

What about failures?

Suggestions for an alternative computing education activity

Urban Nulden

Department of Informatics, Goteborg
University, Box 620
405 30 Goteborg, Sweden
E-mail: nulden@informatik.gu.se
Phone +46 31 773 2763
Fax: +46 31 773 4754

Helana Scheepers

Department of Informatics, University of
Pretoria, South Africa
E-mail: hscheep@econ.up.ac.za

Abstract

In computing education, students are given some real life experience with the development of computer systems. This experience usually does not include project failure and especially escalation situations with difficult decisions that deepen or compound the problems a project has. We argue that the only way in which students will be able to recognize escalation is by actually experiencing a project that is escalating and that will fail. In the first part of the paper escalation and the determinants of escalation are discussed, this is followed by a description of the experiment conducted and the results. From the result of the experiment we conclude that students act in the same way as practitioners do. From this we claim that if we do not change the way in which students are taught, we perpetuate the problem. We end the paper with ideas on how to change computing education to make students aware of, but also understand the problem of escalation situations.

Keywords: Computing education, project management, project failure, escalation of commitment

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Abstract

In computing education, students are given some real life experience with the development of computer systems. This experience usually does not include project failure and especially escalation situations with difficult decisions that deepen or compound the problems a project has. We argue that the only way in which students will be able to recognize escalation is by actually experiencing a project that is escalating and that will fail. In the first part of the paper escalation and the determinants of escalation are discussed, this is followed by a description of the experiment conducted and the results. From the result of the experiment we conclude that students act in the same way as practitioners do. From this we claim that if we do not change the way in which students are taught, we perpetuate the problem. We end the paper with ideas on how to change computing education to make students aware of, but also understand the problem of escalation situations.

1. Introduction

This paper presents an experimental survey conducted to examine how students act in a problematic computing project situation. We hold that the majority of all computing projects undertaken have problems of some kind (e.g., Brooks 1975). Whereas there are many different types of computing project problems, this research is about those computing projects that never seem to end—they become runaways (Keil 1995a). This is a dangerous phenomenon costing organizations millions of dollars each year; both in direct losses and missed opportunities. A project can be described as a runaway when more and more resources are invested despite information indicating that the project probably will fail in meeting the expectations of the stakeholders. In this paper it is assumed that it is possible to denote a project as a failure, which is not always apparent (Lyytinen and Hirschheim 1987). However, we claim that the

awareness of runaways are crucial for both information technology experts and end users who often are central actors in systems development projects.

A runaway project is an escalation situation (Staw and Ross 1987a) and can be described in the following framework: All escalation situations entail some loss or cost as a result of an original course of action, the situations involve some continuity over time, a simple withdrawal is not an obvious solution, the decision maker must have a real choice in deciding whether to persist or withdraw, uncertainty of goal attainment and unambiguous feedback from previous decisions made. Escalation situations emerge through a complex compound of psychological, social, organizational, and project determinants.

Experimental research similar to the research presented in this paper has been done in the US (Schneider 1993; Sabherwal, Sein et al. 1994; Keil, Mixon et al. 1995). In this research, a scenario of a computing project was presented to two groups of undergraduate computing majors who were asked to act as project managers. As the scenario of the project progressed it experienced problems. The task of the subjects was to identify the problems and recommend to top management how to proceed with the project. The responses in the survey were analyzed through the escalation framework. The paper concludes that though most of the subjects stated that the project was in trouble, they were convinced that the right decision was to invest more resources and let the project continue. From the result of the study, we argue that runaway computing projects must get more attention in computing education. We do note that most organizational behavior courses, and similar courses given at for instance business schools, do include aspects of runaways and escalation. However, we question current traditional pedagogical principles of knowledge transfer as an appropriate mode of creating an understanding and eventually teaching how to avoid runaways. The paper closes with some suggestions on how escalation situations can be integrated in computing education.

The remainder of the paper is organized in the following six sections: The first section "Escalation situations" explains and discusses different aspects of escalation. The following section, "Subjects and research design" presents the subjects and the scenario used in this research. The next section, "Analyzing the survey" applies the escalation framework from section two to analyze the survey. The analysis is followed by a discussion section. In section

six educational practice is discussed in the light of the findings in our study. Finally, in “Concluding remarks and further research” we show some practical implications for computing education and outline our further research.

2. Escalation Situations

Research on escalation situations during the past 20 years have mostly been experiments in psychology and sociology under the headings: *knee deep in the big muddy* (Staw 1976), *entrapment* (Fox and Staw 1979; Brockner, Nathanson et al. 1984), *too much invested to quit* (Teger 1980), *escalation of commitment* (Staw and Fox 1977; Staw 1981; Staw and Ross 1987a), *knowing when to pull the plug* (Staw and Ross 1987b), *throwing good money after bad* (Garland 1990). The escalation research has only recently moved into a computing context (Schneider 1993; Sabherwal, Sein et al. 1994; Keil, Mixon et al. 1995). However, different types of failing projects and remedies against failures have been discussed and suggested since the beginning of computing (Brooks 1975). In the following we describe escalation situations and explain how they emerge.

2.1 Characterizing Escalation Situations

An escalation situation can be thought of as a situation where decision makers have continued commitment to a specific course of action despite information suggesting that the course of action is failing (Staw 1981; Staw and Ross 1987a), and even invest more resources (Fox and Staw 1979). Brockner (Brockner 1992) elaborates this further by arguing that an escalation situation is continued commitment in the face of negative information about prior resource allocations coupled with “uncertainty surrounding the likelihood of goal attainment.” Decision-makers become locked into an escalation situation through what Staw (Staw 1981; Staw 1982) calls a “syndrome of decision errors.” Bowen (Bowen 1987) criticizes this and argues that commitment to a further investment occurs because of the equivocality in the situation and not because of an over-commitment to a failed decision. He continues that one can not “technically” err in an ill-structured decision situation.

Commitment, as the central concept in escalation situations, has as such been studied from so many different theoretical perspectives that some argue that the concept should be abandoned in favor of a set of terms (Angle and Perry 1981). For instance, commitment has been described as: the state of mind that holds individuals in a line of behavior (Salancik 1977), the binding of an individual to behavioral acts (Kiesler 1971) and an active counterforce to change (Staw 1982). Commitment, in this paper, is not necessarily good nor bad, but the level of commitment of various individuals in a project will greatly influence the eventual success of the project. Without commitment you really do not have a project.

When commitment induces a person to complete a difficult or unpleasant task that benefits him and others, commitment is good. Obviously, without commitment the hard work required will not be done. However, when commitment leads to a fixation on a policy or behavior of diminishing benefit and rising cost, the situation is obviously problematic.

All escalation situations have characteristics that can be isolated and described in the following framework (Staw and Ross 1987a): (1) they entail some loss or cost—not necessarily monetary—that have resulted from an original course of action, (2) the situation involves some continuity over time—they are not once off affairs, but dilemmas involving ongoing courses of action, and (3) they are situations where a simple withdrawal is not an obvious solution. Moreover, (4) the decision-maker must have a real choice in deciding whether to persist or withdraw (Brockner 1992), (5) there must be unambiguous feedback from previous decisions made (Bowen 1987), and (6) there is uncertainty of goal attainment.

2.2 Emergence of Escalation Situations

Not to lose the essence of how escalation situations emerge; attention should be shifted away from identifying the isolated antecedents of escalation situations and toward analyzing the influence of more general classes of determinants. Staw and Ross (Staw and Ross 1987a) propose a model for analyzing and understanding the emergence of escalation situations in which they suggest four abstract classes of determinants for escalation situations: project determinants; psychological determinants; social determinants; and organizational determinants (figure 1). We will discuss each of these determinants below.

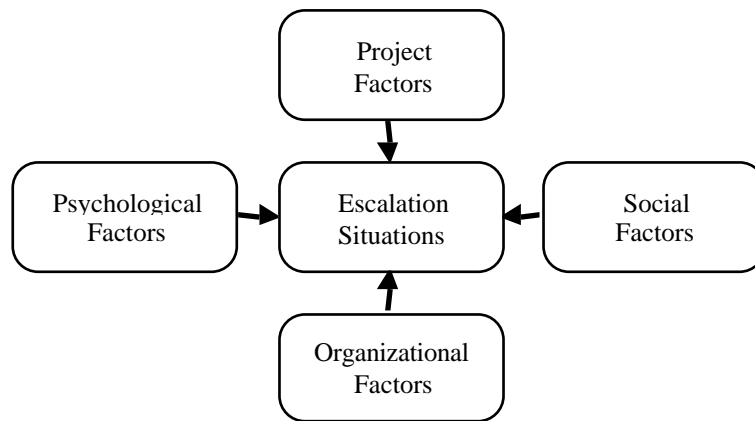


Figure 1: Emergence of escalation situations

The effect each of the determinants will have on different stages of the project is discussed in e.g., (Newman and Sabherwal 1996), but further research is needed. Also, the interrelationships among the four determinants needs to be further examined. However these two issues are beyond the scope of this paper.

2.2.1 Project Determinants

Project determinants are the objective attributes of a project—mostly economic, such as the project’s benefits and costs (Brockner 1992). A project is likely to be continued with high commitment even when it is facing problems, if the project is perceived as a long-term investment, expected to have a large payoff, and/or have a long-term payoff structure (Sabherwal, Sein et al. 1994). High commitment is also likely when closing costs are high and salvage value is low (Staw and Ross 1987b).

2.2.2 Psychological Determinants

Psychological determinants cause individuals to see situations from a promising and optimistic view (Brockner 1992). They explain, to some extent, managers’ unwillingness to admit that an earlier decision was wrong (Staw and Ross 1987a). Underlying psychological theories explaining escalating situations are according to (Keil, Mixon et al. 1995): self justification theory—when an individual desires to demonstrate rationality to himself—and prospect theory—when individuals exhibit risk averting or risk seeking behavior depending on how a

problem or decision situation is framed. “Throwing good money after bad” in an attempt to turn around a failing situation, the so-called “sunk cost” effect, is another example (Arkes and Blumer 1985; Garland 1990).

2.2.3 Social Determinants

Social determinants hold the individual to a course of action regardless of the individual’s own beliefs. Examples are face saving and external justification (Staw and Ross 1987a). Social comparison theory posits that people are concerned with evaluating the appropriateness of their attitudes and behavior. People regard the behavior of others as a model for their own behavior and this occurs when they are uncertain about the appropriateness of their own attitudes or behavior (Brockner, Nathanson et al. 1984). Social determinants also involve a group’s relation to another group and a successful effort by a group may influence other groups to attempt the same approach, often referred to as benchmarking.

2.2.4 Organizational Determinants

Organizational determinants are the structural, cultural and political environment of a project, for example, top management support, administrative inertia, and interorganizational interaction. According to Keil (Keil 1995b) projects are more prone to escalate when there is strong political support and when projects become institutionalized. Institutionalization occurs when a project is tied integrally to the values and purposes of the organization, and when actions are taken for granted because they are so deeply imbedded in the subculture or norms of the organization. Long-standing programs and lines of business are not even considered for discontinuation because they are so closely identified with the organization.

2.3 Avoiding Escalation Situations

Contemporary research on organizational behavior and systems development suggests that escalation situations or runaways projects can be avoided. These suggestions focuses on three aspects:

- The Aspect of Professionalism. All IT professionals have ethical duties when it comes to reporting on the status of a project (Anderson, Johnson et al. 1993; Smith and Keil 1995;

Smith and Keil 1995). Project managers, and other decision makers, must recognize that there is a natural tendency to escalate when one becomes too committed to a course of action. If project managers are aware of other escalation situations and the forces “driving” persistence and “restraining” withdrawal in the situation, their propensity to escalate in the next project is probably lower.

- The Aspect of Decision Processes. The project manager must ensure that as many decisions as possible are subject for discussion, e.g., no decision should be made without explicit consideration of the disadvantages or risks involved in the decision alternative. Negative aspects must be surfaced in all decisions to be made. If no negative aspects are found, postpone the decision until the next day or the next meeting. Since the final decision to continue a failing project often is made by an individual, the process leading to the decision should be a group effort (Schneider 1993). For this, conflict is a mechanism for facilitating learning, e.g., by the use of a devil’s advocate, an individual who plays the formal role of critic to help the decision maker test the assumptions and the logic of the ultimate decision. The importance of the group in the decision process is further emphasized since many decisions made in projects concern problems which are not well defined, i.e., soft problems (Checkland 1981), and have to be discussed from many perspectives.
- The Aspect of Organizational Culture. Organizations should use formal methods to monitor the progress of projects to a greater extent. Serious project audits must be executed on a regular basis. Larger projects have a higher risk for escalation and a greater need for control. These large projects have higher complexity, more stakeholders with different views and criteria for success, greater resource requirements, greater scope and more interactions resulting in more opportunities for inadequacy. Different reactive activities, such as indicators, evaluation, control and assessments are important management issues in project activities. Most organizations have monitoring functions to control deviations in projects, and functions are added to monitor the functions and so on (a common way to control what is not under control). But, no matter how thorough the control, audits and revisions are, all problems are possible to hide, until it is too late to

deal with them. Therefore, a proactive approach to avoid escalation is necessary. With an explicit company policy on failure people in the organization have guidelines for how to act in an escalation situation. An attitude such as “*we have never abandoned any project in this organization*” will surely promote escalation. A central issue in a proactive approach is incentives, such as rewards for project members as well as corrective action when called for. Organizations have to create such an open environment or culture in which individuals and groups are forced to raise the questions necessary to avoid project escalation.

3. Subjects and Research Design

This section presents the two groups of students and summarizes the scenario presented to the subjects. The two groups come from Sweden and South Africa. The reason for this is partly practical, this is where the authors live, but also that the research presented in this paper is part of a larger research effort where the heterogeneity of the South African society and respectively the homogeneity of the Swedish society are studied in more depth. This is however not reported in this paper.

3.1 The Subjects

The first group of student subjects was 47 first year undergraduates in a four year computing program at a Swedish University. The researcher visited a lecture and asked the students to devote 30 minutes to a “decision making study.” No extra credits or other incentives were offered. 10 of the subjects were female and 37 were male. 5 students decided not to participate in the survey. The average age was 24 years and they had an average of 3 years of work experience.

The second group was 70 second year undergraduates in a three year information systems program at a South African University. The researcher obtained permission to conduct a survey about the project described in the scenario. No extra credits or other incentives were offered. Of the subjects 26 were female and 43 were male, 1 student did not identify his/her sex. One

student decided not to participate in the survey. The average age was 20 years and they had an average of 6 months work experience.

3.2 The Scenario

This section summarizes the scenario presented to the subjects. They were asked to play the role of a manager and make decisions about a systems development project in a large pharmaceutical company, MedPro. The scenario was originally written in English and later translated into Afrikaans and Swedish. This might have introduced differences in the text. As a comparison of the two groups was not initially the main focus of this study we did not see this as a major problem. However, retrospectively we believe it would have been more appropriate to use English as the only language for surveying the students as both groups of students have complete mastery of English.

In 1994, the research division of MedPro discovered a very effective new drug for rheumatism. The laboratory tests on the drug were completed late in 1994, and the tests on humans could begin. Testing of new drugs is a regulated task and the FDA has very strict rules for conducting tests on humans. *Your* systems development group has recently designed a prototype of a computer-based system that will both shorten the testing, and improve the quality of the test documentation. Therefore, the CIO at MedPro has recently granted \$5 million for the development of the proposed system, TEST.

Shortening the test phase means that the rheumatism drug will be on the market earlier, and MedPro will increase their profits and they will get a large share of the market before any competitor will be able to enter the same market. The president of MedPro has indicated strong support for the project in the company magazine: “This is the kind of project our organization needs to maintain our position at the top of the market.”

Four years ago, another systems development group designed a very effective system for the marketing and distribution division. Their system has, by all means, contributed to MedPro's position as an efficient distributor of drugs on the world market.

As MedPro is mainly a research organization, the organizational culture is very forgiving when it comes to errors and it is believed that it is necessary to take risks to learn, invent, and

discover. *You* are confident that the system will be a real success and have spent a great deal of time discussing the benefits of TEST with departmental colleagues. *You* also bring up TEST as a subject to get the test division researchers' opinions and suggestions. The test and manufacturing division will shorten the test phase by 50 per cent. The new rheumatism drug will be on the market two years earlier than with the old procedure. Introducing the drug on the market even one year earlier would mean an additional estimated \$8 million in profit. MedPro is very dependent on information technology to maintain its position as world leader within drug development.

The analysis and specification were completed on schedule June 1995. The development phase started shortly afterward with a planned implementation date of November 1995. The test and manufacturing division has put a lot of faith in the new system and has decided to postpone the start of tests on humans until the computer system is implemented. The manual testing procedure is fundamentally different from the new computer-based procedure. It would be very costly to transform results either way.

During the first month of the TEST project, medical press announced that another pharmaceutical company had discovered an effective new substance for treating rheumatism. Their product has shown excellent results in laboratory tests but the competitor has not started tests with humans yet. However, they will start shortly.

Additional personnel should be hired and extensive training is needed to adequately staff the TEST project. Investment in new hardware is required for the TEST system. Furthermore, the TEST system should be compatible with other applications in MedPro, both existing and planned systems. The project team has also tried to ensure that TEST, after some modifications, probably can be used in administering testing of future drugs, but this has not been fully investigated yet.

Minor problems have surfaced in the project group since the first week. Communication among the project staff has not been satisfactory due to interpersonal conflicts, which did result in a split of the project into two groups after the first month of the project. *You* believed that this problem would resolve itself over time, but instead it has become worse. In October, one

month before the planned implementation, the project runs into severe difficulties: the program code is a mess according to an external auditor, and many of the assumptions made in the analysis phase are no longer valid. Large parts of the analysis must be redone, and at least three man months of coding must be repeated. The original implementation date will not be met. Instead, an additional three months is needed to complete the project.

Two additional programmers join the team to handle the problems, but the three months pass and the problems are still not solved. One of the most experienced programmers in the project group finds a 'bug' in the database manager, and assures you that he will fix the problem in one month. Writing the new code takes longer than first anticipated and the project needs an additional three months to be completed and an additional 50 per cent funding is needed to hire two top programmers to structure the code. Senior management are worried and as MedPro's CIO is aware of the problems TEST has encountered he calls an additional meeting in late March 1996. *You* are asked to prepare a short presentation on your preferences for this project's future.

4. Analyzing the Survey

In this section, the survey is analyzed using the escalation framework discussed in a previous section. The mode of analysis in this research was interpretive content analysis (Patton 1990) and the instrument applied in the survey focused on two issues. Firstly, subjects were asked to indicate their comprehension of the problems on a 7 point Likert scale ranging from '*no problems*' (1) to '*big problems*' (7). Secondly, they were asked if the project should be abandoned, this also on a 7 point Likert scale ranging from '*absolutely*' (1) to '*absolutely not*' (7). Each of these questions was followed by an open ended question where the subjects were asked to describe the problems as they saw them, and motivate their decision about abandonment or continuation of the project.

The following methodology was used for the categorization of problems and reasons for continuation for the open ended questions as identified by Weber (Weber 1985). The basic unit used for the classification of the written answers of the students as phrases that could be a whole sentence or part of a sentence. The way in which a phrase was identified was a group of

words describing a specific problem or reason for continuation. Each phrase was classified in one and only one problem group for the problem question or in one and only one determinant category for the abandonment question.

The categories into which the problems were categorized were identified after a preliminary investigation of the answers that were given by the students. Formal definitions were written for the problem categories by using systems development textbooks. The four determinants identified in section two were used as categories for the abandonment of the project. It was necessary to define these determinants in terms of the MedPro case study.

The responses of the students were coded by the authors and by independent researchers. The above mentioned definitions as well as the unit for coding were given to the researchers. The coding by the researchers were compared and any problems with the coding was solved by revising the definitions for each of the categories. The two South African researchers coded the South African students' responses and two Swedish researchers coded the Swedish students' responses. This was done because of the language used by the students in responding to the questions. By using two researchers for the coding and comparing the reliability in terms of stability and reproducibility of the result could be ensured.

4.1 Descriptive Analysis of the Perceived Problem

	Mean	SD	Min.	Max.
Sweden (n=47)	4.79	1.07	2	7
South Africa (n=71)	4.96	0.94	2	7

Table 1: Statistics on subjects' comprehension of problems in the project.

The following definitions were used to code the open ended question on the subjects' comprehension of the problem, or problems, in the scenario.

- 1) Time: an indication that the project is taking longer in time than planned, or phrases that refer to the allocation of more time to complete the project.

- 2) Planning, analysis and design problems: refers to mistakes made in the planning and analysis phases of the project.
- 3) Economic problems: an indication that the project is over budget or that given more money the project will be successful.
- 4) Technical problems: refers to software development problems or hardware problems, it could also refer to problems with the programming of the system (not with people).
- 5) Staffing problems: refers to the experience of group members and the composition of the group members.
- 6) Communication problems: refers to poor communication and cooperation among group members and between group members and users.
- 7) Environmental: refers to competing organizations in the same industry.

4.1.1 Swedish Subjects

This section summarizes the Swedish subjects comprehension of the problems presented in the scenario. The problems are listed in decreasing order and supplemented with anecdotal comments from the students.

1. **Time** was the major problem according to 57 % of the Swedish subjects. The subjects used the following statements to articulated this: *“Actions are dragging out, promised deadlines are not kept.”* Or, *“the fact that the project is slipping—time is also a big problem.”*
2. The second largest problem was **communication problems** according to 53% of the subjects. *“The project group has problems in working in the same direction and toward the overall goal.”* Others found that: *“Conflicts between the people is the biggest problem.”* Whereas others asserted that *“all problems could have been avoided if the conflicts were handled in the beginning.”*
3. **Planning, analysis, and design** problems were stated by 45% of the subjects in terms such as: *“There are no alternative solutions in case something should become problematic.”* Moreover, *“There were some mistakes made in the early work, the*

analysis. This resulted in big problems in the later phases.” Others were less certain: “Non anticipated problems showed, does this depend on poor planning?”

4. **Technical problems** were indicated by 36% of the subjects. *“There has been some programming problems that must be considered before TEST can be put to use.”* Moreover, *“bugs are found, this will take some time to fix. The code must be improved.”*
5. **Economic problems** were also perceived by 36% of the subjects. The following assertions were made: *“They must have TEST running as soon as possible to increase the profit for MedPro.”* Or as losing money: *“Several months delay is eating the profit.”*
6. **Staffing problems** was the sixth most common perceived problem by 23% of the subjects. Statements such as the following were used: *“If the right people would have been in the project from the very beginning, the problems might have been smaller.”* Other subjects saw that: *“people’s competence is overlooked,”* and *“project management is weak since the members’ potential is not utilized.”*
7. **Environmental aspects** were identified by 9% of the Swedish subjects. The approaching competitor was stated by these in phrases such as: *“If other medical companies come before our project is in place, the project will not have gained anything.”*

4.1.2 South African Subjects

This section summarize the South African subjects’ comprehension of the problems in the scenario:

1. **Communication problems** were the major problem according to the South African subjects with 70% identifying it as a problem. They stated for instance: *“Bad communication between team members”, “Communication problems”, “The team should work as a unit”* and *“The project team does not work together.”*

2. **Time** was the second largest problem with 64% of the subjects identifying it as such. They stated for instance: *“Additional time is necessary”* and *“The project is taking more time than planned for.”*
3. Three factors received the same number of comments by the respondents. **Economic problems, Technical problems and Planning, analysis and design problems** each received 41%.
 - a) Statements that were classified as economic problems were: *“Need some more capital to finish the project”* and *“Over budget.”*
 - b) Typical technical problem statements were: *“The software has too many problems/bugs”* and *“Badly structured programs. Bad programming.”*
 - c) Planning, Analysis and design problems were identified by statements such as: *“It seems as if the planning phase has not been completed”* and *“Wrong assumptions made during the analysis phase.”*
4. **Environmental aspects** were stated as a problem by 31% of the subjects, with statements like: *“There is already another company that announced that they have a rheumatism product”* and *“Market share will shrink if we do not continue.”*
5. **Staffing problems** were the fifth most common problem identified by 21% of the subjects with statements like: *“more personnel are needed”* and *“get more experienced programmers to do the programming”*.

4.2 Descriptive Analysis of the Motivation to Continue

	Mean	SD	Min.	Max.
Sweden (n=47)	5.55	1.29	2	7
South Africa (n=71)	4.56	1.5	1	7

Table 2: Summary statistics on subjects decision whether to abandon or continue the project.

During the classification of the comments of the respondents the following three groups were identified: respondents who gave a value of 1 (that signify that the project should definitely stop) to 3 was classified as respondents who wanted to abandon the project; respondents who specified a 4 were classified as unsure of whether the project should continue or not and respondents who specified a 5 or higher were classified as respondents who wanted the project to continue. Only respondents who where unsure or did not want to abandon the project were used in the discussion below. The table below summarize the responses.

	< 4 Abandon	4 Unsure	> 4 Continue
Sweden (n=47)	2	8	37
South Africa (n=71)	12	15	43

Table 3: Summary of the preferences for the projects continuation

4.2.1 Swedish Subjects

In the section project abandonment was suggested as an alternative course of action, only two (4%) of the Swedish subjects suggested that the project should be stopped (gave it a value < 4). Seven (15%) of the subjects gave it a 4 which we interpret as uncertainty whether to continue or to abandon the project. Finally, 38 (81%) of the subjects gave it a value of 4 or greater. The motivations stated to continue the project from the Swedish subjects was as follows in decreasing order:

1. Of the Swedish subjects, 62% motivated the decision with **project factors**. The strongest was the view of a long-term investment. *“Even if it takes longer than planned, it will be a valuable resource in the future. The company will make a lot of money in the future.”* Or similarly, *“the future profits are substantial.”*
2. 33% motivated project continuation according to the **psychological determinants**. The strongest psychological factor was, as expected, sunk cost. For instance, “\$35

million would be wasted if the project is abandoned.” Or in a similar way, *“if the project is canceled now, we would have nothing at a very high cost.”* Self-justification was also a common psychological factor: *“I have strong confidence in the project since I manage it, and I hate to fail.”*

3. **Organizational determinants** also occurred in 33% of the motivations: *“If top management finds the system that important then the system is worth the extra money and time needed, and they are confident that the cooperation among the actors will work, they should continue the project. To me, it seems to be too expensive and will take too long to complete.”*

4. Only 2 out of 45 or 4% had motivations belonging to **social determinants**. This was also expected since we find these types of determinants very difficult to manipulate in this type of experiment. However, we found external justification, such as *“an abandonment would send negative signals. There was a lot of publicity before the project started and I want to save my face.”*

Seven (15%) of the Swedish subjects gave no answer or an answer not related to any of the four determinants. One of the subjects suggesting that the project should be abandoned very rationally stated that: *“Projects slipping in time have a tendency to never get completed.”*

4.2.2 South African Subjects

In the project abandonment section of the questionnaire 13 (19%) of the South African subjects suggested that the project should be stopped (gave it a value < 4). Fifteen (21%) of the subjects gave it a 4, and 42 (60%) of the subjects gave it a value of 4 or greater. The motivation for the South African subjects was as follows:

1. Of the subjects, 66% motivated **project factors**. Long term investments were named as the main reason with statements such as: *“Even if it takes longer to implement the project the long term effect of profitability still exists”* and *“This project can be used for other drugs as well.”*

2. Of the subjects, 13% had motivations of a **psychological** nature. The strongest psychological factor was sunk cost, with remarks such as: “Too much money and time have been spent to stop the project now.” Self justification was also a common factor: “We will still be able to make a success of this project,” “The project is nearly finished and we will still be able to be successful” and “We tried and we learned a lot.”
3. Of the subjects, 13% named **organizational determinants** as a motivation to continue the project. Statements such as the following were used: “The competition should be taken into consideration. We should not stop the project now, else we will lose market share” and “Management is behind the project.”
4. **Social determinants** were identified by 7% of the subjects with statements such as: “Work with the group rather than sending them away” and “If we work together and communicate we can finish this project quickly.”

Nineteen (27%) of the subjects gave no answer or the answer could not be related to any of the four determinants.

4.3 Inferential Analysis

During the statistical analysis the classification of the comments on the problems and the continuation of the project were divided into two groups each to ensure the validity of the ² test. The groups for problems were: respondents who gave a value of 1 to 4 were classified as respondents who identified no problems or were indifferent about the problems (**No problems**) and respondents who gave values of 5 to 7 were classified as respondents who identified problems (**Yes**). The groups for continuation of the project were: respondents who gave a value of 1 to 4 were classified as respondents who did not want to continue with the project or were indifferent to the continuation (**No**) and respondents who gave values of 5 to 7 were classified as respondents who wanted to continue with the project (**Yes**). Table 4 below identify the combined values after the reduction.

Problem		South Africa	27	23	
	Yes	Sweden	25	8	Total: 83
		Total	52	31	
	No	South Africa	16	4	Total: 34
		Sweden	12	2	
		Total	28	6	
		No	Yes	Total: 117	
		Continue project			

Table 4: Summary of statistical analysis

The following hypotheses were tested:

1. Across both samples, when students were positive about the problems did they then specify that the project should continue (thus did they opt for continuation of the project)?

H_0 : There is no relationship between the identification of a problem and the identification of continuation.

H_1 : There is a relationship between the identification of a problem and the identification of continuation.

Performing a χ^2 test (5% significance level) the null hypothesis was rejected ($\chi^2 = 4.32998$).

There seems to be a relationship between problems and continuation and students that identified a positive value for problems will also give a positive value for continuation.

2. Is there a correspondence between the proportion of students that identified problems (**Yes** to problems in the table above) between the South African and Swedish samples?

H_0 : The proportion of students who were positive about the problems (**Yes** to problems in the table above) is the same for Sweden and South Africa.

H_1 : The proportion of students who were positive about the problems (**Yes** to problems in the table above) is not the same for Sweden and South Africa.

Performing a χ^2 test (5% significance level) the null hypothesis was accepted ($\chi^2 = 0.020163$).

The proportion of students of Sweden and South Africa for the identification of problems are the same.

3. Is there a correspondence between the proportion of students that were positive about the continuation (**Yes** to continuation in the table above) of the project between the South African and Swedish population?

H_0 : The proportion of students who were positive about the continuation of the project (**Yes** to continuation in the table above) is the same for Sweden and South Africa.

H_1 : There proportion of students who were positive about the continuation of the project (**Yes** to continuation in the table above) is not the same for Sweden and South Africa.

Performing a χ^2 test (5% significance level) the null hypothesis was rejected ($\chi^2 = 3.88976$).

The proportion of students of Sweden and South Africa for the identification of continuation is not the same. By looking at the data it can be seen that the Swedish students were more likely to continue the project than the South African students.

5. Discussion

In this research we have investigated how students perceive a scenario of a computing project with problems.

5.1 Subjects Understanding of Problems

Rank	Swedish percentage	South African percentage
1	Time	Communication problems
2	Communication problems	Time
3	Planning, analysis and design	Planning, analysis and design Technical problems Economic problems
4	Technical problems Economic problems	Environmental aspects
5	Staffing problems	Staffing problems
6	Environmental aspects	

Table 5: Summary of understanding of problem

By comparing the order of the importance of the problems identified by the subjects, large similarities could be identified as seen from the table above. Communication problems was ranked in the first and second places respectively for the South African subjects and the Swedish subjects. Time was placed first by the Swedish subject whereas the South African subjects placed it second. Planning, analysis and design, technical problems and economical problems were placed in third and fourth position by the Swedish subjects and third by the South African subjects. Staffing problems was placed in the fifth position by both groups. The environmental aspects were placed sixth by the Swedish subjects and fourth by the South African subjects.

5.2 Subjects Motivation For or Against Continuation

When the motivation for continuation is compared, there is also a correspondence between the subjects' identification for motivation. What is different though, is the number in the percentage of subjects who wanted to abandon the project. Of the Swedish subjects, 4% thought that the project should be abandoned and 19% of the South African subjects thought that the project

should be abandoned. There is a bigger tendency with South African subjects to stop the project, as they were more pessimistic about the project, 4.56 vs. 5.55 in motivation to continue.

The differences as outlined above can be explained by the difference in work experience in subjects as well as the theoretical background. The differences can also be ascribed to the different cultural backgrounds of the subjects. South African students are part of a changing society with a very big possibility of conflict between differences in values and beliefs of the heterogeneous groups whereas the Swedish students are part of a homogeneous society with established values and beliefs.

However, our main finding in this research is that the subjects perceived that the project had problems, but were still convinced that the project should be continued. This result is consistent with case studies (e.g., Keil 1995b; Newman and Sabherwal 1996) and other experimental surveys (e.g., Schneider 1993; Sabherwal, Sein et al. 1994; Keil, Mixon et al. 1995). Therefore we conclude that education must include escalation situations and next section is an example for how this can be done.

6. Educational Practice

Reflecting on educational practice in general, we claim that pedagogical principles underlying most educational activities would not address the phenomenon of escalation efficiently. Text books used in systems development , project management and organizational behavior courses have a line or two about escalation situations. We claim that it is not enough. From this perspective, we discuss education principles and practices, however it should be clear that an extensive pedagogical discussion about educational practice is not within the scope of this paper.

Looking at higher education, the most frequently used method of teaching is the lecture. The traditional lecture implicitly embeds an *objectivistic model* of learning (Leidner and Jarvenpaa 1995). That is, the purpose of teaching is to structure the knowledge to be learned and transfer this to passive students through effective channels. The instructor is active and in control of the learning material and the environment where learning is taking place. Information

is transmitted to students with little concern for whether the students understand or assimilate the information transferred (Leidner and Fuller 1996). Assessment and examinations is to determine whether content has been retained (Margretson 1991). The objectivistic model may be appropriate in some educational activities, but we claim it is insufficient in the case of escalation situations. As a contrast and alternative, the *constructivistic model* of learning asserts that rather than transmitted, knowledge is constructed or created. Learners are assumed to learn when they are forced to discover things themselves and not by being instructed. The role of the educator is to facilitate the learning process and support the students in the construction of their knowledge (Slavin 1990).

Whereas objectivism and constructivism is concerned with the individual learner, a *collaborativistic model* assumes that control of learning should rest with a group of learners. Similar to constructivism, collaborativism asserts that learners construct knowledge by making sense in terms of what they already know but also in interaction with other learners (Slavin 1990). This way, learning is the sharing of knowledge from individual views through collaboration. Whereas instructor led learning is inherently a linear and predictable process, collaborative groups ensures a more unpredictable process we also claim it to be a more rich learning experience. The importance of experience in learning is recognized by Graf (Graf and Kellogg 1990) and by Kolb (Kolb 1976) in his learning cycle which begins with a concrete experience (see figure 2).



Figure 2: Kolbs model of the learning cycle

In experiential learning the basic underlying principle is that the best learning is by doing— *learning-by-doing* (Graf and Kellogg 1990). A similar understanding is proposed as— *learning-in-doing* (Pea 1993; Moore and Potts 1994). Examples of experiential learning are internships, computer assisted instruction, live case, case studies, role play, games and simulations.

Clearly, new pedagogics and alternative learning models fundamentally change the roles of the students and instructors (see for instance Scardamalia and Bereiter 1993; Harasim, Hiltz et al. 1995; Turoff 1995). The role changes from the main source of information to a facilitator of the learning process. Rather than lecture information or manage behavior, teachers cultivate skills, focus effort, foster resourcefulness, and maintain an interactive climate of learning. The expected role of the student is that of active participator in the learning process.

Moving the discussion into a systems development education context, we find several examples of collaborative learning activities. Probably the most common activity in systems development education is to divide the class into smaller project teams where each team are requested to complete a systems design and development project, which they have to develop according to the methodology they were taught. Each group has access to a lecturer or instructor who act as their *senior project manager*. The senior project manager is there to

monitor the situation and give advice if the project team have any problems. This gives the students experience in how a system is developed in a group and what possible problems might arise in this situation. Our main critique is that this *project team* operates in an artificial rational environment neglecting several real world problems. However, as this critique is quite common, our interest is and emphasize here is on the phenomenon of escalation situations.

6.1 An Alternative Systems Development Education Activity

In this section we articulate some ideas on how escalation situations can be integrated in system development education. Experiential learning and collaboativism serve as pedagogical foundation for our discussion. Participating in a failure can be a real eye-opener for the students and one that they are likely to remember. In line with the concept of experiential learning, knowledge that is practiced is more efficiently assimilated than knowledge passively absorbed. However, with limited resources, such as time, systems development courses must provide this experience through a simulated situation. What we suggests, is a role play activity in a development project where a group of students work together. It should be noted that role playing escalation experiments has been performed previously (Staw 1981).

The students should be organized in teams and the instructor should provide them with the case material in a continuous fashion throughout the process. This can be documents, models, tapes, and videotapes, all depending on the instructor's enthusiasm and time. The group plan and start the project and the instructor assures that the role play case is 'alive' by supplying information about problems, changes, etc., constantly, see box 1 below for a rough description of the process. Supplying additional information is a delicate task for the facilitator. This demands a lot from the educator as she must create the necessary atmosphere to make this possible. The task is initially to make the group confident and make them believe their work is professionally performed, then successively let problems surface. A central aim in developing an escalation like situation is to facilitate chained decisions, that is, the result of one set of decision influence the rest of the decision making process.

The scenario about MedPro and TEST used to survey the students can be seen as an example of a case where the instructor supplies information as the project progresses. To keep

all participants and the instructor focused and concentrated on the task we believe two hours as an appropriate length for the role play.

Step 1: Present the case to the students as a decision making task where the students are to work in groups and complete a complex project together.

Step 2: Divide into groups consisting of eight to ten students.

Step 3: Case work (there are a number of iterations of 3.1 to 3.3 facilitated by the educator).

Step 3.1: Instructor gives additional information.

Step 3.2: Group discusses situation and work with the project.

Step 3.3: Group proposes course of action.

Step 4: The students present their work with the project in a seminar. Feedback from instructor and peers.

Step 5: Debriefing by the instructor.

Box 1: Outline of role play case study framework

It is very important to debrief the group after the role playing task is completed to achieve the desired effect (Krueger and Dickson 1994). The awareness of the purpose and methodology of the experiential activity is underlined by Jones (Jones 1997) where the damaging effect a simulation/game can have is identified. The reason for the damaging effects is when the instructor does not recognize the methodological conflict in using gaming and simulation. Here the instructor should emphasize the purpose and the underlying principles of the role play. Otherwise there is a risk that the role play will result in the students having low self-esteem and confidence. The debriefing discussion (Step 5) with the students should be augmented by referring to the fast growing body of literature on project failures (Lucas 1975; Markus 1983; Charette 1989; McComb and Smith 1991) and especially project escalation (e.g., Staw and Ross 1987a; Keil 1995b; Keil 1995c), emphasize should also be placed on escalation avoidance.

Hence, what we advocate is consistent with the underlying principle of problem based learning (PBL). The essence of PBL is the understanding and analysis of a problem situation as a basis for acquiring knowledge, skills and attitudes (see for instance <http://www.imsa.edu/team/cpbl/cpbl.html>, or (Boud and Feletti 1991) for an introduction to PBL).

The role playing can of course be enhanced by computer technology. Innovations in technology, such as multimedia, hypertext, video, Internet and virtual reality, is now impacting experiential learning. With our role play as example it should be possible to design and develop a computerized version. Then, the instructor can follow the students' progress through the computerized project diary, a repository where all models of analysis, design and planning are stored, as well as all documents of the decisions made by the group. The instructor can act as the client, top management, governmental organizations, competitors, etc., by communicating information to the project. Examples of these advances in technology are the use of hypertext in teaching systems analysis and design (Kendall, Kendall et al. 1996), the use of multimedia in systems analysis case studies (Farrimond 1997), and the Cardiac Tutor (Park Wolf 1996) where the students are in middle of the emergency room.

7. Concluding Remarks

In this paper we have highlighted a neglected issue in computing education, namely the phenomenon of escalation situations. We conducted an experiment to survey how students perceive and act in a scenario of an escalating systems development project. Below is a summary of our results:

- The conducted experiment shows that students behave consistent with the escalation framework discussed in the paper. Our analysis shows that students perceived that the project had problems, but they still recommended that the project should continue. Comments, about the project, made by the students are consistent with comments made in case studies (e.g., Keil 1995b). The two groups of students participating in the experiment, one from Sweden and one from South Africa, did not show any significant difference in preferences for the continuation of the project.

- We argue for the need to integrate escalation situations into the systems development curricula. We have also argued that we do not believe that escalation situations and the consequences of them can be taught by traditional education principles. We ended the paper with some tentative suggestions on how to include escalation situations in systems development education by developing a, what we would say, fun and realistic collaborative learning experience. As this study is the first in a program, our intention is to design and develop a computer based multimedia scenario according to the guidelines discussed in this paper.
- In this research, we have not surveyed the extensive body of literature on risk avoidance in projects such as IT projects (Boehm 1989; McComb and Smith 1991; Jones 1995). However, we suggests that this literature should be used to augment the discussions **after** the students have experienced the role play outlined in this paper.
- From an end user perspective, we find it very important to be aware of, and to some extent understand, the phenomenon of escalation situations, and how it may affect the project they are attached to in their professional work. By having this knowledge the chance of acting as a whistle blower (Near and Miceli 1995; Smith and Keil 1995a; Smith and Keil 1995b) at the right moment, is considerably higher than without this understanding.

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