrument for making software development more efficient and for delivering software of higher quality by facilitating human understanding, supporting the betterment of software processes, improving process management, automating guidance, and automating support for executing processes [12]. To achieve these benefits, it is important that the electronic process guides are used. We have seen many examples of electronic process guides being little used and thus having little impact on software development practice.

In a single-case holistic study in a medium-size software company, we investigated how participation in creating an electronic process guide through process workshops influenced the use of the guide. We studied three factors regarding developer and project manager usage: frequency of use, used functionality, and reported advantages and disadvantages. We collected data from three rounds of interviews and 19 months of usage logs in a longitudinal study in a medium-size software company. Workshop participants showed a higher degree of usage, used a larger number of functions, and expressed more advantages and disadvantages than nonparticipants. On average, workshop participants accessed the electronic process guide 65 percent more often than nonparticipants. Our study suggests that employee participation has a long-term positive effect on electronic process guide usage.

The implication of these findings is that users of an electronic process guide should be involved in developing it. In the case presented in this study, the participation was manifested in organizing process workshops. This form of participation can be difficult to organize in larger companies. Here, other forms of participation should be sought that help employees to generate alternative solutions and planning implementation because these processes have been shown to relate to performance.

In the future, we would like to see more longitudinal studies of employee participation in software process improvement in order to gain more knowledge on contextual factors, as well as the long-term effects of participation. Also, the questions of how, when, and why electronic process guides are used are important issues which should be addressed in future research.

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