Influencing System Quality by Using Decision Diaries in Prototyping Projects

Kristin Braa

University of Oslo
Department of Informatics
P.O. Box 1080 Blindern, N - 0316 Oslo, Norway
Phone: +47 2 852408
e-mail: kbraa@ifi.uio.no

Abstract

In this paper 1) the need for decision making to be transparent in prototyping projects is discussed and 2) a way to document decision making during such projects is suggested. Further, by extending the established idea of diaries, the use of a diary-based process documentation technique in several prototyping projects is evaluated. This is done in order to examine the extent to which the documentation techniques influence the quality of the system. Projects in which these aspects were tested are described. Decision diaries were used in order to manage and improve the decision making process and in order to make the decisions related to the design more transparent. The underlying assumption was that transparency would improve the quality of the decisions and thus, the system. User satisfaction reports are analyzed. They indicate that decision diaries make decision making more explicit and thus increase the quality of the system design process and the product.

Keywords
Prototyping, decision diaries, participatory design.

Introduction

Prototyping has been on the agenda for the past ten years (Squires et al, 82; Budde et al, 84). Its development can be described as a reaction to many of the typical weaknesses of traditional phaseoriented system development models, such as the waterfall model (Boehm, 76). Traditional system development is based on the assumptions that it is possible to specify the system in advance, and that it is possible to reach a correct specification during one specification phase. The result is often systems of poor quality, systems that are difficult to change and maintain, as well as systems

that do not meet the users' needs (Winograd & Flores, 86; Floyd, 87; Ehn, 88).

In this paper I will use Mayhew & Dearnley's (90) definition of prototyping: "The process of constructing and evaluating working models of a system in order to learn about certain aspects of the required system and/or its potential solution." By a prototype, I mean an early working model of one or more parts of the required system.

Independent of the chosen definition, there is one common motivation behind most definitions: prototyping is mainly concerned with reducing the uncertainty involved in system development (Davis, 82). This is approached through learning and evaluation based on the use of the prototype. Experiments with prototypes provide practical insight into possible solutions. Prototyping aims to involve the users by letting them take part in experiments demonstrating the design of their future application system. In this way, prototypes are a means of communication between the system developers and users. Thus, prototyping is a genuinely participatory approach to system development. Prototypes also enable parts of the knowledge gained during the design process to be implemented. A prototype constitutes an executable specification, and helps to narrow down the gap between specifications and the user's actual needs (Budde & Zullighoven, 90).

Nevertheless, prototyping does not solve all problems. It can also introduce new ones. One can say that decision making in system development is a critical activity with respect to the quality of the product. Decision making is even more critical in prototyping projects because of the large number of design decisions to make and at the same time the lack of documents connected to decision making. A prerequisite for prototyping projects is close cooperation between the developers and the users.

Figure 1. The interconnections of decision making, documents and organizational culture, influencing the quality of prototyping.

Documents are, of course, important when it is necessary to mediate and maintain a common comprehension between members of typically different organizational cultures. This perspective on the successfulness of prototyping will support *real* participation, in contrast to symbolic participation (meaning nominal participation without practical influence).

My claim is that in order to organize decision making from a participatory perspective, and, in order to improve the quality of the decisions, it is necessary to make the decision process transparent. By transparency in decision making, I mean insight into all layers of previous decisions, their priorities and the argumentation behind them. In order to support decision making in a design context, I wish to introduce a process documentation technique called decision diaries. This is an extension of project diaries (Jepsen et al, 89: Naur, 83) with special emphasis on design decisions and goal definitions, in order to make up for the lack of relevant documents in prototyping projects.

It is impossible to create high quality computer systems without genuine user participation. A high standard in terms of user quality, technical quality, and organizational quality, depends on there being a mutual learning process between system developers and users: system developers must learn about the work and the organization in which the computer system is used, and the users must learn about computer science and the technological possibilities (Braa et al 92; Braa & Øgrim, 92).

In this paper, an experiment on decision diaries is presented. This experiment has been conducted in a teaching situation, yet aimed at supporting real prototyping.

The fundamental assumption behind this experiment is that the quality of decision making is of vital importance to the quality of the design of the system. In addition, I assume that more transparent and explicit decision making is nec-

essary in order to ensure real participation in system development projects. I believe that more transparent and explicit decision making processes imply better decisions, especially in a mixture of organizational cultures (cooperating partners). My hypotheses may be summarized as:

- Decision diaries make decision making more explicit.
- Decision diaries improve the quality of the system design.

The hypotheses have been tested in 16 prototyping projects. The results are evaluated later in this paper.

The remainder of this paper is organized as follows. In the next section, I discuss decision making as a critical activity especially in prototyping projects. In section "Organizational Culture and Participatory Projects", I discuss participation in the light of organizational culture aspects. I then describe the process documentation technique decision diary. The experiment, in which the decision diary technique was used, is then presented. In the following section, problems with measuring the quality of prototypes are discussed. In section "Assessment of the Experiment", the experiment is evaluated in the light of the hypotheses presented above. Last, but not least, I outline some conclusions that can be drawn from the experiments, focusing on the possibilities and advantages of using decision diaries in participatory projects, especially in connection with prototyping.

Decision Making in Prototyping Projects

Prototyping projects are often initiated because of a certain degree of uncertainty about, for instance, what kind of a product that should be developed (Davis, 82; Floyd, 84). It is also commonly accepted that the aim of the product often changes during the prototyping process. Decisions made during the project will influence the outcome of the prototyping process. Moreover, because prototyping is not a specification oriented approach, numerous design decisions have to be taken during the process (Budde et al, 91). This, in turn, underlines the importance of decision making in prototyping projects. In a prototyping process, several types

164

of decisions have to be made. Major decisions may, for example, be deciding the overall goal for the next prototype and choosing between alternative designs. Numerous minor decisions, such as selecting field size etc., are also typical. So, almost all decisions in prototyping are concerned with design. Special attention should therefore be given to such decision domains as the overall goal and the subgoals of each prototype. In particular, if the different groups in a project, e.g. users and developers, have different goals, the result can be that the project run into conflict situations.

Prototyping projects are, by definition, not driven by documents indicating possibilities and restrictions. Without a detailed specification, the participants may experiment more freely and thus be invited to suggest new solutions. This situation can be contrasted with conventional system development projects where documents often are used as "contracts", organizing and managing the development process (Andersen et al, 90). The lack of documents in prototyping projects cause several problems with respect to decision making. Documents are often used as instruments in bringing about communication between users and developers. Moreover, decisions are often based on and explained by documents. When decisions are not documented, they may become arbitrary, giving no guarantee of the quality of the product. The situation could be improved by directing attention to decision making and, in addition striving towards more conscious decision making. There is an obvious need to introduce documents in prototyping, in order to improve and manage the decision making. The participants' background in different organizational cultures means the decision making process becomes even more complex. This topic will be discussed separately below.

Organizational Culture and Participatory Projects

User participation is a condition of success in prototyping projects. Users are supposed to be actively involved - symbolic participation is insufficient to get benefit from prototyping (Grønbæk, 91). Actors from the developer organization as well as from the user organization have to cooperate.

In most cases, however, they represent two different organizational cultures. This approach can be both an advantage and a disadvantage at the same time. The advantage is that two perspectives, which "correct" each other, will be represented. The disadvantage is that every organization actually has its tradition represented in the way decisions are made (Bang, 90), and this may, of course, lead to culture conflicts.

System developers are often internally organized in clans. Clans (Ouchi, 80) are typically characterized by internally developed standards and values regulating the activities of the group. The success of a clan organization is dependent on the extent to which the values and standards are shared. Thus, the members have to *create* a common tradition. This does not work particularly well when the cooperating participants come from different organizational cultures. A clan's decision process, based on so-called tacit rules, may be invisible to members of another type of organization.

The developers' rules will be invisible to the participants from the user organization. This causes problems, especially when the users (participants) do not recognize that a decision is being made or has been made. Thus, it is necessary to make tacit rules explicit. According to the ideas of quality assurance (Sommerville, 91), this is in fact, needed in all system development projects. And it applies in particular to participatory projects, where several different organizational cultures are often represented. Developing a common comprehension is a great challenge to participatory projects. My claim is that a shared document that would create a tradition and routine for decision making, would support communication between groups from different cultures.

In order to organize decision making from a participatory perspective, we believe that the user participants must be able to take part in the design process, that the decision process must be transparent, and that documents must be used to manage the design decisions. This should increase the quality of the decisions.

Process Documentation

As mentioned earlier, process documentation can be used to make the decision making process more explicit. This can be done by introducing decision diaries which:

- ensure that the decisions do not contradict the intention
- will probably make it easier to locate decisions
- ensure that misunderstandings can be corrected continuously and even some time after decisions were made
- emphasize who will be affected
- ensure that the decisions are subsequently followed.
- probably support reflection and learning

I will now introduce a technique for documenting the process. Special attention will be given to design decisions, and to formulating and documenting goals formulated during the prototyping process. The process documentation technique is a decision diary. The decision diary has been inspired by the project diary (Jepsen et al, 89, Naur, 83) as well as my experiences of using project diary in a prototyping project as reported in (Kautz, 92). The drawbacks of project diaries are that using them is too time-consuming and that they do not emphasize the central aspect of prototyping, namely decisions. I have added certain extensions in order to support decisions that are concerned with design. If users are supposed to participate in making design decision, they must be given insight into the design decision process. Making decisions more transparent implies making decisions visible to everyone involved in the project.

When using decision diaries, the process should be explained in the most complete and structured way possible. This can be done by paying attention to the following issues:

- The documentation should be written continuously and closely follow the project activities.

- The decision diary should be organized so that both the date and the agenda will be included.
- Every meeting should start with a reference to the decisions made during the previous meeting or demonstration.
- Disagreements regarding previous decisions should be registered and taken into account.
- A time frame should be indicated for carrying out decisions which have not yet been followed up.
- For each decision made, an explanation should be given as to why this solution was selected, which consequences this might have, what the alternative solutions were and why these were rejected.
- The goals for the whole prototyping project and the goal of the next prototype to be developed should be clearly stated in the diary.
- Each session should be closed with a reference to the preliminary agenda/schedule.
- The decision diary should be used for all activities in the prototyping project, such as meetings between developers, and users, negotiation meetings, evaluations, and test situations.

Generally, the degree of detail as well as the style of expression depend of many uncontrollable aspects, such as the situation itself, the cognitive style of the participants, the time available and so on. It is therefore pointless to insist on following strict, infleflexible instructions.

The aim is not to reach consensus in all cases. That is not even possible when several interests are involved. Nevertheless, by writing down the decisions and the underlying arguments, and distributing the diaries to everyone in-

volved, the participants may be provoked in a constructive way. Users' representatives will for instance react to the developers' priorities. Their reactions may even bring latent contradictions to the surface, which might otherwise have been the source of dissatisfaction later in the process, or after the implementation.

Description of the Experiment

The projects were conducted during the course "System Description and Language" at the Department of Informatics, University of Oslo, Norway, during the Spring of 1992. The course was organized in four working groups, each being divided into two project groups (e.g. Information Systems 3 & 4 in Figure 2). The projects were conducted in two main phases: in Phase 1, each group analysed and described an information system in a real organization; in Phase 2, after two groups had exchanged information systems, they started a prototyping project with the system description as their point of departure. Here, I will focus on Phase 2, in which they aimed at suggesting an improved design for parts of the current information system, visualized in prototypes. Half of the prototyping projects were conducted using decision diaries, while the other prototyping projects acted as control groups.

Each group had approximately twelve participants, and they made a description of an information system mainly based on Structured Analysis (Yourdon, 82). When Phase 2 started, the information systems were exchanged, and each description group was divided in two small prototyping projects with approximately six participants each. Consequently, there were two parallel prototyping projects (e.g. 3A and 3B in Figure 2) designing prototypes based on the
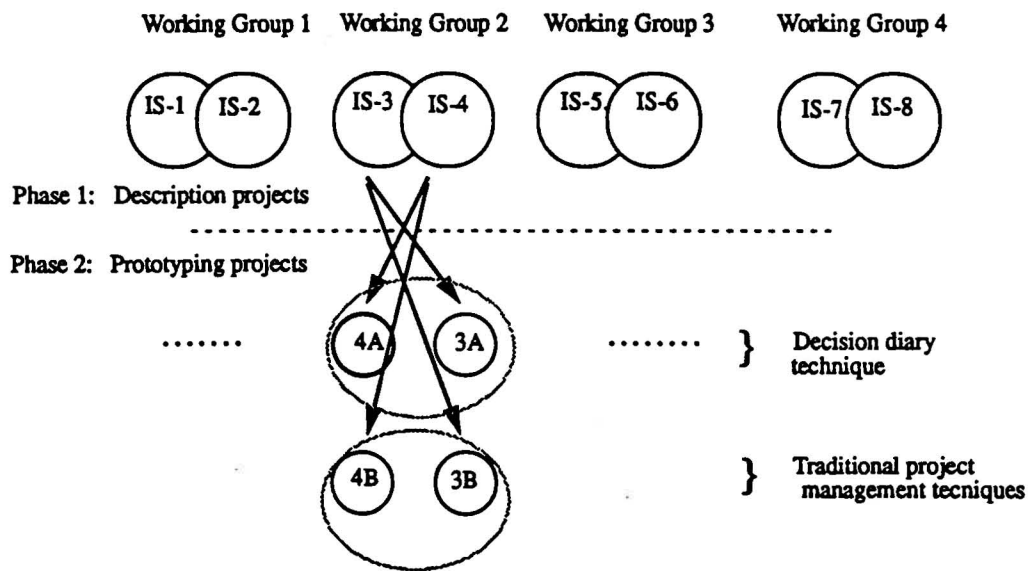

Figure 2. The organization of the projects.
All working groups are organized in the same way.

166

same information system (IS-3). The notation IS-1 to IS-8 in Figure 2 indicate information systems numbers 1 - 8 in real organizations, manual or computerized. Students who described the information system in Phase 2 acted as a user group for another group (since they knew the application area). For example, as indicated in Figure 2, the project group 4A acted as a user group for the project group 3A.

Pairs of prototyping projects used during the experiment different project management techniques. One of the projects used decision diaries to document the process. The other one used traditional project management techniques, e.g. milestones and decision charts. Each pair of projects (e.g. 3A, 3B) had the same preconditions:
• making prototypes of the same information system
• using the same system description as a basis and
• using the same fourth generation tool.

Thus, a comparison between the two projects concerning both the product and the process, should give generalizable results. The difference between the projects using process documentation and the projects using traditional project management techniques was that they did not interact with the same users. It should be possible to evaluate how the use of the specific technique will influence the product quality, by comparing the corresponding prototypes based on the same preconditions. There were eight comparable pairs of projects and, all in all, sixteen prototyping projects. Hence, it should at least be possible to find a tendency.

How to Measure Quality of Prototypes?

One of the main problems related to measuring the quality of prototypes is how to actually measure that one prototype is qualitatively better than another. In the context of this experiment, typical user satisfaction factors have been applied (Kim, 89). My aim was to find a difference between projects using process documentation on the one hand, and projects using traditional project management techniques on the other hand. I have, however, used them in an applied sense. This includes user expectations as a key factor in explaining user satisfaction. The main explaining factor is the discrepancy between the expected information service quality and perceived information service quality (Kim, 90).

This view on quality is also supported by the definition of quality by Bang et al. (91): *Quality is a reflection of one or more person's evaluation of the correspondence between their expectations and their experience of a product or a service.* Here, quality is seen as a subjective issue.

Experience shows that in prototyping, user expectations are high at the beginning of the project, and it is easy to become disappointed when only some parts of the system are implemented or when the system actually is a plain interface without any functionality. Since learning is an important factor in prototyping, the quality of the process is also an important factor.

To collect feedback from the participants I used questionnaires. In addition, I observed all the projects' last presentation sessions, where prototypes were presented to the users for feedback. The questionaires contained different questions to users and developers. The questionaires were distributed at the beginning of the last presentation session and time was allocated for answering them.

My aim was to find how much more satisfied the users in the projects using decision diaries, were with the prototypes than the users in the projects using project management techniques of more traditional character. The object of this was in order to evaluate the difference in quality of the prototypes.

Assessment of the Experiment

Methodologically, the experiment is a combination of field experiments and laboratory experiments. Laboratory experiments maximize the precision of measurement and the control of variables; the price is a certain lack of realism and generalizability (McGrath, 84). Analyzing existing information systems, automated or manual, in eight existing organizations, compensates for some of the weaknesses of laboratory experiments. Projects not using decision diaries were initiated as control projects. This was done in order to compare the two projects which used different documentation techniques. The weakness of the method is that the users are, so to say, "simulated". Nevertheless, I feel that this is one of the most applicable ways to examine my hypotheses.

Below, the results of the study are presented. A total of, 62 questionnaires were answered. When the answering percent is indicated in Tables 1 - 3, it means that no answer was given to that particular question. The questions were organized as a composition of partly quantitative, partially qualitative questions. One example of a qualitative, open questions is "How did you use process documentation". Answers to these questions are, of course, difficult to measure. The evaluation of the more qualitative answers will be discussed later in this section. First, I will take a look at the quantitative questions.

Table 1: Users' satisfaction with the prototypes

Projects using Decision Diaries	%	Projects not using Decision Diaries	%
Satisfied	56	Satisfied	32
Prototypes not as expected	12	Prototypes not as expected	21
Didn't have any particular expectations	21	Didn't have any particular expectations	21
Answering percent	88	Answering percent	75

Table 1 shows the users' satisfaction with respect to the prototypes of their own project. I have divided the users in two main groups; those who used a decision diary and those who did not. This was done in order to demonstrate the difference between the groups. I have used user expectation as

167

a key factor to explain user satisfaction. As we can see, a larger proportion (56%) of users of the decision diary technique, were satisfied with the prototypes than those not using this technique (32%). A similar tendency can be seen in the number of users who were disappointed with their prototypes ("Prototypes not as expected" in Table 1). Also, fewer decision diary users were disappointed than others. (12% vs. 21%).

In Tables 2 and 3, the users (Table 2) and the developers (Table 3) responsible for the different prototypes are shown. The comparison of the prototypes (i.e. the prototype based on the same information system and different process documentation technique) was conducted in a session during which the different prototypes were presented.

Table 2: Users' comparison of the prototypes

Projects using Decision Diaries	%	Projects not using Decision Diaries	%
Own prototypes best	32	Own prototypes best	21
Other prototypes best	15	Other prototypes best	11
Difficult to compare	35	Difficult to compare	24
Answering percent	82	Answering percent	57

Table 2 shows that more users of decision diaries considered their own prototypes to be best than did users in the control projects.

Table 3: Developers comparing the prototypes

Projects using Decision Diaries	%	Projects not using Decision Diaries	%
Own prototypes best	26	Own prototypes best	14
Other prototypes best	12	Other prototypes best	27
Difficult to compare	56	Difficult to compare	32
Answering percent	94	Answering percent	75

In Table 3, the developers compare the prototypes presented by both projects. The difference between the group of projects is greater among developers (Table 3: 26% vs. 14%) than among users (Table 2: 32% vs. 21%). It seems that developers in projects using the decision diary technique were better able to answer these questions than the others. Only 6% did not answer this question while 25% of the developers not using decision diary failed to answer this question. This may indicate several things: 1) that the design of the prototypes was considered in more detail (supported by the fact that 26% of the users liked their own prototype, while 14% liked the other group's prototype best) and that it was therefore easier to answer the ques-

tions, or 2) that by using the decision diary technique they have become more accustomed to making such evaluations.

The tables indicate great differences in the answers of the projects using decision diaries and the control projects with respect to user's satisfaction, their assessment of the different prototypes and especially the answering percent. Table 1 shows that the users in projects using decision diaries were more satisfied with the prototypes than the users in the other projects, and that the prototypes fulfilled their expectations. It does not necessarily mean that the prototypes are of particularly better quality, but rather that the commitment was stronger. The big difference in the answering percentages may indicate this. Another explanation could be that the participants using the decision diary technique where more aware of what was going on and so better equipped to answer such questions. The presentation of the prototypes revealed that the prototypes of the projects using decision diaries were generally of better quality than the others. This is supported by the results, (summarized in Table 1).

In connection with the more qualitative questions, the quality of the diary users' answers appear to be higher than those of the other group. The answers were more reflected, longer and more innovative. This may indicate that the participants were forced to reflect upon their activities when they had to register the arguments in the diary. This did not only concern those who were directly responsible for actually writing the diaries, but it was clearly more general.

My previous experience is that writing and maintaining the diaries can easily becomes too time-consuming and that often too much information is collected. In this experiment, this was not the case. Interesting enough, only one participant thought that writing the diary was too time consuming. The way I see it, the most interesting issue is whether the participants *feel* this take to much time, rather than the exact amount of time used. In other words, if they benefit from writing diaries, it does not feel too time-consuming. The only person who answered that it was too time-consuming, did not experience the use of the diaries as beneficial.

Another difference to earlier reported uses of diaries (Jepsen et al, 89) is that in this experiment, user guidance was included describing how to use the technique and what to register. In earlier reported use of project diaries no such guidance was given.

In addition to the main results, other illustrative comments were given in the completed questionnaires.
Several project participants used the diary to organize the project and the meetings:
- "If big changes should be made, it was helpful to have an overview of what should be done and what had actually been performed[1]"
- "Decision diaries made the meetings more effective;

---

1. Author's translation.

168

we used the diary to get information about previous decisions in actual situations",
- "We referred to the previous decisions written at the diary in the beginning of every meeting. This indicated what we should do".

Several participants became fans of decision diaries:
- "Decision diary is a must!"
- "We no longer need to quarrel about who said what"
- "Without the decision diary we would not have been able to complete the projects".

The Easter holiday divided the prototyping project in two parts. Many participants expressed that the diary was of great help to remember the status of the project and to stick to the decisions that had been made, as well as to remember the argumentation behind the decisions.

The experiment shows that the decision diary technique helps to prevent decisions from becoming arbitrary by forcing participants to argument for or against them. In addition, the technique helped the participants to know what had actually been decided and to keep a status of the project.

In addition to the instructions for using a decision diary, the participants developed new ways to use it. They used it, for example, as an evolving documentation of user requirements as well as a kind of log of user comments of the prototypes.

Conclusion
Having evaluated the results of the experiment, I conclude that my hypotheses have been supported.

The project was based on the fundamental assumption that the quality of decision making is crucial for the quality of the design of the system, and that more transparent and explicit decision making is necessary in order to ensure real participation in system development projects. I wish to claim that more transparent and explicit decision making processes lead to better decisions, especially where several organizational cultures are involved. However, this is not a directly testable hypothesis in this setting, since the project was conducted by students who did not of course, come from culturally different environments. But they played roles, and it seems that users from projects using decision diaries were more reflective and more integrated in the decision process.

My working hypotheses were that:
- Decision diaries make decision making more explicit.
- Decision diaries improve the quality of the system design.

It seems clear that by using decision diaries the decisions became more explicit and that the diaries could genuinely be useful in clearing up misunderstandings, keeping track of previous decisions etc. (cf. Section 7).

According to the criteria I used to evaluate the quality of the prototype, I can claim that the hypotheses were supported in that the users in the projects using decision diaries were clearly more satisfied with the prototypes (summarized in Table 1). From a subjective point of view, this implies that the prototypes were of better quality.

The use of decision diaries also seems to influence the quality of the whole prototyping process. Answers to the questions in the questionnaire indicate that participant learnt a lot from using decision diaries.

To sum up, the experiment shows that the extensions to the diary technique have been useful. Users were forced to register decisions and to pay special attention to the argumentation behind them. In other words, it seems that the decision diaries help to focus on key issues of the system development process.

An important result is also that user guidance on what to include and how to use the decision diary was important. The diaries were, in most cases used to organize the meetings as well as the project itself, as prescribed in the user guidance. This indicates the usefulness of user guidance when using diaries. This approach to diaries has not been examined in the context of earlier studies on the topic (Jepsen et al, 89).

Some users also developed other application areas for the diaries, such as logging the user requirements. This implies that the technique is flexible and supports innovation. I regard this to be one of the most important criteria when evaluating the usefulness of a technique.

Prototyping projects are normally conducted in many ways, and a documenting technique has to be flexible. As reported by Mathiassen and Stage (90), project management has to be strengthened in prototyping projects.

As documented in the results of the experiment, the decision diary technique has proved to be flexible (it was used in eight different ways). It can be claimed that in practical prototyping situations, this technique will be useful exactly because of this quality. The level of ambition and the ways of use may have to be finely tuned, but the main principle will be retained.

Experience from the use of decision diaries indicates that the technique is a useful contribution to prototyping projects in terms of organization and management, as well as for documenting the prototyping process.

Aknowledgement

References
Andersen, N.E., Kensing, F., Lundin, J., Mathiassen, L., Munk-Madsen, A., Rasbech, M., Sørgaard, P. (1990), Professional System Development; Experience, Ideas and Action. Prentice Hall, United Kingdom, 1990.

Bang, H. (1990), Organisasjonskultur. (Organizational Culture), TANO, Norway, 1990.

Bang, S., Efsen, S., Hundborg, P., Janum, H., Mathiassen, L., Schultz, C. (1991), Kvalitets styring i systemutvikling, (Quality Management in System Development), Teknisk Forlag, Denmark, 1991.

Boehm, B.W. (1988), A Spiral Model of Software Development and Enhancement, in IEEE Computer, pages 61-72, May 1988.

Braa, K., Bratteteig, T., Kaasbøll, J., Øgrim, L. (1992), ENtry to the FIRE project, FIRE report no. 2. Department of Informatics, University of Oslo, 1992.

Braa, K. & Øgrim, L. (1992), Quality Assurance - An Assurance of Quality?, in Bjerknes et al (ed) Precedings of The 15th IRIS, Information system Research seminar In Scandinavia, University of Oslo, 1992.

Budde, R., Kuhlenkamp, K., Mathiassen, L. (ed)(1984), Approaches to Prototyping, Springer-Verlag, Berlin, 1984.

Budde, R & Zullighoven, H. (1990), Prototyping Revisited, in Raviv et al, Computer system and Software Engineering, pages 418-427, IEEE Computer Society Press, USA, 1990.

Budde, R., Kautz, K., Kuhlenkamp, K., Zullighoven, H. (1992), Prototyping - An Approach to Evolutionary System Development, Springer-Verlag, Berlin, 1992.

Davis, G. B. (1982), Strategies for Information Requirements Determination, IBM System Journal, Vol. 21, 1982.

Ehn, P. (1988), Work-oriented Design of Computer Artifacts, Almquist and Wiksell International, Stocholm, Sweden, 1988.

Floyd, C. (1984), A Systematic Look at Prototyping, in Budde, R., Kuhlenkamp, K., Mathiassen, L. (ed)(1984), Approaches to Prototyping, Springer-Verlag, Berlin, 1984.

Floyd, C. (1987), Outline of a Paradigm Change in Software Engineering, in Bjerknes et al Computer and Democracy, pages 191-210, 1987.

Grønbæk, K. (1991), Prototyping and Active User Involvement in System Development: Towards a Cooperative Prototyping Approach, Ph. D Thesis, Computer Science Dept., Aarhus University, 1992.

Jepsen, L.O., Mathiassen, L., Nielsen, P.A. (1989), Back to Thinking Mode - Diaries as a Medium for Effective Management of Information System Development, in Behaviour and Information Technology, Vol. 8, pages 207-217, 1989.

Kautz,K. (1992), Communication Support for Prototyping Projects, in Proceedings of PDC'92, Participatory Design Conference, (Cambridge MA US, November 6-7, 1992).

Kim, K.K. (1989), User Satisfaction: A Synthesis of Three Different Perspectives, Journal of Information Systems, USA, 1989.

Kim, K.K. (1990), User Information Satisfaction: Toward Conceptual Clarity, in Proceedings of the Eleventh International Conference on Information Systems, Copenhagen, December 1990.

Mathiassen, L. & Stage, J. (1990), Complexity and Uncertainty in Software Design, in Proceedings of the IEEE International Conference on Computer Systems and Software Engineering, pages 482-489. IEEE Computer Society Press, Washington DC, 1990.

Mayhew, P.J. & Dearnley, P.A. (1990), Organization and Management of Systems Prototyping, in Information and Software Technology, Vol. 32, No 4, pages 245-252. 1990.

McGrath, J. (1984), Groups: Interaction and Performance, Prentice Hall, N.J. 1984.

Naur, P. (1983), Program Development Studies Based On Diaries, in Psychology of Computer Use, pages 159-170. Academic Press, London, 1983.

Ouchi, W.G. (1980), Markets, Bureaucracies, and Clans, in Administrative Science Quarterly, Vol. 25, pages 129-141, March 1980.

Sommerville, I. (1989), Software Engineering, Addison-Westley, 1989.

Squires, S.L., Branstad, M., Zelkowitz, M. (1982), Working papers from the ACM SIGSOFT Rapid Prototyping Workshop, ACM SIGSOFT, 1982.

Winograd, T & Flores, F. (1986), Understanding Computers and Cognition - A New Foundation for Design, Ablex Publishing Corporation, Norwood, New Jersey, 1986.

Yourdon, E. (1982), Managing the System Life Cycle, Yourdon Press, New York, 1982.