

# The Effectiveness of an Electronic Performance Support Systems on Learning and Performance.

Theo J. Bastiaens

Wim J. Nijhof

Harmen J. Abma

University of Twente, The Netherlands

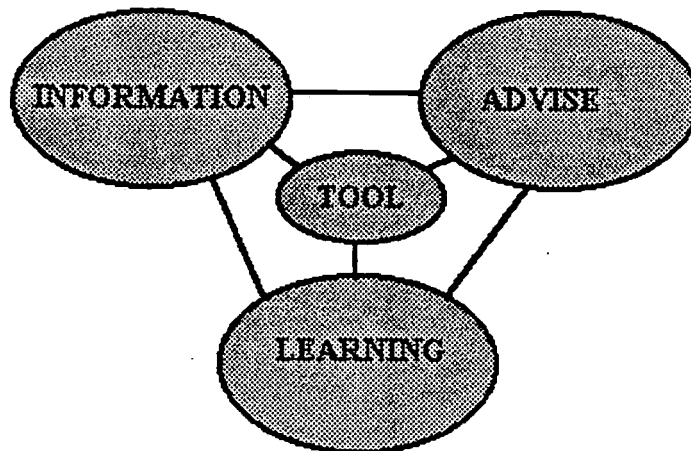
*This research is measuring the effectiveness of Electronic Performance Support Systems (EPSS). Some of the major advantages of EPSS, like increasement of productivity and better learning outcomes are evaluated with insurance agents working on laptops. Theoretical statements, research framework and hypothesis are presented. The conclusions are drawn and no significant improvement on productivity or learner results has been seen.*

In the last ten years the Computer Based Training (CBT) market grew tremendously and the quality of the programs increased. Sound and vision were added, educational technology improved the design and structure. Nowadays key words are just-in time learning and learning by doing. For that CBT had to be revised and integrated in the workplace. One way to integrate learning in the workplace is using Electronic Performance Support Systems (EPSS). EPSS supports and monitors employees while they are working; but EPSS is not only an alternative for the human master in the master/journeyman paradigm, it is more. EPSS is an integration of all the electronical sources and tools employees need to do their job. Developers and researchers working in the field of EPSS have high expectations. EPSS will improve productivity and learning outcomes. What are their assumptions? A short historical overview of corporate training can help.

Since the early seventies most of the employees in business and industry are trained by classroom instruction. They are treated as a homogeneous group. The master who's the expert teaches the desired knowledge and skills. The problems of classroom instruction are related to costs and benefits. There is a lot of money involved; turnover costs etc. The benefits of classroom instruction are relatively low. Employees have to learn skills in a theoretical way. Learners have problems to relate the classroom instruction to their own specific situation. Reasons to change the paradigm to the good old master/journeyman paradigm. Since the middle ages this paradigm has been proven. At the workplace a master is doing his job. The journeyman observes the master and tries to imitate the him. A cheap and efficient way. Nowadays it is hard to use this paradigm because of the number of employees. But there are some good properties in this training on the job. Related to classroom instruction training on the job is often cheap. Employees don't have to leave their workplace anymore (Jacobs & Mc Griffin, 1987, Jacobs, 1990). The learning processes are more concrete and active (Münch, 1990). The transfer is higher because of the identical situation between the learning environment and the workplace (Wexley & Latham, 1991). All these advantages stay when CBT is used in the workplace. Besides that people can get trained whenever and where they want. But CBT has problems too. Employees have to stop working when they use CBT. Training with CBT is still an separate event (Gery 1989). Employees will benefit from the integration of learning with their job. EPSS is possibly the solution for all the problems stated above. This research will try to explore some conclusions.

EPSS is a concept which integrates the electronical sources employees need to do their job. Employees need tools to perform, they have to look up information quick to use in their job, they want to learn certain subject-matters or skills when needed and they want to get expert advise to guide them through difficult parts of their job. For that reason an EPSS environment exists of four components (fig 1).

**Figure 1.** The components of an EPSS.



EPSS provides employees with just-in time knowledge, information and learning at the right moment (Gery 1992). High transfer, no need to leave the workplace and more active learning processes are advantages of training on the job. Specific EPSS advantages are immediate access to information and learning, a reduction of the amount of formal training in advance of task performance and a reduction of the supervisor time spend on employees. It has the additional advantage that the responsibility focus changes from the trainer and training program to individual job specific learning experiences (Gery, 1992). Performance support systems can be important in employees self management or self-directed teams (Bramer & Senbatta, 1993) and will improve the workers productivity (Raybould, 1990, 1991). Law (1994) tries to find scientific evidence for the surplus value of EPSS from current cognitive theory. He relates performance limitations to cognitive explanations. Performance requiring large amounts of factual knowledge, proficiency of skills infrequently utilized on the job or simultaneous processing of a large amount of information have an cognitive explanation. It places high demands on long term memory without adequate processing, declarative and procedural knowledge that decayed or in a limited capacity of the working memory. In Law's opinion EPSS can provide an extension of long term memory and reducing the working memory load.

### **Problem Statement**

In the first paragraph a lot has been stated but little has been proven. This research project attempts to evaluate an EPSS on the effectiveness. In literature a few disadvantages were found. Just-in time training at the workplace, providing employees small task-oriented training granules and employees taking control of their own learning process will create problems. Clark (1992) gathered some subjects we have to take into account. In her opinion employees may fail to build a unified picture of their job when they have to distract information from an EPSS. Several little information parts will create a fragmented knowledge base. Especially novices need a high level overview of the content to relate details of training. She doubts about the learner control in EPSS. She cites research of Milheim and Martin (1991) which proves that learner control is not as effective as instructional control. It is expected that the introduction and implementation of EPSS will summon resistance. Employees are not likely to give up working 'the old way'. And when not, there is an other problem. The pressure in their work. Employees will not have the time to engage the training support. A more philosophical question is related to the long term effects of

EPSS. Will it 'de-skill' workers? Will it 'de-motivate' workers? Or will it automate the low level tasks and bring in more time to perform tasks on higher level (Carr, 1992)?

It is not possible to give answers on to all the questions. In general we want to measure the effectiveness of EPSS. We expect EPSS to be more effective than the "old situation". "Effectiveness" is split up in effectiveness on learning (learner results) and effectiveness on working (productivity). The next section will explain the setting and will further state our underlying expectations.

### **Research questions**

The project is executed in cooperation with a large Dutch insurance company. This company is selling insurance products to their clients by a widespread network of insurance agents. These agents are working for the company on a commission based system. The company administrates the sold products and provides background information and training to their agents. The insurance agents operate from their home office by visiting (potential) clients. The training program exists of an introduction course for new agents and specialized (related to specific products) courses for advanced agents. In general training means classroom instruction, experts provide knowledge, manuals and textbooks to read at home. The training department ascertained this way of training not to be (cost)effective. The expensive courses didn't lead to better outcomes in learner results and productivity. As the policy for the future was to develop a computer tool to communicate better and quicker with their head-office (sending, receiving data), the training department joined a project which provides all their agents with laptop computers in the near future. The idea was born to develop an EPSS for insurance-agents. The EPSS was developed and exists of information, advise and learning about their products. The agent can read information about a product and can automatically calculate with their clients data. The EPSS will give an advise based on the specific situation of the client. The agents support their sales presentation with slides and pictures. They also get Computer Based Training (CBT). The casebased modules enclose all their products. A self test indicates the preparedness of knowledge and skills related to the products. The company expects such an electronically environment to be more effective. To test the expectations three main groups were compared. The first main group is the group working and learning in a traditional way. This group gets a traditional classroom instruction and they work pen/paper based (forms, hand-books) and get information from manuals. The second main group is working and learning with an EPSS. The third group is a control group. For several reasons it was not possible to do preliminary research. So we compare the two treatments (traditional and EPSS) with a 0-group. This third main group didn't have any training and is working on a traditional way. In order to judge about learning and working we split up the treatments in two parts; the first is the working part. It's the tool program in the electronical environment and the forms and hand-books in the traditional way. The second is the learning part; the CBT in the electronical environment and the classroom instruction in the traditional group. To make the description of this research more complex we had to deal with other variants. In table one the groups are stated.

**Table 1:** Three main groups and their variants.

TREATMENT	n
1 TOOL & CBT (EPSS)	12
2A TOOL & CLASS	8
2B PAPER & CLASS	4
3A TOOL	5
3B PAPER	7

The main hypothesis "EPSS is more effective than traditional classroom training and traditional pen/paper based working". This thesis is split up in several research questions. The question related to training is; Agents in the EPSS group, trained with CBT, will score higher on a learners test. In other words these agents will have higher learner outcomes. The research question related to working is; agents working with EPSS will score higher on selling. The productivity will increase. As this EPSS is a new system, we are also interested in the evaluation of the components involved, the feedback, the support and the opinion of the users. Answers and questions on these components are important for future development. In this paper we will only try to answer the questions above. Although the next section "methodology" will give an overview of the whole project, we will not go further into the quality of the developed EPSS. At the end we will try to show causes for the outcomes.

### Methodology

The data collection in this project is split up in a qualitative- and a quantitative part. Table two shows the method used to gather the information, the target group, the treatment and the amount of persons involved.

At the start of the project we collected the sales results of 1993. To give an opinion about the productivity we used their sales of insurance's in the field of annuity. These insurance's are topics in the CBT and classroom training. At the end of the project their results over 1994 were collected. It was expected that agents using an EPSS would sell more annuities compared with agents not using an EPSS. The next measurements were the interviews (n= 12). Four people of every group were interviewed. They answered on structured questions related to our variables (see next chapter). At the end of the interview they got a case. They had to respond to a practical situation and had to process the data. This practical situation was observed to give insights in people using their computer or manuals and forms. This was done to relate performance differences to productivity and learning results. These learner results were measured on all the agents (n= 36) in a test. They all got the same test on pension insurance's. Next all the agents got a questionnaire (n=36). The questionnaire was separated in two different parts. The first was a general part based on our variables, the second was related to the specific treatment. After they filled up the questionnaire the whole group held a discussion (n= 36). This session was important to collect the ideas of the agents. They have to work all day with EPSS. They know what is effective and what they like. So gathering their experiences is worthwhile. To compare the assertions of the agents we talked to their managers (n=8). What is their opinion about EPSS, productivity and change? They discussed positions related to EPSS. In the section results and conclusions our findings are forwarded.

**Table 2.** overview of the methodology.

	O1	XA	OA1	O3	O4	OA2	O5	O6	O7	O8
	O1	XB	OB1	O3	O4	OB2	O5	O6	O7	O8
	O1	XC	OC1	O3	O4	OC2	O5	O6	O7	O8
	O1	XD	OD1	O3	O4	OD2	O5	O6	O7	O8
O1	Sales results '93, agents (n=36)									
Oa1..d1	Inteview , agents (n=12)									
O3	Observation, agents (12)									
O4	Learning test, agents (n=36)									
Oa2..d2	Questionnaire, agents (n=36)									
O6	Discussion, agents (n=36)									
O7	Questionnaire, managers (n=8)									
O8	Sales results '94, agents (n=36)									
XA	TOOL&CBT (n= 12)									
XB	TOOL&CLASS (n= 8)									
XC	PAPER&TOOL (n= 5)									
XD	PAPER (n= 7)									

**The theoretical construct behind EPSS**

A lot has been written about EPSS, less has been proved. From literature a theoretical framework has been constructed. The framework encloses the variables who exert an influence on the EPSS. Work, learning, treatment and background have their effect. In table three we state our variables. Work, learning and background are general. The treatments TOOL, CBT CLASS and PAPER are specific.

**Table 3.** the framework with an influence on EPSS.

Constructs	Variables
<b>Work</b>	
quality	service, communication, adequate advise, sales talk
productivity	sales results
___attitude towards work	satisfaction, self-confidence
___performance	independency, commercial, daily work
<b>Learning</b>	
way of learning	processing, guidance, study conceptions
<b>Tool</b>	
communication.	interface, support
advising client	advise
obtaining information	time to learn, applicable, studiousness

<b>CBT</b>	
communication	interface
pedagogical/didactic dimensions	structure, experience validity, feedback cooperative learning
general	usability, integration with TOOL
<b>Class</b>	
training and support	training, support
pedagogical/didactic dimensions	structure, experience validity, feedback cooperative learning
effects	effects
<b>Paper</b>	
presentation	presentation, support
advise	advise, help
obtaining information	time to learn, applicable, sources
<b>Background</b>	
personal data	age, sex
experience	educational background, working and computer experience
attitude towards innovation	working with new technology

---

## Results

When an opinion is given about EPSS we combine TOOL and CBT. Traditional working and learning is PAPER and CLASS. To be able to use the data the independence of the groups had to be sure. First this independence had to be tested on age, working experience, educational background and innovation willingness. On age and working experience no significant difference was found (one-way analysis of variances for age,  $n=36$ ,  $p=.45$  one tailed and for working experience  $n=36$ ,  $p=.27$  one tailed). Also for educational background no significant difference was found. But on innovation willingness the score of the TOOL-group was significantly higher regarding the CLASS group (Mann-Whitney Test,  $n=9$ ,  $p=.016$  one tailed) and the PAPER group (Mann-Whitney Test,  $n=12$ ,  $p=.037$  one tailed). A reason for this result is hard to give. It is possible that people in the TOOL group are more affected to the project and more innovative for the reason that they are working with new technology. But the other groups working with new technology (TOOL&CBT, TOOL&CLASS) aren't more innovative than the traditional groups. The conclusion is that there is no difference between the groups except the one above. We take the view that the groups are selected at random.

We had to test the reliability of the items involved. The limit was .60 (Cronbachs Alpha). Because of the size of the groups we had some problems with the reliability of the items. The variables that were useful ( $\alpha > .60$ ) are shown in table four.

**Table 4** The variables used

Variable	Alpha
Work	-
Learning	-
Tool	
interface	.75
studiousness	.63
CBT	
interface	.75
feedback	.95
cooperative learning	.95
effects	.63
Class	
training	.87
support	.83
cooperative learning	.76
effects	.94
Paper	
presentation	.83
support	.86
advise	.70
help	.77
obtaining information	.73
Background	
attitude towards innovations	.73

***Hypothesis 1 related to support*** With these items we tested the following hypothesis: Agents working with the computer (TOOL, TOOL&CBT, TOOL&CLASS) like the presentation and the interface of the computer more than the agents working pen and paper based (PAPER, PAPER&CLASS). This is not the case. However agents do like the presentation of their traditional handbooks and form more (Man-Whitney Test,  $n=36$ ,  $p=.005$  one tailed). The mean rank (15.52 for the computer and 25.27 for the traditional way) shows the advantage for the traditional form. This was supported by results on the interviews. Agents like the traditional presentation more because it is quicker (glancing through a manual) to look things up. Reasons for this preference may have to do with the construction and userfriendliness of the EPSS or the agents are not accustomed to the EPSS yet (they were working with it for four months when the evaluation took place). The used hypothesis was that the computer (TOOL&CBT, TOOL) would support the agents better while they are working compared with the traditional way (PAPER,PAPER&CLASS). The result is that there is no significant difference. The computer didn't support the agent better or worse (Man-Whitney Test,  $n= 36$ ,  $p=.29$  one tailed). This result is against all expectations. It was expected that the computer would provide a better support than the traditional methods.

*Hypothesis 2 related to learning* When we looked at the learning part the following hypothesis was stated; agents learning with CBT (TOOL&CBT) like the presentation and the interface of the CBT more than the agents who followed a classroom training and who had to deal with a teacher presentation (TOOL&CLASS, PAPER&CLASS). On the test (Man-Whitney Test,  $n=24$ ,  $p=.012$  one tailed) the mean rank, 9.25 for CBT and 15.75 for the classroom instruction shows that the presentation of the teacher was appreciated more. In the interviews the most common reason to like traditional classroom training more was the contact with other colleagues. They see training as a social event. In their daily work they don't have contacts with colleagues. They like seeing each other at a training. Now they are afraid that CBT will take them away their social event. The next statement was that agents learning with CBT like to learn alone (TOOL&CBT), . Agents in classroom instruction like to learn together with other colleagues (TOOL&CLASS, PAPER&CLASS). The answer on this hypothesis is that this is right. Agents in the classroom instruction do like to learn in cooperation with others and agents learning with CBT do like learning alone (Man-Whitney Test,  $n=24$ ,  $p=.0007$  one tailed). The last hypothesis related to learning was agents learning with CBT (TOOL&CBT) think that they learn more effective than agents in classroom training (TOOL&CLASS, PAPER&CLASS). In fact agents in classroom training think that they learn most effective in this way. The hypothesis is not true. CBT is not appreciated as most effective (Man-Whitney Test,  $n=24$ ,  $p=.050$  one tailed).

Next we looked at the results on the learning test. The test was split up in a case and in questions to test their knowledge. In the practical situation the agents had to give an ideal advise to a fictionary client. With this case the quality of the solution is measured. With the questions their background knowledge was tested. Both are important in their daily work. When we look at the results of the cases and we compare the groups trained with CBT (TOOL&CBT), classroom training (TOOL&CLASS, PAPER&CLASS) and no training (TOOL&PAPER) we see that there is only a difference between training and no training. Classroom training compared with no training shows a significant difference (T-test,  $n=24$ ,  $p=.043$ , separate variance one tailed). CBT compared with no training also shows a significant difference (T-test,  $n=23$ ,  $p=.018$ , separate variance one tailed). In both cases training was more effective than no training. this is not surprising. The difference on the case between CBT and the classroom training was not significant (T-test,  $n=23$ ,  $p=.24$ , separate variance one tailed). Conclusion is that it doesn't matter whether agents were trained with CBT or in a traditional classroom. When we look at the questions to test their background knowledge there is no difference between the group with CBT and the group with classroom training (T-Test,  $n=23$ ,  $p=.149$ , separate variance one tailed). There is a significant difference between classroom training and no training ((T-Test,  $n=24$ ,  $p=.009$ , pooled variance one tailed). The score of people that were trained was higher. CBT compared with no training didn't show a significant result ((T-test,  $n=23$ ,  $p=.060$ , separate variance one tailed).. That is remarkable. The standard deviation causes this effect (CBT standard deviation = 27.67, no training 41.860). The overall conclusion is that there is no significant difference between CBT and the traditional training.

*Hypothesis related to work* The company is training people to make more money in future. The next part will compare the sales results between the three groups. We only looked at one part of their sales. This results are related to the sold annuities in 1993 and 1994. Several other influences (like a difference in the political situation in the Netherlands) were not measured. It is hard to relate these results to the treatment. Knowing that these results are not only caused by the treatment we carefully state the following: the productivity of the group learning with the computer will be significantly higher in 1994 (the year they started working with the computer). First a comparison between the sales in 1993 and 1994 took place. The significant difference between the two years were split up between the groups (CBT, classroom training and no training). A one-way analysis of the variance was not significant ( $n=36$ ,  $p=.230$ , one tailed). The conclusion is that there is no difference in sales between the groups. It doesn't matter whether agents are trained or not, it has no significant effect on the selling of annuities. Finally we test the hypothesis whether agents working with the computer sold more than agents working pen/paper based in 1994. The group working with new technology (TOOL&CBT,



TOOL&CLASS, TOOL) and the group working in a traditional way (PAPER&CLASS, PAPER) were compared on their selling results. The expectation is; agents working with new technology will sell more in 1994 than agents working in a traditional way. This hypothesis seems not to be true (T-Test,  $n=36$ ,  $p=.23$ , one-way). There is no significant difference between the two. Working with the computer will not result in a higher productivity on annuities. Did the agents sell anything more at all in 1994? Yes, they did, but not all of them. The CBT group didn't sell significantly more (paired T-Test,  $n=12$ ,  $p=.055$ ). The group trained in a classroom situation did have a higher productivity (paired T-Test,  $n=12$ ,  $p=.0014$ ). The group without training did also do significantly better (paired T-Test,  $n=36$ ,  $p=.015$ ). The way people work didn't have any special influence. The group working with new technology has higher results in 1994 (paired T-Test,  $n=25$ ,  $p=.003$ ). The group working in a traditional way scored significantly higher too (paired T-test,  $n=19$ ,  $p=.0052$ ). The overall conclusion training doesn't contribute anything to the productivity in this situation.

## Conclusions

We tried to evaluate the effects of EPSS on learning and productivity. The setting was a large insurance company in The Netherlands. This project was a pilot project. This pilot had a lot of limiting conditions. But that is not unusual in this type of research. Although we would have loved larger groups. We tried to measure EPSS in the field where the surplus value is expected. For that a framework was developed. In the framework are variables which have an impact on the effectiveness of the EPSS. The expectations in the first chapter were tested. In general the EPSS in this project is not so successful as in literature often is stated. This EPSS did have information, learning and advise. Although the researchers have some remarks on the development of the EPSS, it is not a badly constructed one. Maybe the integration of the CBT can be better (those small granules) but this lack of integration is not the reason that agents don't like the EPSS a lot when they have to learn with it. Of course there are reasons, like the social event reason, not related to the effects. But also on the effects the influence of EPSS is hardly measurable. Productivity doesn't increase. The learners results are almost the same as in the traditional situation. An advantage as just-in time learning is hard to see. Agents don't have the time to look up information. They postpone training. As a result the just-in time training becomes inadequate working. The employees didn't take the responsibility for learning. In future the direct managers has to take the responsibility for their learning. The advise and information part of the EPSS didn't do any better than the traditional manuals. The agents thought it is quicker to look up information in books. The overall conclusion is they like the old way better. What are the reasons for it. Is this the expected resistance? No, they told us some good things. They like the automation of certain tasks, like the fill up of forms and counting the benefits for their clients. As is stated by Carr (1992) they know have the time to do other things, like talking to their clients. And that is important. The agents also like it that they now have the possibility to show or present something to clients. This was harder in the traditional situation. Now they feel more professional and a client is trusting them more. Positive findings of EPSS haven been seen in the project. These advantages are on the whole related to controlling the costs. There is no direct improvement of productivity and learner benefits. Further research has to be done to improve EPSS and prove these findings in other settings.

## References

- Bramer, W. L., & Senbatta, G. (1993). The New Wave of Performance Support. *Cief Information Officer Journal*. . september/october.
- Carr, C. (1992). Performance Support Systems- The Next Step? *Performance & instruction*, februari '92, 23-26.

- Clark, R.C. (1992). PSS- Look Before you leap: Some Cautions About Applications of Electronic Performance Support Systems. *Performance & Instruction*, may/june, 22-25.
- Gery, G. J. (1989). Training vs. Performance Support: Inadequate Training is Now Insufficient. *Performance Improvement Quarterly*, no. 2, vol 3, 51-71.
- Gery, G. J. (1992). *Electronic Performance Support Systems*. Boston: Weingarten Publications.
- Goodrum, D.A., Dorsey, L.T., & Schwen T.M. (1993). Defining and Building an Enriched learning and Information Environment. *Educational Technology*. nov. 10-20
- Jacobs, R.L. & Mc Griffin T.D. (1987). A Human Performance System using a structured On-the-job Training Approach, *Performance & Instruction*, july '87, 8-11.
- Milheim, W.D., & Martin, B.L. (1991). Theoretical basis for the use of learner control. Three different perspectives. *Journal of Computer-based instruction*, 18, 3, 99-105.
- Münch, J. (1990). Lernen am Arbeitsplatz. Bedeutung innerhalb der Betrieblichen Weiterbildung (Learning at the job. Importance in corporate education). In: Schläffke, W. Weiss, R. (eds). *Tendenzen Betrieblichen Weiterbildung*. Köln: Deutscher Instituts-Verlag GmbH, 141-176.
- Raybould, B. (1990) Solving Human Performance Problems with Computers. A case Study: Building Electronic Performance Support Systems. *Performance & Instruction*, nov/dec, 4-14.
- Raybould, B. (1991) *An EPSS Case Study: Prime Computer*. Ariel PSS corporation, 1-11.
- Reeves, T.C. (1994). *Electronic Performance support Systems as Electronic Texts in Graduate Courses*. Paper presented at the AERA 1994. University of Georgia.
- Wexley, K.N., & Latham, G.P. (1991). *Developing and training human resources in organizations*, New York: HarperCollins publishers Inc.