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Abstract

This paper reports the results from a study on spreadsheet program use conducted in several departments within a city administration. Fourteen volunteer participants began the study by taking a two-day course on the spreadsheet program in question.

The purpose of the project was to study spreadsheet program use longitudinally in a natural setting. That only three of the fourteen participants became spreadsheet program users made the question of why the others did not start using the spreadsheet program an interesting one.

This paper explores the non-use phenomenon in the context of the spreadsheet program and focuses on four aspects: implementation, organizational support, the spreadsheet program package, and personal and task characteristics. The study suggests that different factors contribute to non-use.

Keywords: implementation, end-user computing, spreadsheet program, case study.

1 Introduction

Since the introduction of the first spreadsheet program, VisiCalc, in the late seventies, spreadsheet programs (SPs) have become one of the most often purchased and used personal computer (PC) programs in business. Several factors have contributed to this widespread use:

- The relatively low price of PCs and software packages has made an investment in a PC and an SP a relatively inexpensive activity in most organizations.
- Spreadsheet programs are perceived as relevant tools for many business tasks in organizations (Benson 1983, Brooke & Duffy 1986, Quillard *et al.* 1983, Nilles *et al.* 1986). SPs are also used for "value-added" applications to gain competitive advantage. For examples, see (Meyer & Boone 1987).
- SPs are relatively easy to learn.
- SPs have several "direct manipulation" attributes (Shneiderman 1987, Hutchinson *et al.* 1986).
- Most business people are familiar with an SP's underlying metaphor, a spread sheet or a ledger sheet, and a calculator. This metaphor also is a good model of task domains like accounting, budgeting, and investing (Dolk & Konsynski 1985, Norman 1986).

It is not an exaggeration to say that SPs have had a major impact on model building and model use in organizations (Brooke & Duffy 1986, Dolk & Konsynski 1985). However, the widespread use of SPs and SP models has not been without problems. A 1984 *Business Week* article described several cases of serious SP mistakes. If they had not been spotted, the mistakes would have cost the companies profits, reduced investor confidence, and so on. Several authors also have pointed out problems of spreadsheeting (Gruschcow 1985, Seymour 1984, Levy 1985). Creeth estimated that the number of spreadsheet models, used in organizations, that contain errors range from 20 to 40 percent (Creeth 1985). Carlsson and Konsynski discussed some of these problems and how SP-user support can help to avoid these problems (Carlsson & Konsynski 1989). For example, structured design techniques were recently proposed as one way to approach spreadsheeting problems (Ronen *et al.* 1989). Previous studies on SP use have either been single-time studies using data collected from questionnaires or from structured interviews, or studies in less natural settings (often laboratory studies). To investigate SP use in depth, we designed a longitudinal study using a natural setting. Despite the SPs "userfriendliness" and "metaphorical soundness", only three of the fourteen participants became SP users. Why the other eleven participants did not become SP users is an interesting question. This paper explores this non-SP-use phenomenon. Figure 1 summarizes the design of the "non-use"-part of the large study.

Research objectives: Explore reasons for non-SP-use of a group of persons, who in a pre-SP-course interview indicated they were going to use the SP in their jobs.

Unit of analysis: Individuals.

Multiple cases: 11 non-SP-users (plus 3 SP-users).

Period of study: The study was conducted in 1984-85 during a time period of 15 months.

Site selection: The same education/training on the SP (that is to say the same implementation). They were non-programming end-users. Voluntary SP-course participation, and voluntary SP-use. Possibility to interview the subjects before the SP-course. Persons in the public sector, local government. The 14 persons did not have any horizontal or vertical collaboration relationships.

Data collection: Multiple sources, mainly semi-structured interviews (presented in Section 4).

Data "analysis": A discussion of reasons for non-SP-use with a specific focus on four general aspects: The implementation process, the organizational context, the SP package, and characteristics of a person.

Figure 1: A summary of the setup of the study. Outline adapted from (Benbasat *et al.* 1987)

Results of the followup study of the three SP users are found in (Carlsson 1988a and 1988b). We studied them for more than a year. Even though the overall purpose of the study was to enhance our understanding of how DSS use can affect decision making, our study of the three users who built their DSS using the SP meant that we studied end-user developed DSS. Some view DSS as cognitive aids to augment decision makers in their information processing activities. We studied these users from a broader perspective: To consider a DSS not only as a cognitive aid but also as an intervention into a decision making process.

In describing different views of offices, Hirschheim distinguishes between analytic and interpretivist perspectives (Hirschheim 1986). The analytic perspective sees "... office action in terms of manifest behavior" (Hirschheim 1986, p. 334), e.g., in terms of what activities are undertaken and changes in these activities that are due to an implementation of a CBIS. Stabell points out that such a perspective "... provides little basis for describing the cognitive processes of the

manager that are involved and that link activities" (Stabell 1983, p. 236). Stabell also points out that the perspective "... can not 'see' aspects of decision making that extend over activities separated in time" (Stabell 1983, p. 236), which the interpretivist perspective can. We tried to apply both perspectives. To develop an interpretivist perspective, we used a version of Kelly's Role Construct Repertory Interview (Kelly 1955) to capture a person's perception of a relevant set of information sources used by the person in his job. Each of the three users was interviewed four times. The first interview occurred before they had attended a course on the SP. The collected data was transformed into a measure of integrative complexity developed by (Stabell 1978). This measure is related to complexity theories that are theories of individual information processing. The theories focus on the *how* of information processing, or in other words they are *structural* approaches to individual information processing (Streufert & Streufert 1978, Streufert & Swezey 1986). Integrative complexity is a central concept in cognitive complexity theories. It reflects a person's *differentiation* and *integration* of his conceptual structure of a domain. In our study the domain was information sources. Differentiation concerns how an individual uses constructs, i.e., bipolar attributes, to discriminate between objects in a domain. The objects in our study were the specific information sources. Integration focuses on how a person interrelates his constructs. Integrative complexity can be regarded as a cognitive style that has two important features that distinguish it from most other cognitive style measures: It might change over time due to training, education, practice, reflection, and other factors (Streufert & Swezey 1986), and it is also possible that a person is more cognitively complex in one domain than in another (Streufert & Streufert 1978, Streufert & Swezey 1986). Our data suggest that over the time of the study, the perception of the three users of their information sources became more integratively complex. This change in perception can be interpreted as that learning occurred. We suggest the changes that occurred were partly due to SP-model building and SP-model use. The way the three used the SP resembles Kolb's experiential learning model (Kolb 1984). Streufert and Swezey say that growth of cognitive complexity and flexibility is often associated with experiential learning (Streufert & Swezey 1986).

We also focused on the tasks and activities the three used the SP for (an analytic perspective). In most cases, SP use did not lead to just pure mechanization of the task. Instead, changes occurred in the tasks, e.g., their purpose. This type of change can be characterized as learning. For more extensive discussion of the study of the three users, see (Carlsson 1988a, 1988b, in preparation).

The remainder of the paper is organized as follows. Section 2 gives a brief overview of some previous implementation research results. Section 3 presents the research setting and Section 4 discusses the research methods. Section 5 explores the non-use phenomenon and different reasons for non-SP-use. Section 6 presents the conclusions of the study.

2 Research on Computer-Based Information Systems Implementation

Empirical studies of Management Science models, MIS, and DSS implementation can be divided into two major approaches: factor studies and process studies. For an extensive review of factor and process studies, see (Lucas 1981). Different papers on implementation research are also found in (Schultz & Slevin 1975, Doctor *et al.* 1979, Schultz & Ginzberg 1984) and in a special issue of (Interfaces 1987).

Factor studies, see examples in (Alter 1980, Lucas 1978) attempt to identify and measure factors that have an impact on achieving success or causing failure in implementing computer-based information systems (CBIS). Ginzberg, in a review of factor studies, identified more than 100 factors reported as having a necessarily sufficient correlation with implementation success (Ginzberg 1975). Examples of critical factors are: management support, perceived usefulness of the computer-based information systems, and technical feasibility of the computer-based information system.

In process studies CBIS implementation is often regarded as a process of organizational change. In a descriptive sense these studies seek to understand the behavior of different stakeholders in the implementation process and the impact of the process on the outcome of the process. In a normative/prescriptive sense process models are used to guide CBIS implementation processes. A good example of process studies is found in (Ginzberg 1975, 1979). Ginzberg studied several CBIS implementations and found that implementation processes close to Kolb-Frohman's model of the consulting process (Kolb & Frohman 1970) were rated as more successful than those that deviated from Kolb-Frohman's normative model (Ginzberg 1975). For other process studies, see (Hurst *et al.* 1983, Keen & Gambino 1983, Henderson & Schilling 1985).

This study, which is a mix of process and factor studies, differs from most other CBIS implementation studies in several ways. First, use of the SP was voluntary. Participants could have accomplished their tasks without using the SP, but they indicated in the pre-course interviews that they intended to use the SP. Second, a tool, a DSS-Generator, not a specific system was "implemented". SPs are considered to be tools for end-user development, that is, the specific systems are built by the systems' users. Hence, this study was conducted in an end-user computing environment. A person in this environment has more direct control of his own computing needs. Additionally, the end user must fill the design and building roles because the traditional EDP support is absent.

Using results from previous implementation studies, this paper focuses on four general aspects of SP implementation:

- *The implementation process.*
- *The organizational support*, which is the support context within which the persons' non SP uses are embedded. Organizational support include: man-

agement support, personnel and organizational arrangements for making the SP available, and related SP services and support, e.g., access to mainframe data.

- *Characteristics of a person and tasks.* Based on previous research, it is reasonable to assume that non-SP use will, in part, depend on a person's organizational role and his attitudes toward and expectations of the SP.

- *The SP package*, which is not only the SP in "isolation", but more importantly the SP in relation to tasks and job role.[1] The SP in "isolation" refers to things like ease of use, command structure, etc.

Lucas proposed a conceptual framework for "successful CBIS implementation" that attempts to synthesize the process and factor approaches to implementation (Lucas 1981). The framework consists of implementation factors and hypothesized relationships between the factors. His implementation factors are: client actions, technical characteristics, attitudes toward system, decision style, and personal and situational factors. The four aspects of SP implementation presented in this paper include Lucas' factors, but we do not hypothesize any specific relationships between the aspects. Instead, our view is an "emergent perspective" which "... holds that the uses and consequences of information technology emerge unpredictably from complex social interactions" (Markus & Robey 1988, p. 588).

3 Research Setting

3.1 The Participants and Their Organization

The 15-month study was conducted in a city administration. Fourteen persons volunteered to first take a two-day course on the SP during working hours. The course was regarded as jobrelated by the participants' superiors. All the participants were regarded as discretionary and voluntary "users": no one was "forced" to use SP in the job, and they could carry out their jobs without using an SP. Before taking the SP-course, the participants could be classified as nonprogramming end-users. Rockart and Flannery's classification of end-users describes nonprogramming end-users as those "... whose only access to computer-stored data is through software provided by others... Access to computerized data is through a limited, menu-driven environment or a strictly followed set of procedures" (Rockart & Flannery 1983, p. 778). Participants were working in different jobs and positions, and they were not vertically or horizontally cooperating with each other.

Instead of treating each participant's job as unique, we tried to find a way to classify them based on some aspects of their jobs. Other studies have shown that different roles/jobs are involved with computing in different ways, see for example (Danziger & Kraemer 1986, Nilles *et al.* 1986). We use a two-dimensional classification scheme adapted from (Danziger & Kraemer, 1986):

- A person's discretion and autonomy in the organization.
- The dominant characteristics of a person's information processing activities "... with data that are amenable to computerization" (Danziger & Kraemer 1986, p. 28). This "... dimension distinguishes those with 'high' pervasiveness of data-handling in work, meaning their data-handling tends to be direct, continual and multimodal (that is, involving considerable generation and manipulation, as well as use of data) from those with 'low' pervasiveness, meaning that their data-handling tends to be indirect, intermittent and use-oriented (relative to generation and manipulation of data)" (Danziger & Kraemer 1986, p. 29).

Using this scheme, Danziger and Kraemer defined four types of information workers (see Figure 2):

1. *Managers*, the top department-level administrators, primarily department heads and divisions heads.
2. *Staff professionals*, those who serve top managers in a mainly staff capacity, primarily planners, policy analysts, budget and management analysts, and accountants.
3. *Street-level bureaucrats*, those line personnel who directly provide public goods and services to citizen-clients, namely police detectives and patrol officers.
4. *Desk-top bureaucrats*, those administrative and clerical workers who provide general administrative assistance for internal government operations or in support of the provision of goods and services to clients, primarily departmental administrative assistants and bookkeepers, traffic ticket clerks, and record clerks. (Danziger & Kraemer 1986, p. 183)

Autonomy in the organization's hierarchy	Pervasiveness of data handling in work: High	Pervasiveness of data handling in work: Low
High	Staff professionals 3(2)	Managers 3(1)
Low	Desk-top bureaucrats[a]	Street-level bureaucrats[b]

[a] Often referred to as back office workers

[b] Often referred to as front-line workers

Figure 2: A taxonomy of information workers. The numbers are from this study. Numbers in parantheses are SP-users and the other numbers are non-SP-users

Differences between managers' and professionals' use of CBIS have been found in some other studies (Nilles *et al.* 1986, Rockart & DeLong 1988). Stabell, in discussing a theory of decision support, and considering previous research, argues that managers' and professionals' need for decision support differs (Stabell 1988). This study identifies a third class of users: desk-top bureaucrats. They have less autonomy and discretion in the organization than managers and professionals, and their jobs are more prescribed by rules, formal job descriptions, and instructions from superiors.

3.2 Introduction and Implementation of PC and SP

Within the city administration, the EDP department is responsible for computers and information systems and for the CBIS and computer strategy. It also evaluates hardware and software, and makes decisions on what should be purchased and used. Design, development, implementation, and maintenance of mainframe application programs is done by the EDP department, and it is responsible for installation of and service on terminals, printers, networks, etc.

Less than two years before this study started, the EDP department decided that a specific type of microcomputer would be used as mainframe terminals. Adding a disc drive, a printer, and more primary memory made it possible to use the microcomputer as a standalone PC with a printer. As a PC, it was used mainly for word processing. Early in 1984, the EDP department was aware of at least 275 microcomputers in the administration. Most were used only as terminals.

The EDP department purchases most of the PC software and sells it to the different departments. Central purchasing is a way to standardize software use. Training and education of PC and terminal users are managed and administered by the Personnel department.

3.3 Course Administration

Participants took a two-day course in spreadsheeting in the spring of 1984. Two courses were held, one in March and one in April. Application and admission to the course happened in three steps:

1. In the fall, a "City administration course catalog," with a short description of the SP course and other courses offered, was distributed to the different departments. Every employee had access to the catalog. See Figure 3 for a description of the actual SP course.

2. Each employee could apply for a course if it was relevant and related to the employee's job. The employee would then go to his supervisor for approval to take the application to a committee. Each department had a committee that rank ordered all applications from that department. These lists were then turned over to the Personnel department.

Intended for:	Employees working with analysis and calculations, and/or want to learn the systems' different possibilities
Aims:	To give an understanding of the SP's different areas of use
Duration:	2 days
Course content:	Overview of the SP Use of the calc function Use of the help functions Communications with other programs, e.g. for creating diagrams
Course fee:	1.000 Swedish crowns

Figure 3: Description of the SP course. From "Course Program", a 60 pages booklet distributed by the Personnel administration.

3. Personnel chose who would be admitted. No specific rules existed for this selection process, but important factors included relevancy to the applicant and the number of applicants from a department versus the total number of employees in that department.

SP courses were held during working hours, and the fees were paid by the respective department. Personnel managed the SP courses although the courses were taught by persons from a private educational organization.

After contacting the city administration, we received, from the Personnel department, SPcourse participant lists with names and phone numbers. We first contacted the course participants by telephone. Everyone we contacted agreed to participate in the study.

3.4 Content of the SP Course

Each SP class lasted two days. The course was keystroke-and function-oriented. It sought passive understanding of the SP, e.g., the mechanics of spreadsheet program use. No attempt was made to link use of the SP to the participants' jobs. Participants were also given the following: an SP manual, paper copies of transparencies used by the instructor during the course, and some simple exercises. None of the exercises were related to any of the participants' jobs.

We observed both classes, taking notes of what was happening. Seven participants were in each class, and five PCs were available. Each participant, during some moments, shared a PC with another participant, but each person was a single user approximately 70 % of the time. Of the three who became SP users two came from one course and the third came from the other course.

4 Research Methods

The following methods and techniques were the principal means to collect data:

- An interview to identify a person's perception of his job and roles in the organization, a set of other persons that he interacts with, and information sources that he considers valuable in his job (See Section 4.1 for a list of questions asked).
- An interview that centered around a person's expectation of the SP (a pre-SP-course interview, see Section 4.2).
- An interview that focused on non-use of the SP.

Several secondary sources including pamphlets, city yearbooks, and personal memos were also used. Other interviews gathered different background data, e.g., data on the number of microcomputers in the city administration and the EDP department's responsibilities. All meetings with participants were tape recorded and transcribed. After the SP course, two on-site interviews were conducted with the non-SP-users, 4-5 weeks and 8-10 weeks after the courses. These semi-structured interviews focused on reasons for non-SP-use. Results were compared with answers from the previous interviews to determine why the participants had changed their minds. At the end of the study, after 15 months, we also did one phone interview with each of the non-SP-users. These interviews confirmed that none of them had used the SP since their SP courses.

4.1 Job Description and Role Definition Interview

The first interview focused on the participant's perception of his job and his roles in the organization. It also identified persons that the participant interacts with, and the information sources he finds most valuable in his job. We adapted an interview schema developed by (Kahn *et al.* 1964) and used by them in a study on two aspects of organizational stress: role conflict and role ambiguity.

The schema focuses on goals, sub-goals, tasks, responsibilities, etc., in a person's job. It assumes that goals, sub-goals, tasks, etc., are at least partly organizational-socially defined. An individual's goals, etc., can not be defined starting from global objectives of the organization and using an explicit means-ends analysis. Neither can a person's responsibilities be derived only from a formal job description and an organizational chart. The following interview questions were used:

1. How would you describe your job to someone who knows absolutely nothing about it?
2. Later, I would like to refer to the major tasks and activities involved in your job. Can you tell me what should be included in a list of your major tasks and activities?

3. Some of your tasks and activities are probably more important to your job than others. I would like you to rank all the items on this list (from step 2) in order of their importance.

4. How do you know what you are supposed to do in your job? How about written documents like job descriptions, policy statements, memos, etc.—do they help determine your activities? Professional schooling or specialized training?

5. To what extent have you been able to define this job for yourself—to carve out your own area of responsibility, to make major changes in your tasks and activities, and the like?

6. Who is your immediate supervisor? What is his/her position in the organization?

7. Is there anyone else you report to—anyone else to whom you are directly responsible for some of your activities? What is his/her position in the organization?

8. Are you a supervisor? Is there anyone who reports directly to you? What are their positions?

9. Are there others, besides these you have mentioned, that you cooperate with in your job (their work might affect you, or your work might affect them)?

10. In your job you probably use information from many different sources like people, written documents, print outs from computer-based information systems, etc. Which are the most important information sources in your job?

We developed follow-up questions and we collected demographic data, information on the participants' previous and present use of computers and CBIS, and their general familiarity with information technology.

4.2 Expectations of the SP

Several studies have indicated that a person's expectations of a CBIS may have an impact on that person's use of the CBIS and on person's assessment of the CBIS. At least two MIS/DSS studies are relevant: DeSanctis' laboratory experiment (DeSanctis 1982, 1983) and Ginzberg's field study (Ginzberg 1981). Both studies measured expectations before the systems were in use, and did not, as in some other studies, apply expectation theories afterwards to explain some findings. For examples of this latter type of analysis, see (Vertinsky *et al.* 1975, Robey 1979). The key point here is that DeSanctis' and Ginzberg's studies were theory-driven.

Another study, reported after our study was conducted, also indicates that perceived value and expectations are important factors in understanding how persons assess CBIS. In a study of 10 large organizations, Rivard identified six factors that were important contributors to user satisfaction with end-user computing. One of these was "User attitude toward end-user computing" (Rivard 1987, p. 26). Rivard's result suggests that a positive attitude toward enduser computing is likely to lead to higher user satisfaction.

DeSanctis' study tried to explain different DSS use using three independent variables: motivation, locus of control, and cognitive style. The study tested three hypotheses:

1. "The extent of a decision-maker's use of a DSS is a function of that person's motivation to use the system" (DeSanctis 1983, p. 6).

2. "Extent of voluntary use of a DSS is a function of the locus of control personality dimension. Persons high in internal locus of control will tend to use a DSS more than persons high in external locus of control" (DeSanctis 1983, p. 8).

3. "Extent of voluntary use of a DSS is a function of the user's cognitive style. Persons high in analytic ability will tend to use a DSS more than persons low in analytic skill" (DeSanctis 1983, p. 8).

DeSanctis found a positive correlation between a person's use of a DSS and the person's motivation to use it, that is a positive relationship between a person's positive attitudes and amount of voluntary DSS use. She also found that locus of control, which is a personality variable, interacted with motivation in determining voluntary use of the DSS. In short, locus of control refers to the extent to which a person sees the world as one to act on (internal control) or as the world acts on him (external control). The study showed that internals have a greater tendency to use a DSS. These findings can be used in connection with a person's answers on some questions in the "job description and role definition interview" (Section 4.1).

Ginzberg conducted a thorough literature review of CBIS implementation studies and studies on effects of disconfirmed expectations on performance satisfaction and identified five areas of expectation that are likely to be important in determining a user's response to an MIS:

- the reasons for developing the system (its goals and objectives);
- the importance of the problem being addressed;
- the way the system will be used;
- the impacts the system is likely to have on the organization; and
- the criteria which should be used to evaluate the system. (Ginzberg 1981, pp. 464–465).

In a field study Ginzberg tested his hypothesis: "There will be no relationship between the realism of users' pre-implementation expectations about a MIS and their post implementation ratings of system success" (Ginzberg 1981, p. 465). He found that users who held realistic pre-implementation expectations were both more satisfied and used the system more than those who held less realistic pre-implementation expectations. Transferred to our study, it means that we can hypothesize that a person who has realistic pre-implementation expectations will use the system more often and also be more satisfied with it than a person who has less realistic preimplementation expectations. While Ginzberg's study focused on one specific MIS system developed by MIS-professionals, our study focuses on a tool, the SP, and end-user development.

The following questions were asked to obtain a participant's expectations of the SP:

1. Why do you think you will use the SP? What reasons do you see for using it?

2. What tasks and activities do you think you will use the SP for in your job?

3. How important are these tasks and activities?

4. How often do you think you will use the SP?

   - Less than 1-3 times per month
   - Approximately 1-3 times per month
   - Approximately 1-3 times per week
   - Approximately 1-3 times per day
   - More than 1-3 times per day

5. Who will use the SP?

   - You will build the spreadsheet models yourself
   - You will use (run) spreadsheet models that have been built by colleagues
   - You will build spreadsheet models that will be used by your colleagues

6. What consequences (effects) do you anticipate from SP use, on you and your job, for your department? Effects on activities, tasks, collaboration, and communication, etc.

7. How do you think you should assess the success or failure of the SP? What criteria do you think should be used for an assessment? How do you think your colleagues would do this assessment?

The *meaning* of realistic pre-implementation expectations had to be solved. Ginzberg used an expert group's pre-implementation expectations as realistic expectations. The expert group was made up of designers and managers. In our case, a similar group that could formulate these realistic expectations did not exist. Instead, we discussed the participants' answers, that is, their expectations, with experienced SP users, so "realistic" is interpreted as realistic in relation to the SP's functions, features, and capabilities. For example, if a person thinks he can build a model that requires more cells than there are available in the SP, then he has an unrealistic expectation. On the other hand, a subject could build a spreadsheet model for an activity, but the problem might be better solved manually or with another type of computer-based tool. In such a case it is not possible to objectively say what is a realistic or an unrealistic expectation. We will elaborate on this when discussing non-SP-use.

When to measure the participants' expectations was another problem. We measured their expectations before they took the SP course, that is, before they had SP hands-on experience. In retrospect, we could have measured expectations immediately after the course. Expectations might have changed during the course as they did for one participant who, during the SP course, found that he could not use the SP for a specific problem he had identified in the expectation interview.

4.3 Other Collected Data

Other methods and techniques also were used to collect data. In Section 1 we described a method to capture a person's perception of his information sources: the Role Construct Repertory Interview. We conducted this interview with all fourteen participants. Differences in integrative complexity existed between the fourteen persons, but nothing indicated that persons with either high or low integrative complexity became SP users or non-SP users (It is important to note our small sample size). Among the hypotheses DeSanctis tested in her study was that "Extent of voluntary use of a DSS is a function of the user's cognitive style" (DeSanctis 1983, p. 8). DeSanctis did not find any differences between low and high analytics in their attitudes toward and use of the DSS. In other words, DeSanctis did not find a relationship between cognitive style and use of the DSS (hence, DeSanctis' hypothesis was rejected). Although we were using a different measure of cognitive style, our data suggests the same result.

In the first post-SP-course interview we tested a person's knowledge of the SP. We did both a recall and recognize test of SP-commands. We will return to this test in Section 5.2 when we discuss the SP package.

5 Exploring Non-SP Use

Summing up the situation, we had fourteen participants that:

- Expressed a willingness to start using the SP.

- Had management support, implied because SP knowledge was regarded as relevant job knowledge to the participants and they were admitted to the two-day SP course.

- Had taken a two-day SP course.

Still, only three of the fourteen participants became SP users. Why? For each non-SP user, no single aspect or factor explained non-use; instead, several aspects and factors contributed and will be discussed in this section.

As the title of the paper indicates, two main reasons existed for not starting to use the SP: *Won't* and *Can't*. Won't, means that a participant, for one reason or another, "decides" not to use the SP, despite stating in a pre-course interview that they would use the SP. Can't, means that a participant would like to use the SP but is having trouble doing so. For the eleven non-SP users, the reasons for non-SP use were a mix of "won't" and "can't." The next two sections discuss non-SP use. First, in terms of "won't" and "can't", and then in terms of *why*, that is, the reasons for "won't" and "can't."

5.1 Johnny Can't or Won't Spreadsheet

Johnny Won't Spreadsheet

One desk-top bureaucrat decided not to use the SP. In the pre-course interview he had identified a task appropriate for SP use: managing large projects. During the SP course, however, he found that a data base or a generalized DSS would be more appropriate.

In the staff-professional group, three participants decided not to use the SP. Since they were not administrative personnel, they were not as familiar with the SP metaphor as were the administrative personnel.

Two of the managers did not use SP because some of the data they needed were available in standard report form generated from mainframe systems. At the time of this study, PC users were not allowed to download data from mainframe systems. Instead, the managers used their staff to do additional calculations/analyses on data from the mainframe systems. These managers used the mainframe systems in both a direct and an intermediary mode (in the latter case by using their staffs). The staff used pocket calculators. The two managers' decision to not use the SP was based on a "cost/benefit" analysis. The third non-SP-using manager had proposed building an SP model to be used by other departments in estimating the cost of projects required from his department. Building the model was postponed because the other departments showed little interest. The manager believed the proposed SP model was not very central to his job, but that it would be more useful and valuable to the SP-model users (the other departments).

Johnny Can't Spreadsheet

Four of the five desk-top bureaucrats who handled a great deal of data in their work, claimed they would like to use the SP. Their main concern was their inability to modify their job. This concern manifested itself in several ways. First, building an SP model requires free time for designing and testing activities. Data from the three SP users suggests that, in many cases, designing, testing, and using an SP model the first time requires more time than doing a task/activity the old way. The four doubted they could free up the necessary time; and implementation and use of SP models means not only mechanization, but also changes in activities, task and purposes of task. Second, to use an SP, a person must translate his task and activities into the representation form required by the SP. This transformation is often not a trivial task. A third concern was non-accessibility of mainframe data. Finally, several of the desk-top bureaucrats believed that critically needed support from management, superiors, colleagues and EDP personnel was inadequate.

5.2 Why Johnny Can't or Won't Spreadsheet

Implementation Process

An implementation process should enable a person to use a computer-based tool or a CBIS in an effective and efficient way for his tasks. The SP course can be regarded as the main implementation effort in this study. The SP course focused on the mechanics of SP use. More difficult is gaining an understanding of how to use the tool effectively in one's job. This active understanding requires another type of course and more resources.

Along with this understanding must come the "active knowledge" to build good spreadsheet models, to select suitable tasks and activities, to estimate resources needed to build a model, and so on. Data from the three SP users suggests that such topics should be included in enduser computing courses. Research on human-computer interaction has pointed out that mental models can play an active and positive role in learning a new device or a new computer-based tool (Carroll & Mack 1985, Kieras & Bovair 1984, Young 1983). The teacher did not try to provide the persons with an adequate mental model of the SP, so each participant created their own mental model.

The three SP users built their SP models differently. The manager was more of a "barefoot modeler." He based much of his model building on "does this make sense" and "let's see what this will show." The staff professionals, with formal modeling education and training, relied on well proven formulas and models. They were also more concerned about reliability, validation, etc. This suggests that the cause of some of the spreadsheeting problems pointed out in Section 1 may be that an SP is too powerful. In practice, we often put these powerful tools in the hands of naive model builders.

One of the desk-top bureaucrats found out, during the SP course, that he

could not use the SP for a task he thought he could use it for. Since the teacher was from another organization, he could not help him solve this application-based problem.

Organizational Support

Managers often require support in the early and late phases of the decision cycle: problem finding and definition, problem formulating, problem selecting, and follow up and postimplementation activities. These activities are often data intensive and the relevant data often is available in a mainframe system. The three managers approached these phases differently. The SP-using manager's department was undergoing decentralization. Changes were occurring in responsibilities and in processes. The department's services, effectiveness, and efficiency were being questioned by politicians and others. The department was working hard to show what it had been doing, it was doing, and what it would do in the future. This assessment, supported by SP use and SP models, led to a new understanding of the services provided and the requirements for providing them. Although much of the data came from other mainframe CBIS, the SP models used them in new and different ways.

The two non-SP-using managers were working in more stable environments. Their data use was more routinized and institutionalized, and they used their staff for data analysis. They wanted to be able to download data to their PC. Technically, downloading was possible, but the EDP department would not allow users to "play around with data" they were responsible for. The EDP department believed that downloading requirements could become a problem in the future but at that time it was a low-prioritized requirement. Downloading was briefly mentioned in the SP course, but the teacher did not know about the EDP-department's policy or the technical possibility for downloading data.

Lack of organizational support prompted the desk-top bureaucrats to not use the SP. Even though Personnel, the EDP department, and their managers gave lip service to support, the desk-top bureaucrats were, to a large extent, left unsupported. The SP-using manager received strong support from other managers and his superior after the first SP model he built proved valuable to his department in a critical budget process.

SP Package

None of the course participants had any major problems in learning to use the SP in a passive sense. The first post-course interview included a free recall "test" of commands in the SP (this interview was conducted 4-5 weeks after a course). We asked the participant to tell us which 10 SP-commands he found most important. Most could only name a few (2-5) commands. The three who had used the system after the course could name 8-12 commands. To test if the nonSP users had forgotten the system, we used a deck of cards with the abbreviation of the SP commands, as shown in the highest menu-level in the SP. Participants were asked

to identify the different commands including their name and function. All of the non-users could name and/or describe all 13 commands. For many commands they also described how they had used it in the SP course. We concluded that all the fourteen could use the SP.

The tasks/activities a person has to accomplish in his job play a role in how easy or hard he finds it to use an SP. Carlson proposed an approach for designing DSS, the ROMC (Representation, Operations, Memory aids, and Control mechanisms) approach (Carlson 1979). For a more thorough description of ROMC, see (Sprague & Carlson 1982). ROMC emphasizes the importance of how data is represented (picture, chart, equation, etc.) and how that data is presented on a screen. SP offers one way to represent data/information. Although it is possible to print out results of an SP model in a graphic form, it is still not possible to actively work with the graphic representation. The three non-SP-using staff professionals were more familiar with other ways to conceptualize and represent information. One worked in physical planning and was accustomed to drawings and graphs with complementary data in the form of text and figures. The other two were engineers and were more familiar with drawings and equations.[2]

Characteristics of Person and Tasks

Section 3.1 classified types of information workers. Because staff professionals and desk-top bureaucrats handle a great deal of data their jobs are suited for computer support. The staff professionals can further be divided into technical professionals (three non-SP-users) and administrative professionals (two SP-users). This use/non-use outcome suggests that SPs are more suitable for administrative tasks. In the pre-SP-course interview the administrative professionals considered the tasks they were going to use the SP for as more central and critical than the technical professionals thought their SP-tasks to be. We then assumed that it was more likely that the administrative professionals would start using the SP.

The desk-top bureaucrats faced another obstacle to their SP use. Even though they considered their SP tasks as central and critical, they seemed to lack the autonomy and ability to make changes in tasks and activities. Katz and Kahn, among others, have pointed out that membership in an organization carries with it restrictions for its members (Katz & Kahn 1978). These restrictions take different forms for different members.

Data from the "job description and role definition interviews" confirms the presence of restrictions. The desk-top bureaucrats' job descriptions were more specific and at a lower detail level. Descriptions were also more activity-specific. Staff professionals' and managers' job descriptions were stated more in terms of goals, and the descriptions were at a task level. Because they have to find tasks for their goals and activities for their tasks, they have been given greater autonomy. The desk-top bureaucrats had, to a lesser extent, been involved in defining their jobs, that is, filling their jobs with tasks and activities, and, to a lesser extent, made changes in their jobs. Compared to the jobs of staff professionals and

managers, their jobs focus more on efficiency.

Our data on autonomy confirms what DeSanctis found in her study (DeSanctis 1982 and 1983). Locus of control, which in her study was a personality variable, interacted with motivation in determining voluntary use of the DSS. As discussed in Section 4.2, locus of control refers to the extent to which a person sees the world as one to act on (internal control) or as the world acts on him (external control). DeSanctis' study shows that internals have a greater tendency to use a DSS.

Desk-top bureaucrats, at least when discussing jobs, perceive the organizational context as acting on them, while the other two groups seem to be more of the internal control type. Although our data on locus of control agrees with DeSanctis, her study was a laboratory study and the measure she used can be regarded as a context free measure. In other words, a person is always an internal or an external control type. We, however, considered a person's perception of his situation and his formal and formalized position in the organizational structure. This broader view is important in studying implementation in an organizational context. For example, an internal control person, measured by a context free measure, might in his organizational position be very restricted in terms of what he is allowed to do. These restrictions will most likely have an impact on his actions.

As pointed out in Section 5.1 the desk-top bureaucrats claimed to have problems using the SP:

- Freeing up time for design, testing and using an SP model the first time.
- Perceived consequences of SP model use. They perceived that there would be changes in activities, tasks and purposes of tasks.

Most tasks a person performs in an organization are linked to other tasks and activities performed by other persons. Data from the three SP users suggests that the use of SP models usually is more than just mechanization. It also leads to changes in activities, tasks, and purposes of tasks. It is reasonable to assume that the desk-top bureaucrats, to a lesser extent than the other two groups, have the ability to force, negotiate, or manipulate changes upon other members of an organization. They, more or less, must have the other person's OK before starting to use the SP, especially in cases where the SP use is not a mere mechanization.

Why do the desk-top bureaucrats not explain their problems to their supervisors? Are they afraid of their supervisors? The desk-top bureaucrats claimed they had no problems in their relationships with their supervisors, at least not problems that hindered them from bringing up the issue. Reasons for not bringing up the problem were related to things like: I can not estimate how much time I will need to build this model; I can not assess the likely impact of using the SP; Will it save me some time for other tasks? Obviously, the managers lacked an understanding of the desk-top bureaucrats' problems.

One of the desk-top bureaucrats had unrealistic expectations and would have been better off with another type of DSS-generator, like a data base, or a generalized DSS.

Comparing the managers with the staff professionals, and especially the administrative professionals, the latter group had a clearer view of what they were going to use the SP for. They indicated specific tasks or activities they would use the SP for. The managers, on the other hand, identified areas to be supported by SP use, which is a description of perceived use at a more general and vague level than specific tasks and/or activities. This suggests that a clearer and realistic view of use leads to a greater tendency to use an end-user tool. At the same time it should be noted that these differences could be found in their job descriptions, indicating that these differences are job dependent.

6 Conclusion

We set out to do an in-depth study of SP use in an organizational setting. Out of a group of fourteen persons, only three became SP users. All fourteen were motivated to use the SP, had management support, and were given a two-day course on the SP. This paper explored the non-use phenomenon in terms of four factors: implementation, organizational support, spreadsheet program package, and characteristics of a person and tasks. These factors contributed to and explained the different degrees of non-use for the eleven non-users.

Even though SP and other end-user tools are considered easy-to-learn tools, have direct manipulation attributes, and are relevant for business tasks, a person mau not use them in an organizational context. The study suggests that it is not sufficient to provide a computer-based tool, give a training course, and rely on persons' positive attitudes in implementing end-user tools. We should point out that "non-SP-use" should not be interpreted as a failure. Given their situations, the non-users had "rational" motives for their non-use. At the same time, an experience like this SP-adventure might well contribute to a future negative attitude towards computer-based tools and CBIS.

From an organizational point of view one can argue that each person should not be treated as a separate subject. It is possible to apply a portfolio approach where one instead evaluates the portfolio, that is, one treats all the persons as part of one portfolio (Gremillion & Pyburn 1982). The outcome of this portfolio is three users and eleven non-users. It is possible that the three users make the whole portfolio profitable. It makes a difference at what level we evaluate investments in end-user computing. Here we had an individual focus.

Finally, to summarize:

- It is important that end-user computing and computer-based tools fulfill and satisfy both user and organizational needs. This seems obvious, but this study suggests that persons may lack a "language" to express their needs, especially softer needs like time for development of applications, on-

going education and support. This study also suggests that there might be low managerial and organizational awareness of the softer problems.

- Ceteris paribus, use is more likely when users perceive a higher degree of autonomy in the organization. This suggests that it is worthwhile to consider different implementation processes and organizational support for different classes of persons.

- Efficiency and effectiveness gains must be real to the users (and the organization). How to easily assess the likely impact of use is an area that lacks good models and measures.

- Trivializing changes that must take place in work habits is a good way to increase the chances for failure in implementing end-user computing. Change takes a lot of understanding and a lot of training, education, and retraining of users.

- Use is more likely when a tool's underlying metaphor is in harmony with how a person perceives the tasks/activities to be supported. One approach is to help a person find a tool that harmonizes with his perception of his task and activities. This can lead to mechanization and efficiency gains, but might have no real impact on how the task is performed. Another approach would help a person find a tool that can enhance the person's effectiveness and efficiency. This approach requires more resources and support than the first approach, but it might be worthwhile.

- Use is more likely if tasks and activities to be supported are perceived as being critical and central.

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Notes

1. The term "computer package" sometimes refers not only to the hardware and software but also to the personnel and organizational arrangements for the delivery of computing services, see for example (Danziger *et al.* 1982). This paper treats the SP as a separate aspect. Personnel and organizational arrangement for making the SP available and related services and support are considered organizational support.

2. An extensive body of research on human-computer interaction focuses on external-internal task mapping (Moran 1983), the reformulation of a given task in the external world into its internal concepts of a computer-based system. Examples of

approaches/models with this focus on human-computer interaction are: The information processing approach and the GOMS model (Card *et al.* 1983); external-internal task analysis (Moran 1983); production system approach to analyze cognitive complexity of interactive systems or devices (Polson *et al.* 1982, Kieras & Polson 1985, Kieras & Bovair 1984); and gulfs of execution and evaluation (Norman 1986). In these models the tasks/activities discussed and used as examples only require routine cognitive skill, like text editing. Carlsson & Stabell (1986) discuss the applicability of a keystroke-level model, adapted from (Card *et al.* 1983), to the study of SP. In their discussion on the applicability of the model they conclude that it might be useful for studying the passive understanding of SP, that is, how to operate the system. To study active understanding, that is, understanding of how to use the SP in decision processes, other approaches are needed.

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