**South African Computer Journal**
Number 23
July 1999

**Suid-Afrikaanse Rekenaar-tydskrif**
Nommer 23
Julie 1999

# Computer Science and Information Systems

# Rekenaarwetenskap en Inligtingstelsels

**The South African Computer Journal**
*An official publication of the Computer Society of South Africa and the South African Institute of Computer Scientists*

**Die Suid-Afrikaanse Rekenaartydskrif**
*'n Amptelike publikasie van die Rekenaarvereniging van Suid-Afrika en die Suid-Afrikaanse Instituut vir Rekenaarwetenskaplikes*

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# Guest Editorial
# Computer Science and Information Systems: The Future?

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## 1 Introduction

As president of the South African Institute for Computer Scientists and Information Technologists (SAICSIT), I have visited a number of campuses and companies, in an attempt at arriving at a general assessment of the state of our subjects in South Africa.

An issue which I consistently pick up is that while everyone seems to think that computer-related skills are extremely important and in short supply, our academic departments are also extremely under-resourced.

At the last Southern African Computer Lecturers Association (SACLA) conference (28-29 June, Golden Gate), I had the opportunity to discuss the problems other academics see. This editorial lists some of the problems reported at SACLA, and proposes a way forward.

## 2 Problems

At SACLA, I led a discussion of problems seen in our academic departments.

There was wide agreement that both Computer Science (CS) and Information Systems (IS) departments were under pressure to increase student numbers (massification), and were seen as cash cows to prop up less popular subjects. It was broadly agreed that staffing was a critical issue: too few posts for the workload, salaries way out of line with industry (half or less, as compared to the US, where an academic salary may be 80% of an industry salary). Recent graduates often make more than professors which makes it hard to persuade our students to become academics (even to do higher degrees). Attracting a recent PhD with a sense of adventure is may be possible, but attracting experienced people used to earning a salary in a strong currency is hard. IS jobs are worse than CS, as the skills required are more like those in business. Support staff salaries are an even harder issue: their skills relate even more directly to job descriptions in industry.

A problem in addressing our concerns is that we are so overworked that we don't have time for "politics": academics with no students have time on their hands, but we don't. More industry support not only with directly addressing problems but with taking on university administrations would be useful, but they too have major problems and don't have free time.

## 3 Solutions?

Solutions are harder to identify than problems.

The SACLA session ended with a proposal that we conduct surveys of our institutions and businesses, to find out what the problems are, as a starting point for going to university administrations, government and business.

Another idea was to attempt to find common cause with business in taking on problems they have in common with academia, including the skills shortage, the insufficient capacity of our education system, and dealing with employment equity.

One of our biggest difficulties is to free up time to deal with issues such as resource allocation within our universities. The "competition" is frequently other academics with time on their hands, since they have too few students, and therefore are in a position to spend time looking after their interests.

What is needed now is some thought about how to pull ourselves out of the mess we are in. In particular, we need strategies to exploit our strengths: our high demand among students, the high demand for the skills we produce and the ubiquitous applicability of computer technology.

Given the wide use of computers, it would seem obvious that our areas should be strongly supported by a range of role players, yet the fact that so many different groups are interested in computer technology in one way or another has tended to fragment efforts to enhance our industry and academic institutions.

Clearly, from conversations I have held, some departments are in much better shape than others. Even so, some kind of collective effort is likely to achieve more results than if we allow ourselves to be pushed around as individuals. Addressing the fragmentation of efforts seems a worthy goal in itself, to reduce duplication and contradictory goals.

I appeal to anyone who has constructive ideas on how to take our subjects forward to contact me. Let us work on building ourselves up. The economy depends on us, much more than on most other academic disciplines. It's time we made that point, and made it strongly.

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## Dates and Publication Details

early booking deadline: 14 September • on-site registration starts: 17 November 1999
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# Electronic Performance Support Systems: Appropriate Technology for the Development of Middle Management in Developing Countries

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## Abstract

*The shortage of suitably qualified middle management in South Africa, and its impact on the potential success of the RDP is well documented. There are various ways of addressing this problem. These methods range from conventional class room training through interactive television and computer-based training. What all these have in common is that they require the trainee to be taken out of the work environment in order to be trained and thus valuable production time is lost. One way of countering this is by providing on the job training at the point of use and at the time of need. Delivering such a system by computer, is known as an Electronic Performance Support System (EPSS) By integrating tasks, tools and skills into a hypermedia environment, supported by an expert system, EPSS can deliver expert knowledge to the user at the time of need. This objective of this article is twofold. Firstly it will examine the current literature concerning EPSS, , and secondly it will discuss a pilot project, launched by a major corporation, and report on initial results. The study is non-empirical and the methodology is qualitative, based primarily on interviews with and opinionnaires received from initial users of the product. Although the results cannot be generalized, they provide good initial support that EPSS could go some way towards de-skilling tasks for middle management.*

**Keywords:** *Electronic performance support systems, evaluation, user acceptance, automation, computer-assisted instruction*

**Computing Review Categories:** *K.4.3, (K.3.1), (H.5.3), (H.4.1)*

## 1 Introduction

This paper discusses the development and formative evaluation of an Electronic Performance Support System (EPSS) to assist middle management in the construction industry with generating contracts in the format of the *New Engineering Contract* (NEC) (Institute of Civil Engineers, 1993). The context is post- apartheid South Africa which, in addition to being a developing country, is experiencing rapid change. Much of this change impacts severely on middle management. There are two reasons for this, firstly, affirmative action leads to a hasty replacement of experienced white managers with less experienced black managers. Secondly there has been a marked exodus of expertise from South Africa in the form of the so- called "brain drain".

### 1.1 A shortage of adequately trained middle management

Even without the brain drain, the high South African birth rate, together with the expectations of a recently liberated Black population has placed an increasing emphasis on the need for effective middle management. According to Breytenbach, (1995) "In order to meet with the expectations created by the Reconstruction and Development Programme, South Africa will have to build ten cities the size of Soweto during the next ten years". He continues that the human resource requirement for this would be "more than 100 000 skilled artisans, electricians plumbers and architects and more than 200 000 new entrepreneurs". Although he gives no indication of how he arrived at those figures, no extensive survey is required to show the lack of competent middle managers in South Africa. Craig, (1995) points out that using traditional training methods "there are 75 million man years (plus/minus) of training to be done".

Currently the problem is addressed in two ways: by increasing conventional training, or implementing technological solutions, sponsored either by the South African government, foreign governments or charitable institutions through non-governmental organizations; or by the private sector.

### 1.2 Conventional solutions

According to Craig (1995) there are about 1000 literacy and adult training programs currently running, reaching about 100 000 people, about 60 000 through employee training programs. Much of the training is provided by opportunists, interested in profit rather than quality. Not all are poor courses, but, they satisfy a very small proportion of the need.

## 1.3 Technological solutions

Technological solutions usually take the form of interactive television (ITV) or computer-based training (CBT). Organizations such as the Africa Growth Network and many other providers of satellite distance learning broadcast courses ranging from elementary courses for bank tellers to Masters' Degree programs in association with universities. The South African Navy reported much success using traditional CBT in the form of *Plato 2000* (Weller, 1995). Similarly there are numerous other technological solutions in the workplace (See Joubert, 1994).

## 1.4 Implementation problems

### Interrupted work

Traditional training requires employees to be taken off the production line, compromising productivity. The same goes for CBT and ITV. The trainee usually retires to a venue where the training is presented and, therefore, is away from the workplace.

### Hard workers work harder

Some employers try to overcome the problem of interrupted work by placing the burden of on-the-job training of new appointees onto their experienced colleagues. Thus the workload of the experienced employee is increased since training a new colleague becomes an additional responsibility. Since this task is given to the most competent colleague there is the further problem of punishing the innocent with increased workload, leading to tension in the workplace. The training colleague's work is often interrupted by the trainee, leading to reduced productivity.

### Latent learning

Conventional CBT, while having the advantage of allowing interactive, self-paced training at all hours, is primarily modular and linear. This means that a learner needs to complete at least a module at a time. It also means that the learner is faced with having to learn content out of context, and needs to retain much inert information "just in case". This occurs even more so in traditional training and ITV.

### Time and money

Furst-Bowe (1996) identifies lack of time financial resources as major obstacles to implementing technology in training programs in the United States of America. Things are no different in South Africa where time is running out for meeting electoral promises and money is in short supply through low productivity and (ironically) poor training.

### Resistance to change

Change involves learning new ways of doing things. DiBella et al. (1996) argue that, "along with asking why organizations do not learn, perhaps we should examine what organizations do learn and why organizational learning does take place" (p. 362). They indicate that "to develop learning capability organizations must distinguish between learning *what* they know and to, from *how* they learn" (p. 377). Collis and Verwijs (1995) emphasize the *adoption* of a new system as an evaluation focus and argue that while "many evaluation approaches focus on how well the use of the system helps the user to reach a specific performance goal" (p. 23), this may not be suitable for EPSS, because, "if a product is not eventually used, then it will not be commercially viable, and no critical mass of support and insight about the product will develop" (p. 25).

## 1.5 Organizational learning

DiBella et al. (1996, p. 370) maintain that "you cannot achieve high quality standards with an uneducated workforce". In discussing what makes organizations learn they claim that "staff also expect learning to occur through the very mechanisms whereby work is accomplished" (p. 366). They report that at companies such as FIAT automobiles "each functional unit is also expected to build a *memoria technika*, a database containing knowledge about components and processes" while at Motorola, "actual problems form the basis of educational design" (p. 371). Organizational knowledge is as a dimension where "at one pole, knowledge is seen in very personal terms, as something that an individual possesses by virtue of education or experience. This kind of knowledge is lost when an old hand leaves an organization; processes and insights evaporate because they were not made part of a collective memory. At the other pole, the emphasis is on defining knowledge in more objective, social terms, as a consensually supported result of information processing that is accessible through a documentation centre or other tangible forms of organizational memory" (p. 373). For Goodyear (1995) it is essential to support a workforce by "Providing them with just-in -time access to professionally-relevant information, research-based and other" (p. 46), but, "More important, we believe, is to help them redesign their working practices and the tools which support their working practices" (p. 46).

Electronic performance support systems are designed to capture organizational knowledge in the tools with which the work is done.

## 1.6 Electronic Performance Support Systems

Raybould (1995, p. 66) defines an electronic performance support system as follows:

> "An EPSS is the electronic infrastructure that captures, stores and distributes individual and corporate knowledge assets throughout an organization, to enable an individual to achieve a required level of performance in the fastest pos-

sible time and with the minimum of support form other people."

The purpose of the EPSS is to provide just-in-time performance support at the moment of need. The support could be in the form of procedural assistance or granular training. A more complete description of EPSS follows later.

# 2 Research problem and research questions

The research problem central to this paper is the appropriateness of electronic performance support systems in providing on-the-job assistance and training in the construction industry. The focus lies on the design and formative evaluation of the EPSS and its acceptance by users. The following research question could be formulated: How successful could an Electronic Performance Support System be in assisting mid-level managers in the construction industry the design and management of the New Engineering Contract. Collis and Verwijs (1995, p. 23) argue that "with EPSS, however, the great variety of ways and contexts in which a user will turn to the system for support make it very difficult to isolate the system as a causal factor in that user's performance or to compare one system with 'an alternative"'. To counter this they suggest a usage-orientated research methodology by evaluating the product not so much for its internal validity, but for the likelihood of users accepting it. This is dependent on three aspects:

- the extent to which it matches user needs,
- its ease of use, and
- its capacity to make work easier.

Following their suggestions, the research question can be refined as follows:

**Will the EPSS be accepted by the users?**

It is now necessary to discuss the phenomenon of EPSS and the context in which this specific one was implemented.

# 3 EPSS, what, why and how?

## 3.1 Characteristics of EPSS

Gery (1991, p. 34) explains that "the goal of an electronic performance support system is to provide whatever is necessary to generate performance and learning *at the moment of need*". An electronic performance support system has "the means to model, represent, structure, and implement that support *electronically* - and to make it universally and consistently available *on demand* at any time, any place and regardless of situation, without unnecessary intermediaries involved in the process" (Gery, 1991, p. 34). Goodyear (1995, p. 50) emphasizes that "an EPSS need not just be an informational resource which can be interrogated by the user, it can take a more active part in supporting a work process". Des Jardins and Davis (1995, p. 9) refine this support to include "expert knowledge, searchable references and data, granular training like cue cards, and automated tools". In essence electronic performance support differs from training in that the outcome of the interaction with the system results in a finished product, not just in a trained candidate (Des Jardins and Davis, 1995).

In order to do this, the EPSS has two components. The first is an "Infobase" containing information files in the form of text, graphics, flow charts, formulas, animation, photographic images, audio and video clips in a hypermedia environment. The second is the Support System. Barker and Banerji (1995, p. 5) mention the necessity "to provide appropriately designed task-orientated support tools". This component is where the work is done. It calls on the "Infobase" when necessary. The system could include any number of the following:

- An **advisory or expert system** performing tasks such as structuring problems, analysis, diagnosis, and calculations much in the way "wizards" function in many *Microsoft Office* applications,
- **productivity software**, such as spreadsheets or word processors,
- **dedicated application software**, such as project schedulers, electronic mail, and electronic diaries,
- **help systems** which assist with using the software, including the system shell,
- **interactive training sequences** which, unlike traditional CBT are granular and task-specific, although they can be strung together to form a longer training module,
- **assessment systems** either for self evaluation or employee assessment for certification purposes, and
- **monitoring, assessment and feedback** systems which observe user performance.

Barker and Banerji (1995) feel that "an important aspect of these tools is the nature of the end-user interfaces that they contain" (p. 5). They should be simple and allow users the quickest possible access to information or tools. The principal design problem lies in integrating all the various options into one easy- to-grasp interface. Gery (1991) suggests that the interface should contain facilities such as back tracking and should allow lateral and back access.

Table 1, adapted from Gery (1991), shows the difference between performance support and traditional help systems.

From table 1 it can be seen that an EPSS differs from a help system in that it is actually able to assist in doing the work, it does not just provide information. EPSSs also differ from traditional CBT, as illustrated in table 2.

| EPSS | Help Systems |
|---|---|
| Support a broad range of job tasks | Supports software-related tasks |
| Provide "what if"type of advice | Provide passive information only |
| Can support complex, interrelated tasks | Provide descriptions of procedures |
| Accepts and processes user input | Presents information as a result of menu options |

Table 1: EPSS v Help Systems (Adapted from Gery, 1991)

| EPSS | CBT |
|---|---|
| Hypertext environment with multiple access | Infobase structured within predetermined presentation sequences |
| Contains a range of support mechanisms to assist user in performing a task | Outlines procedures to be followed by the user<br>Does not actually help with execution |
| Accepts and manipulates user input | Checks user input against model answer or calculated answer |
| Available on demand and in context | Forms an event in a larger teaching process<br>Available when its turn comes up |
| Emphasis on user construction of individualized learning sequence based on need | Structured according to design of the developer |
| Granular | Modular |

Table 2: EPSS v CBT (Adapted from Gery, 1991)

Where traditional CBT supplies pre-packaged information in a pre-determined way, an EPSS makes necessary information available on demand and assists in using that information to produce the required performance.

Des Jardins and Davis (1995, p. 9) mention personal computer "wizards" as examples of electronic performance support tools "whose assistance in creating a database, spreadsheet, document or presentation results in a finished product rather than simply a user tutorial". Gery (1995) distinguishes between extrinsic, intrinsic and external performance support. "Wizards", cue cards, coaches and guides provide external support in that they have to be called from outside the main program to fulfil their function. On the other hand, intrinsic support is inseparable from the product "for example, holding a mouse over an icon for two seconds in *Microsoft Office* results in the appearance of words describing that icon's function" (Gery, 1995, p. 71). External performance support may come from a help desk and not be part of the user's system at all.

Dorsey et al. (1993) describe an "Electronic Briefcase" for sales staff, the goal of which "was to construct the tools and materials to support workers wherever they worked" (p. 21). The integrated software which formed the EPSS consisted of sales process management and reporting, sales account information and management, automated report generation from sales data, proposal templates for the word processor, job- related help for writing sales proposals and product information in a hypertext environment.

In South Africa, although a few companies have items that they claim to be EPSSs, these are restricted mainly to need-driven, granular CBT modules.

## 3.2 Why EPSS?

Raybould (1995, p. 66) lists three strategic and four cost advantages of electronic performance support systems. Strategically EPSS could lead to "improved quality, increased retention of corporate knowledge, and improved responsiveness to business change". The main reason for quality increase is that with the support available critical information or procedures are less likely to be forgotten. Without performance support, corporate knowledge is situated in the heads of its workers, and should they leave or be transferred, the knowledge leaves with them. With an EPSS, the know-how resides in the computer and is available to any of its users. The organization is more responsive to change because should procedures change, the EPSS can be adapted and workers will need less retraining.

The cost advantages of EPSSs include "increased productivity, reduced lost opportunity costs, reduced support costs; and reduced training event costs" (Raybould, 1995, p. 67). Productivity is increased because with good support it takes less time to perform a given task. Lost opportunity has to do with those things which cannot be done until staff have been trained to use the new system. Support costs are reduced because the supervisors or colleagues need to spend less time coaching others and there are fewer calls to the help desk. Obviously, since an EPSS is designed to reduce the need for training, there will be a reduction in training costs.

## 3.3 How? Building and implementing EPSS

Des-Jardins and Davis (1995) list the following prerequisites for a successful EPSS project:

- Commitment to needs assessment and project support,
- Cooperation between subject experts and designers,
- The skills of a multi-disciplinary team, and
- A well-considered plan as to whether the system will be developed from scratch or wrapped around an existing application.

Law (1995) stresses the value of rapid prototyping and formative experimentation in enhancing the chances of success.

Collis and Verwijs (1995) put all this together in their four phase design model:

Phase 1 involves "iterative conceptualization of the product and agreement among the design team and representatives of potential users as to what the product should do, be like, and how it will be used" (p. 24).

Phase 2 consists of "iterative clarification of the design through rapid prototyping" (p.24).

Phase 3 sees "beta versions of the product, in a from ready for limited field testing and formative evaluation of the product" (p. 24). Phase 4 is the releasable version complete with documentation and support.

Although EPSS technology is relatively easy to build and could provide solutions, one of the major problems of any form of technology-assisted training lies in its adoption and use. Furst-Bowe (1996) mentions lack of compatibility between systems, lack of management support, and insufficient trainer skills as barriers to implementation.

Success should be measured not so much in the look and feel as in the product's acceptance and use by target users. (Collis and Verwijs, 1995).

# 4 A case study

## 4.1 Research setting

### The corporation

This paper reports on an evaluation of an EPSS developed for an organization that needed employees to learn an entirely new system of contracting. The corporation is a large semi-state owned utility provider with in excess of 30 000 employees, ranking with the bigger banking groups as one of the largest importers and exporters of money in the country. It is one of the largest employers of contractors in the South African construction industry. It was hoped that EPSS would reduce the requirement for more traditional forms of training (Wood, 1995) and promote the use of the *New Engineering Contract* (NEC) which represented a change from a product-orientated contract to a process oriented contract and would require a considerable redesigning of the work process.

The three strategic and four cost advantages of EPSS as identified by Raybold (1995) are highly applicable in the environment for which the corporation's New Engineering Contract Support and Training (NECST) EPSS was designed.

### Improved quality

One of the reasons for standardizing on the NEC was that employees had been cutting and pasting previous contracts in designing new ones thus exposing themselves and the corporation to a barrage of legal complications. The NEC was adopted as a standard form of contract to eliminate such loopholes. The NECST EPSS was designed to prevent errors in drawing up a NEC contract.

### Increased retention of corporate knowledge

With expertise being a scarce resource, having it situated in the computer rather than in the employees was highly desirable. The NEC consists of a pre-written contract with a number of core clauses and a number of optional clauses. Some optional clauses are interdependent and cannot be selected with or without some others. The training need could be reduced by an electronic contract generator which would allow the user to select various clauses and disallow invalid options, while also addressing questions as to the implications of each clause and providing training on demand.

### Improved responsiveness to change

As the NEC reflected a major change in the corporation's contacting strategy, it was hoped that and EPSS would help facilitate such a change if workers started to do their work differently directed by the EPSS. Previously existing contracts were usually tinkered into new formats to suit the requirements mainly of the corporation by putting as much risk as possible on the shoulders of the contractors, while the corporation took as little risk as possible. The result was that contractors quantified such risk and added it to the cost structure. The NEC divides risk more evenly. However, carrying more risk also means carrying more responsibility and a great deal of training would be required to bring contract managers to the required level of competence.

### Increased productivity and reduced lost opportunity costs

The corporation was hoping for increased productivity by using this tool, coupled with reducing lost opportunity costs, particularly as loopholes in a contract represent a lost opportunity.

## Reduced support and training event costs

With only 10 people initially knowledgeable about the NEC, it was impossible to provide support, so EPSS was strongly indicated, while training 1000 contract managers would have been prohibitively expensive.

## General

The appropriateness of EPSS as a solution is further supported by Hudzina's (1996) findings that the primary users of this technology were businesses and industry, with education and government organizations as secondary markets. The corporation is a government-owned industry, running along business lines, with a commitment to the education of its employees - so in a sense it covers all four market sections.

## 4.2 The product

This section discusses the process used in developing the product and then follows a brief product description.

## Design strategy

Once EPSS had been decided upon as the vessel for the implementation of the NEC, a one week needs analysis seminar was conducted with stake holders (potential users) to determine what aspects would need to be incorporated into an EPSS of this nature, and how the infobase would be constructed. The stake holders in this seminar acted as subject matter experts to maximize their commitment to needs assessment and project support, to enable cooperation between subject experts and designers, and to acquire the skills of a multi-disciplinary team, as called for by DesJardins and Davis (1995). As no training support existed for the NEC at all, it was clear that this product was to be developed from scratch.

All the potential users had not yet been convinced of the need to change from the old form of contract to the NEC, resulting in difficulties with needs assessment. Since they were not convinced that they should use the NEC, they could not say what they needed in order to use it well.

The subject matter experts were unfamiliar with the concept of EPSS and expressed severe doubts that the knowledge and skills which they had acquired over many years could be transmitted through computer- based training. Once the concept of EPSS had been explained, good cooperation occurred.

On the last day a mock-up of the product was presented to the group to test their opinions and invite comment. This resulted in great enthusiasm and much valuable information was gained. This supports Law's (1995) comments on the value of rapid prototyping.

On this followed a three month development period during which the developers of the NEC, as well as the traditional chalkboard trainers and some initial users were regularly consulted and involved in an iterative design process where formative experimentation (Law, 1995) was conducted regularly.

## Product description

The product comes very close to being a fully-fledged EPSS as described by Gery (1991). Given that the whole tool is designed to produce an outcome in the form of a contract and its management, it falls into the category of a intrinsic performance support (Gery, 1995).

The **Infobase** at the heart of the EPSS, is a hypertext document, constructed in *Hyperwriter*, containing the NEC in its entirety, with hyperlinks to comments on relevant clauses. The program allows for boolean searches, as well as hyperwords, and has extensive navigation facilities such as back tracking and bookmarks, while it also provides a record of time-on-task, which is handy for determining which sections were visited most by the users.

The **advisory system** consists of a contract generator, constructed in *Clarion*, where the user specifies options or completes dialogues leading to the generation of a final clean copy of the contract. The system knows which clauses should go together and advises the user should incorrect combinations be specified.

The generated contact is piped through to the **productivity software**, *Microsoft Word for Windows*, where the corporate logo and other details are added.

The data generated by the contract generator can also be piped to **dedicated application software** such as a project management tool or electronic diary to remind users of due dates specified in the contract.

Dedicated **help systems**, constructed in *Robohelp*, assist in moving from one task to another, should the interface not be as intuitive as it was designed to be.

Drawing from the infobase, is a collection of **interactive training sequences**, authored in *Asymmetrix Multimedia Toolbook*, forming a granular, rather than modular, CBT unit that deals with the contract on a clause-by-clause basis. It can be accessed as a linear tutorial, or as context-sensitive help when needed.

There are two **assessment systems**. The first is a self test which can be done as a conventional test or coupled to a game of "BlackJack". The second is a formal computer-based examination.

**Monitoring, assessment and feedback** systems allow the developer to fine tune the system, and also allow the users to keep track of their own performance.

## 4.3 Research methodology

The research followed the first three of the four phases suggested by Collis and Verwijs (1995). The first phase was one of "iterative conceptualization of the product and agreement among the design team and representatives of potential users as to what the product should do, be like and how it will be used" (p. 24). The second phase, "iterative clarification of the design through rapid prototyping" (Collis and Verwijs, 1995, p. 24) took place on the last day

of the initial development workshop. This modus operandi was followed throughout the development period. Subject matter experts, trainers and representatives eventual users were involved on an ongoing basis. After the development period in the third phase, "beta versions of the product, in a form ready for limited field testing and formative evaluation" (Collis and Verwijs, 1995, p. 24) were implemented in a number of beta test sites.

The bulleted section below shows the refinement of the research question as adapted from Collis and Verwijs, 1995). The main question "Will the product be accepted by the users?" is divided into questions about usefulness, usability and making work easier, which have sub-questions of their own.

- Will the product by accepted by the users?
  - Is the product useful?
    - Does it fit in with the personal work needs of the users?
    - Does the electronic performance support add value to the learning content?
  - Is the product useable?
    - Is the user interface easy to use?
    - Is the product easy to learn?
  - Does the product make the work easier?
    - Does it fit in with the work environment?
    - Does it fit in with working procedures?
    - Do the users have the time needed to use it and does it save time for them?

The methods used to gather data to answer these questions included observation and usability testing, expert reviews, an implementation log, interviews with users and a questionnaire distributed to users.

The completed product was installed on the computers of various potential users, selected at random, and comment was invited and also solicited by means of a questionnaire. Of the 21 potential users contacted, nine had not yet used the product, while 12 were users of the EPSS.

# 5 Findings

The findings reported here are mainly anecdotal and were collected during the beta test phase. Much of what is reported is still tentative because "people need experience of the technology, and the forms of communicative educational activity that are enabled by that technology, before they can make firm, concrete statements about what they would see as being better technology, better pedagogy or better organizational approaches" (Goodyear 1995, p.45).

A problem that could impact on the research at this stage is that both the NEC *and* the EPSS that would facilitate its use, are new concepts and both were regarded with initial suspicion. It will be necessary, in further research, to separate user response into those that deal with

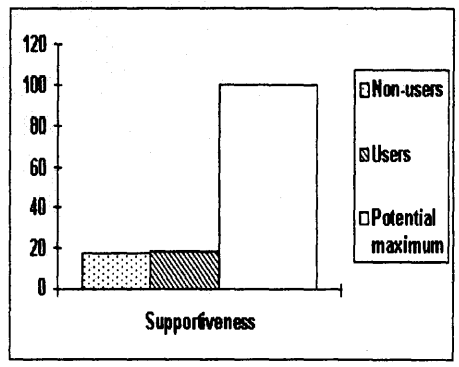


Figure 1: Supportiveness of work environment

the contract, and those that deal with the EPSS. There will, invariably be interference across the two concepts. Some users may claim to dislike the EPSS because they are uncomfortable with the clauses of the NEC that are contained in it. Others may find the EPSS so useful that they claim to like the new contract better than the previous one, whereas they simply like the ease with which it can be generated.

The findings are now discussed in order of the research questions.

## 5.1 Is the product useful?

### Does it fit in with the personal work needs of the users?

In order to determine perceived need, subjects were asked to rate the supportiveness of their work environment as a percentage (see figure 1). It was found that:

- There was not much difference between the perceived supportiveness of the work environments of users and non-users.
- In both instances the supportiveness was notably low.

The low perceived supportiveness of the working environment (less than 20%) could indicate that both users and non-users of the EPSS had a need for some kind of performance support, be it electronic or not. In reply to a question on facilitating the implementation of the product, one user responded: "Get management on our side". This tallies with the perception of low support. Users did not realize that management was paying for the development of the product.

### Does the electronic performance support add value to the learning content?

Although users found added value in that the product allowed them to execute tasks based on the content, they did have trouble with interpretation of content. This problem lies within the nature of the product itself. The content

deals with legal issues involved in designing and executing a contract. The majority of problems occurred in the self-test and the final exam. As is the case with many legal questions, these questions are often open for debate. Even the multiple-choice distracters, such as "partially correct" came up for criticism. Some respondents felt that the distracters should be either "Completely Correct" or "Completely Incorrect". "Partially Correct" was open to too much interpretation. This was aggravated by the fact that the questions themselves were open to debate. The question designers response was that the questions in the "self test" section were designed to get the users to think about the options, rather than to provide yes/no answers. More research will be needed to find a solution to this problem. In a certain sense, promoting discussion about content can be regarded as added value. Interestingly enough suggestions for improvement of the product included a request for more problem-type questions.

The real added value is the fact that the contract is generated as the learning happens.

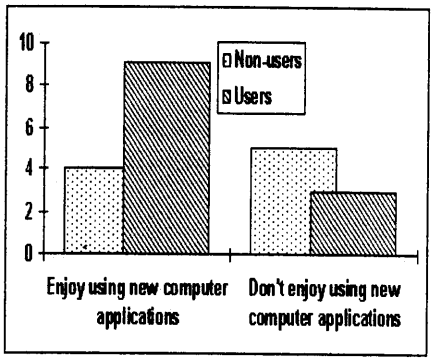


Figure 2: Attitude to learning new applications

## 5.2 Is the product useable?

### Is the user interface easy to use?

No user found the interface difficult to interpret, probably because of the constant fine tuning of the interface during the development phase. The users polled were all computer literate and familiar with the *Windows* environment in which the entire product was created. When the product is released to the workforce, further research will have to be done to gauge the response of those who are not familiar with the platform. Suggestions for improvement included a simpler introduction and using simpler language. Many of the potential users are not native speakers of English.

### Is the product easy to learn?

Very few problems occurred in learning to use the EPSS. Much of this can be ascribed to the attitudes of users towards new technology.

Considerably more users enjoyed using new computer applications than did non-users (see figure 2).

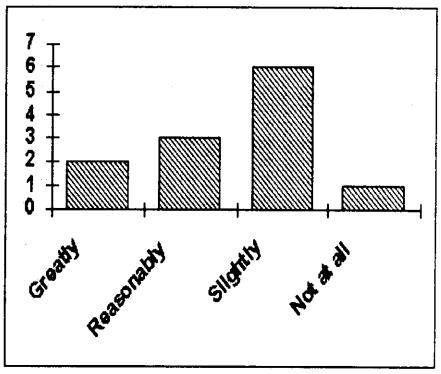


Figure 3: Does the EPSS make the work easier

## 5.3 Does the product make the work easier?

A straightforward question on the questionnaire, "Does the EPSS make your work easier?" was answered as follows (refer to figure 3):

- Greatly: 2
- Reasonably: 3
- Slightly: 6
- Not at all: 1

Thus, 11 out of 12 users indicated some improvement.

This bodes well for acceptance by users, but in order to determine their level of comfort with the product one

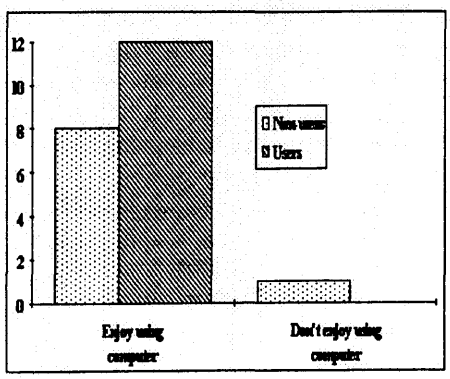


Figure 4: Attitude to using computers

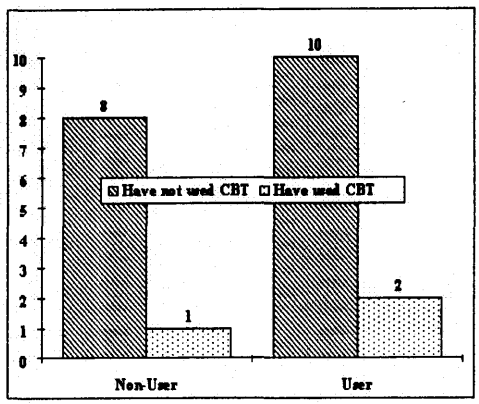


Figure 5: Familiarity with Computer-Based Training

would have to determine if the product is in line with their work environment and procedures. The only suggested improvement was for more macros to automate document creation even further.

## Does it fit in with the work environment?

It was decided to implement the product specifically for people who were already working with computers. Investing in computers for users without them would be too expensive and might also result in another possible articulation for user resistance. When users were polled on their attitude to their current working environment it was found that (refer to figure 4):

- All candidates had been using a computer for some time, and
- Most candidates enjoyed using a computer.

Since the EPSS contained some form of CBT, users' familiarity with this medium was also obtained. Most users and non-users were familiar with CBT (refer to figure 5).

From the above it can be seen that there was no resistance to using the computer as medium, as productivity

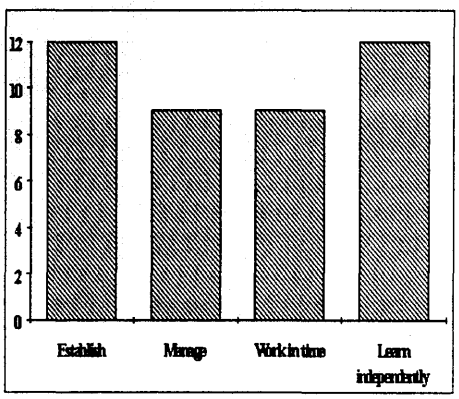


Figure 6: Improved Skills

tool, or for training and support. One highly computer-literate user, asked for the game to be made more interactive.

Given that there is a need for support and no resistance to computer-based support, there might well be a need for an EPSS.

## Does it fit in with working procedures?

Some questions were designed to determine the nature of the environment into which the EPSS would be deployed. The questionnaires show that users felt the EPSS improved their ability to (refer to figure 6):

- Establish a NEC contract: 12
- Manage a NEC contract: 9
- Get their work done: 9, and
- Learn and adapt independently: 12.

Fitting in with working procedures implied that users would have to adjust their working procedures. This was firstly because the new contract would require new procedures, and secondly because generating it on computer would require new procedures. Users were asked if the EPSS caused them to restructure tasks (refer to figure 7).

- Greatly: 2
- Reasonably: 5
- Slightly: 5

Thus, All users reported restructuring tasks to some extent.

The performance of an EPSS in terms of making users restructure tasks could be an important indicator of its acceptance, as it would indicate that users would do things differently so that they could use the system. Moreover, restructuring of tasks would amount to organizational learning as indicated by DiBella et al. (1996).

The questionnaire also asked for suggestions to improve performance standards.

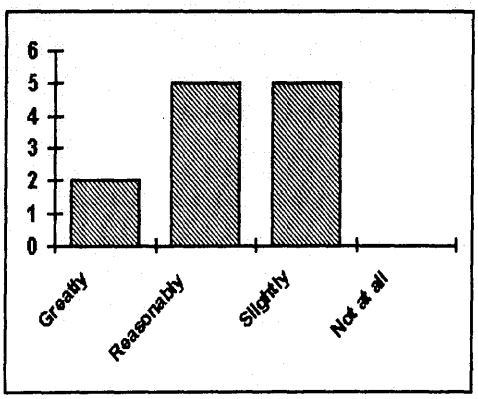


Figure 7: The EPSS caused users to restructure tasks

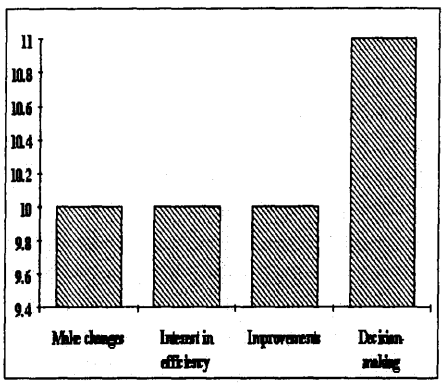


Figure 8: Suggestions to improve performance standards

It is interesting that a much higher percentage of users offered suggestions on how to improve performance standards than did non-users (see figure 8).

Among the suggestions for improving performance standards were:

- Set goals and incentives.
- Employ the right people.
- People should be encouraged to be self-motivated.
- The environment should be more motivating.
- Tighter targets should be set.
- More negotiation should take place.
- More realistic targets should be set.

It is interesting to note that the suggestions all had to do with organizational matters and not with the EPSS.

## Do the users have the time needed to use it?

In determining usablility, one needs to determine firstly how easy it would be to learn how to use a new product.

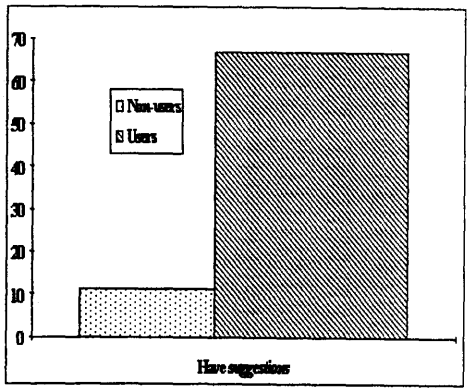


Figure 9: Time to learn new things

A precondition to this may be a willingness on the part of new users to make time to learn. It was found that those who did use the system indicated that they found time to learn new things (refer to figure 9):

- 83% of the users of the product felt that they had time in their daily schedules to learn new things.
- Only 63% of the non-users indicated that they had such time.

It is difficult to conclude that having time to use something would make one use it. The word "time" is often understood as a synonym for inclination, as in: "I don't have *time* for that sort of thing". One would therefore have to measure the attitude of users.

On an attitudinal level users felt that the following aspects were improved using the EPSS (refer to figure 10):

- Willingness to make changes to long- standing practices
- Interest in efficiency
- Ideas about ways to improve working environment and organization
- Independent decision-making.

## Does it save time for the users?

- Greatly: 2
- Reasonably: 4
- Slightly: 4
- Not at all: 2

Thus, 10 out of 12 users indicated some improvement.

In terms of dynamic testing anecdotal reports were encouraging. One of the more skeptical subject matter experts, who initially expressed doubt about the possibility of computerizing human expertise gained through years of experience in the workplace, later reported that the EPSS

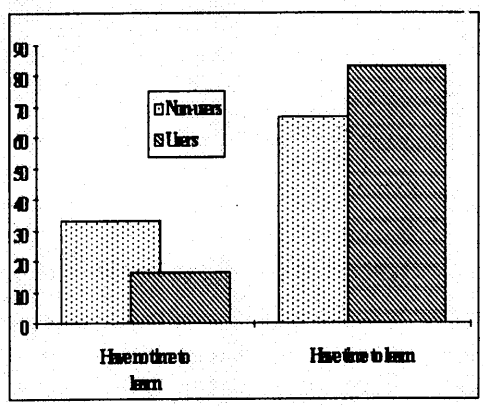


Figure 10: Attitudinal improvements

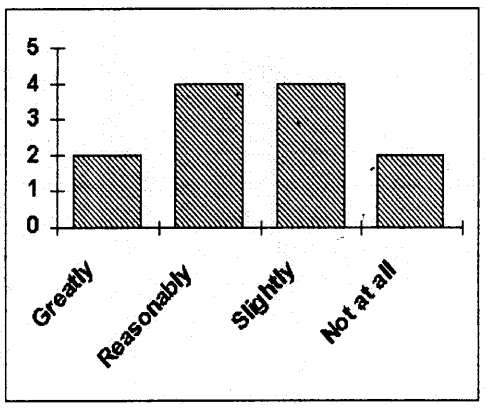


Figure 11: The EPSS caused users to get work done faster

enabled him to generate a new contract in one quarter of the time it would have taken in the traditional mode. Other anecdotal comment on the success of the product includes the fact that a further two similar EPS Systems have been commissioned by the corporation for other contracts.

# 6 Conclusions and recommendations

Although the research is incomplete and the results cannot be generalized, there are strong indications to support the continued use of electronic systems to support the performance of mid-level management.

From the experience gained during the development of this system, a few recommendations arise.

Subject Matter Experts should believe in their subject matter. Much time was wasted while management were tried to convince subordinates of the need to change to the NEC. Using the EPSS as a "carrot" to lure the stubborn ones was not a good idea.

Subject matter experts should be familiarized with the format of the product. They see opportunities of delivering knowledge that they might not have shared initially for fear that it could not be transmitted properly.

Involving the subject matter experts in the beta test worked well, except that some had become bored with the exercise and failed to return their questionnaires. Follow-up visits had to be conducted.

When subject matter is contentious, and when questions can have more than one interpretation, it becomes difficult to debrief subject matter experts. They tend to debate the various options with one another and bring in any number of different variables. It is recommended that the questions be given to the experts individually and that a Delphi-procedure, rather than a think-tank, be used to reach consensus. Questions which obtain low levels of consensus should not be included in the test. They might be used as rhetorical questions or even be put in a section on their own, reserved for "brain teasers".

From the experience with NECST, it can be seen that EPSS provides a valuable alternative in coping with a society in which all the skills may not be in place to have a specific job done.

The evaluation, based on Collis and Verwij (1995) predicts reasonable to high user acceptance and provide good initial support for EPSS as a solution to the training needs of middle management. One problem still lies outside the scope of this evaluation and calls for further research. If the results indicate user acceptance, then a new research question is, "Why did the other nine of the 21 users polled not use the EPSS?"

# References

[1] P Barker and A Banerji. 'Designing electronic performance support systems'. *Innovations in Ed-*

*ucation and Training International*, **32**(1):4-12, (1995).

[2] GF Breytenbach. 'The use of appropriate technology in mobilizing human potential to create an employment pool'. Paper presented at the Technology-Assisted Training Conference, Johannesburg, South Africa. (1995).

[3] B Collis and C Verwijs. 'Evaluating electronic performance support systems: A methodology focused on future use-in-practice'. *Innovations in Education and Training International*, **32**(1):23-30, (1995).

[4] S Des Jardins and H Davis Jr. 'Electronic performance support systems: Making the transition'. *Eyes on the Future: Converging Images, Ideas and Instruction*. Selected readings from the Annual Conference of the International Visual Literacy Association. Chicago. (1995).

[5] AJ DiBella, EC Nevis and JM Gould. 'Understanding organizational learning capability'. *Journal of Management Studies*, **33**(3):361-379, (1996).

[6] LT Dorsey, DA Goodrum and TM Schwen. 'Just-in-time knowledge performance support: A test of concept'. *Educational Technology*, **33**(11):21-29, (1993).

[7] J Furst-Bowe. 'Competencies needed to design and deliver training using instructional technology'. *Proceedings of Selected Research and Development Presentations: National Convention of the Association for Educational Communications and Technology*, Indianapolis. (1996).

[8] G Gery. *Electronic performance support systems*. Boston: Weingarten Publications, (1991).

[9] G Gery. 'The future of EPSS'. *Innovations in Education and Training International*, **32**(1):45-55, (1995).

[10] P Goodyear. 'Situated action and distributed knowledge: A JITOL perspective on EPSS'. *Innovations in Education and Training International*, **32**(1):70-73, (1995).

[11] J Craig. 'Global trends and technology based training developments worldwide: How this impacts on South African training and education practitioners'. Paper presented at the Technology-Assisted Training Conference, Johannesburg, South Africa. (1995).

[12] M Hudzina. 'Electronic performance support technology: Defining the domain'. *Performance Improvement Quarterly*, **9**(1):36-48, (1996).

[13] Institute of Civil Engineers. *The New Engineering Contract*. London: Thomas Telford Services Limited, (1993).

[14] ME Joubert. 'Die gebruik van wiskunde RGO-programme om syfergeletterdheid in volwassene basiese onderwys te bevorder'. Unpublished M.Ed dissertation, University of Pretoria. (1994).

[15] M Law. 'Developing electronic performance support systems for professionals'. *Proceedings: Annual National Convention of the Association for Educational Communications and Technology (AECT)*. Anaheim. (1995).

[16] G Raybould. 'Making a case for EPSS'. *Innovations in Education and Training International*, **32**(1):65-69, (1995).

[17] B Weller. Interview on the use of Plato 2000 during the integration of former ANC forces into the SA Navy, July 4. (1995).

[18] D Wood. 'Electronic performance support systems: look mom! No training'. *Journal of Interactive Instruction Development*, **8**(2):28-34, (1995).

Received: 15/7/98, Accepted: 26/10/98

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**South African Computer Journal**

Number 23, July 1999
ISSN 1015-7999

**Suid-Afrikaanse Rekenaar-tydskrif**

Nommer 23, Julie 1999
ISSN 1015-7999

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