FUSING SIMULATION AND PERFORMANCE SUPPORT–THE WINNING COMBINATION FOR IMPROVING EQUIPMENT READINESS?

Lt Cdr Dave Joyce RN
Synthetic Maintenance Training Research Officer
HMS COLLINGWOOD
Fareham, United Kingdom

ABSTRACT

The most impressive military capability is of little use if the equipment that provides it is unavailable when needed. Although modern military equipment is becoming increasingly reliable, this is causing real problems in the maintenance training community as technicians are typically unable to maintain their skills via hands-on experience of diagnosing and fixing faults. When faults eventually do occur, technicians are unable to perform well, leading to prolonged equipment down-time and hence reduced readiness.

This paper presents the results of a detailed study which was carried out in HMS COLLINGWOOD, the Royal Navy's School of Communications and Weapon Engineering. The study compares the effectiveness of traditional laboratory-based training, a maintenance simulation and a state-of-the-art Electronic Performance Support System (EPSS) at the micro level. The results indicate that, correctly employed, these approaches can dramatically shorten training time, increase the effectiveness of personnel at their place of work and provide a vehicle to make knowledge management a reality in the military context. The synergistic combination of simulation and EPSS therefore provides a very powerful toolkit to enable personnel to maintain equipment at a high state of readiness without the need for exhaustive training. The paper concludes by presenting a methodology for assessing the suitability of this approach to support the readiness of varying equipment types.

ABOUT THE AUTHOR

At the time of writing, Lieutenant Commander Dave Joyce was the Project Manager for the Electronic Performance Support Project run within HMS COLLINGWOOD. A Weapon Engineer by background, he has previously served in the Defence Evaluation and Research Agency and a variety of HM Ships. He holds an MSc in Defence Simulation and Modelling from the Royal Military College of Science and a BEng in Electronic Engineering. Following a recent appointment, he is now the E-learning Consultant within the Royal Naval School of Educational and Training Technology, responsible for developing the Royal Navy policy on e-learning.

FUSING SIMULATION AND PERFORMANCE SUPPORT–THE WINNING COMBINATION FOR IMPROVING EQUIPMENT READINESS?

Lt Cdr Dave Joyce RN
Synthetic Maintenance Training Research Officer
HMS COLLINGWOOD
Fareham, United Kingdom

INTRODUCTION

The training of Royal Navy maintainers has remained relatively unchanged for a significant period of time. Following career training, maintainers undertake a number of Pre-Joining Training (PJT) courses for the various equipments that they will be responsible for at sea, the majority of which involve practical work on examples of the equipment fitted in Training Establishments. Such courses last from one day up to 16 weeks, and the PJT 'package' for a typical maintainer can thus occupy some months. On completion of formal training, the maintainer's performance is expected to improve once at sea as a result of practical experience of the ship-fitted equipment.

The increasing reliability, complexity and changing repair philosophy of modern and projected future equipment is eroding this traditional training paradigm to the extent that it will become unsustainable in the medium term. Future equipments, platform manning policies and maintenance management methodologies will conspire to render the maintainer's training almost completely ineffective by denying him or her the opportunity to put their skills into practice on completion of training. 'Skill fade' will become endemic unless a new approach to this vital task, which directly affects equipment availability and hence Operational Capability, is adopted.

THE ELECTRONIC PERFORMANCE SUPPORT PROJECT

In order to investigate how this future scenario could be avoided, the Electronic Performance Support Project was instigated to investigate whether technology-based training techniques could be exploited. Initial research, including attendance at previous I/ITSEC events, indicated that two contrasting but potentially complementary approaches to the training and on-the-job support of maintainers could be adopted. Generically, these can be termed Equipment Emulation and Performance Support, embodied in an Electronic Performance Support Systems (EPSS). With funding provided from the UK Defence Logistics Organisation, representative examples of each approach solutions were procured and subjected to a rigorous objective assessment, where performance of maintainers who had undertaken standard training was compared with those using the novel approaches. To do this, it was necessary to select a candidate equipment which already had an existing training course. The Type 1007 navigation radar, widely fitted throughout the Royal Navy, was selected for this purpose. Radar 1007 was deemed suitable as it combined high student throughput (allowing baseline data to be gathered quickly), relatively limited scope (keeping cost down) and programme maturity (minimising the likelihood of the training changing mid-trial).

EQUIPMENT EMULATION

The use of simulation techniques for maintenance training addresses a requirement that is subtly different from other forms of technology-based training: simulation, of whatever type, allows a trainee to *practice* in order to gain proficiency by repetition. Traditional training needs analysis divides the desired objectives into three categories – knowledge, skills and attitude. In order for a student to be able to gain skills, they must be able to repeatedly attempt a task, and hence simulation (of whatever form – live, virtual or constructive) is implied.

Simulation as a training technique is most familiar in the shape of flight simulators. Such devices are typically very high fidelity, allowing prospective pilots to practice both cognitive (mental) and haptic (physical) skills in a virtual environment. Similar technology is now employed to train many other types of operators, including ship handlers (bridge simulators) and the varied roles performed in an armoured battle group. However, the use of simulation for maintenance training, in the UK at least, is much less prevalent.

In the United States and Canada maintenance trainers have been used for some time in the air engineering arena. Such trainers, such as those produced by ECC Corporation or Atlantis Aerospace, typically involve high fidelity mock-ups of the relevant part of the aircraft, with the key components relevant to the training task controlled by computer to mimic fault or set-up conditions. A very similar approach has recently been adopted at the British Army's training facility for the WAH-64 Apache attack helicopter. This consists of representative trainers for all the aircraft systems, coupled with a final trainer which integrates the majority of systems into one dummy airframe (McQuilter, 2000). Given their high physical fidelity, such trainers permit the practice of both haptic and cognitive skills, and thus permit the vast majority of the training objectives which would traditionally use a real aircraft as a training aid to be met. Although this kind of trainer is cost-effective compared with a real aircraft, it is still a relatively expensive training aid.

A much lower cost approach was described in McLachlan and Jacobson's 1999 I/ITSEC paper. This described how Lockheed Martin Canada had provided a series of Maintenance Procedure Trainers (MPT) for the Canadian Navy to provide maintenance training for the Halifax Class Patrol Frigate. The MPT is a PC-based system that allows trainee maintainers to interact with a 2D representation of the equipment in both normal and faulted conditions. Following the success of the programme, Lockheed Martin now markets the emulation under the name VISTA (Visual Interactive Training Application). Although similar capability was present in the UK in the shape of companies such as Vega or Virtual Presence, Lockheed Martin had the most experience of producing trainers for Naval equipment, and it was thus decided to procure a limited-scope VISTA application for the 1007 radar.

In common with the other VISTA/MPT applications, the 1007 VISTA application permits the trainee maintainer to interact with the radar down to a level appropriate to the repair policy. Therefore, while all test gear, readings and indications which the maintainer requires to fault-find to LRU level are represented correctly, the maintainer cannot take 'random' readings on circuit boards. While this may seem a significant limitation, it must be appreciated that the instruction in the current training course is also in accordance with the repair policy, and this is thus not a problem in the steady-state. Of note however, is that if the repair policy were to change to a more detailed level, it would be necessary to modify the emulation to support this. For the purposes of the evaluation, a total of 9 fault scenarios were provided for the 1007 radar, although more would be required to replace the existing training course in total.

The VISTA application is used as computer aided instruction by an experienced instructor in a suitably-equipped classroom. To enable the instructor to monitor the progress of the students, classroom management software is provided which allows the instructor to monitor every interaction between each student and the simulated radar. This in effect allows equipment training to migrate from 'serial production' (many students constrained by one piece of training equipment) to 'parallel production' (many students working on their own simulated equipment) without the instructor losing track of their progress.

In addition to the classroom role, the Canadian Navy is now starting to use the existing applications as continuation training packages. Each ship is now provided with a CD-based 'library' of all the relevant applications for its fit, allowing maintainers to stave off skill fade. An extension to this concept is discussed later in the paper.

ELECTRONIC PERFORMANCE SUPPORT SYSTEMS

In the early 1990s the idea of *Performance Support* – the provision of training and information during, rather than before task execution, began to be explored in the commercial world. This was not due to any change in the concept itself, which was embodied in the mediaeval apprenticeship: a one-to-one teaching relationship between the bonded apprentice and his master based around 'real' tasks. Rather, the renaissance of Performance Support was triggered by the combination of unprecedented rate of organisational change in the commercial world and the continuing increase in power of personal computer systems.

Early work by Raybould (1990) was followed by the seminal work by Gery (1991) *Electronic Performance Support Systems: How and Why to Remake the Workplace through the Strategic Application of Technology*. Such early visionaries foresaw that the concept of Performance Support, which had last been realised in the one-to-one environment of the bonded apprentice and his master, could be revived in the modern era through the power of modern computers. Such a computer, acting as a combination of information repository and expert mentor, would form an Electronic Performance Support System, or EPSS, and allow an employee to perform to the required standard without the need for prior training.

Adoption of Performance Support in the military has thus far been confined to some pilot work in the United States, mostly under the banner of the

Advanced Distributed Learning (ADL) initiative. Such work, much of which has been reported at I/ITSEC (Cichelli, 2000, Arnold & Brandt, 2000), has achieved very promising results both in terms of effectiveness and return on investment. In a joint memorandum dated 6 December 2000, the Under Secretaries of Defense for Acquisition, Technology & Logistics and Personnel & Readiness set up an initiative to "expand and accelerate the use of Job Performance Technologies throughout the Department."

A number of different definitions of EPSS exist. The author's own, which distils elements from these, is as follows:

"An EPSS is an electronic device which provides information, software tools and procedural knowledge, already available to an organisation, to an employee at their moment of need, in order to enhance their performance of the task in hand."

The key phrase in the majority of EPSS definitions is *at the moment of need*. The concept of Performance Support recognises that the key to successful performance is having access to resources, whether these are tools, information or knowledge, at the point in time where they are actually needed. Achieving this has three significant advantages: firstly, the task is completed in an optimum manner, secondly, no time or resources are wasted in providing such assets prior to the requirement for their use, and thirdly, the employee learns from this experience. This final point is key, and is the defence against the argument that widespread use of EPSS would lead to a de-skilled workforce in thrall to their computers: experimental evidence (Hibbard (1999), Kiser (2000)) reinforces the intuitive view that the vast majority of learning occurs while actually performing a task. It is this 'point of need' that the combination of information and a meaningful context provide the spark that leads to the assimilation of new knowledge and hence understanding. Thus EPSS provide a means to optimise the learning experiences available to the workforce, leading ultimately to more capable employees who have genuine understanding of what they are doing.

EPSS is a very different approach from traditional training, and is not applicable to every area. An excellent set of criteria is given by Banerji (1999), which, applied to a variety of military tasks, indicate that equipment maintenance is a highly suitable candidate for the concept, provided that a computer can be integrated into the way in which a technician carries out their work. In order to find such a candidate system for evaluation as part of the project, a number of the US pilot projects mentioned earlier were examined. The most suitable product for the purposes of the project was the Intelliworxx 'Maintenance Mentoring System'. This is a maintenance-based EPSS which had been developed from its roots in General Motors for use by the US Marine Corps under funding from ADL. Intelliworxx was therefore asked to produce an EPSS for Radar 1007 maintainers for evaluation as part of the project.

The EPSS can best be described as consisting of 3 parts: the hardware, comprising the mobile computer and its peripherals, the viewing software, which permits the EPSS content to be browsed, and the EPSS software content itself. Intelliworxx provided the hardware and viewing software; EER Systems produced the EPSS content as subcontractors to Intelliworxx. The overall aim of the system is to provide hands-free access to information while the maintainer is actually working on equipment. This objective impacts on the specification required for each of the components, which are described in detail in the following paragraphs.

The Intelliworxx Voicetablet, pictured below, is a ruggedised 'tablet' computer which is designed to be used in a hands-free manner at the place of work. In actual use, the computer comes in a carry case, which includes a shoulder strap and screen cover which can be folded to hold the screen at a comfortable viewing angle when in use.

Figure 1: The Voicetablet Computer

In essence, it consists of a fully-featured Pentium 3 PC, which, on its base-station, is complete with a keyboard and network connection. In its portable configuration, the primary interface is via the touch screen, although hands-free operation using speech input from a microphone headset is also possible. The operating system on the tablet is currently Windows 98 although NT is also supported.

The EPSS content is configured as a succession of HMTL and ASP web pages, and thus could be viewed using Microsoft Internet Explorer or Netscape Navigator. In order to permit use of the speech interface, and thus hands-free operation, the Voicetablet has Intelliworxx's own browser, known as Mentorworxx Explorer, installed. This is in fact a customised version of Internet Explorer 5, with modifications added under license from Microsoft, primarily to permit use of speech input, but also to enhance the graphical interface to make it easier to use with a touch screen as opposed to a mouse. Mentorworxx Explore picks up any hyperlinks on the loaded web page as 'sayable' commands; in addition, the standard Internet Explorer functions, such as "go back" may also be spoken. The final addition to the browser is the automatic facility to load full-screen graphics, such as circuit diagrams, in the Kodak Imager which is a standard part of the Windows operating system. This allows a voice-driven zoom and pan facility which allows large graphics, such as circuit diagrams, to be navigated relatively easily.

The Mentorworxx browser permits the user to feedback into the EPSS in two different ways. Firstly, the command 'make a note' will bring up a text box where the user can add their comments on a procedure step, either by using an on-screen keyboard or by dictating via the speech input. Such comments might be a suggestion for improvement or simply additional information which the maintainer found useful in carrying out the step. Once saved, the 'note' is then 'attached' to the relevant page and can be viewed the next time it is accessed. All saved notes can also be accessed independently. Each is referenced by time, date and the page to which they refer, allowing this facility to be used by the design authority to collate corrections or suggestions for improvement. Secondly, the browser can be used to fill in forms (such as a standard defect report form), which can be constructed using off-the-shelf web-page authoring tools. The voice input facility can be used to input both to drop-down options for fields in the form and to freely dictate into text boxes. The feedback system potentially allows data to be accurately recorded into the EPSS while the maintainer is actually at the equipment, minimising the likelihood of error.

The EPSS content is the most important part of the system, as it is this which the maintainer is using the hardware and viewing software to access while on the job. The 1007 EPSS content consists of a mixture of HTML and Active Server Pages (ASP) which are presented to the viewing software by Personal Web Server, an integral component of Windows 98. HTML is used for introductory menus, while the procedures, which form the bulk of the content, are ASP. The use of ASP allows the procedural content to be stored as an Access database. Pages are compiled 'on the fly' by Personal Web Server for viewing through the browser. It must be emphasised at this point that although the technology used in the EPSS is web-based, the content resides on the hard drive of the Voicetablet – there is no connectivity to a network as the system currently stands.

The EPSS content was compiled from 3 main sources: the technical Books of Reference, the instructional handout issued during the current training course for radar 1007, and the instructor's experience and knowledge of the system and how it is maintained in practice. Having developed a 'process model' of the way in which the maintainer accesses information, Intelliworxx and EER Systems were then able to re-arrange the BR and instruction handout data into a 'task-based' interface. The information is thus arranged to support the maintainer in carrying out a diagnostic procedure.

Once a subset of the 1007 system is selected, the EPSS then presents the procedure for diagnosing faults in that area. Each procedure is broken down into the smallest discreet steps which can be presented on one screen, and any supporting information which the maintainer requires in order to carry out the step is hyperlinked to it. Such information can include, but is not limited to:

- Location Diagrams
- Circuit Diagrams
- Circuit Animations
- Tool Use Animations
- Reference Documentation

It is equally possible to link in video clips where appropriate, which are again displayed seamlessly using the Windows Media Player within the viewing software. However, any of the 'just in time training' material, such as video clips or animations, must be short (around 30 seconds maximum) and directly related to the procedural step which the maintainer is carrying out – any longer and context may be lost. The strength of the EPSS is in presenting the supporting information in context – if the material is too long, the context will be lost.

Following initial delivery, a number of improvements were made to the content in house. In particular, more graphics were added, the majority of which were from the VISTA emulation. An important point raised during this procedure was that, had the procurement of both the VISTA application and the EPSS been as a single system, the VISTA graphics could have been used throughout the EPSS content. This would have reduced Intelliworxx/EER Systems costs by around 40%, a significant saving.

TRIALS DESIGN

In order to trial the two candidate approaches, detailed baseline performance data was gathered from students during the 2_ day fault-finding module of the normal training course for radar 1007. The most important measures of effectiveness were 'time to diagnose cause of fault', 'time to repair fault' and 'number of mistakes made', although other statistics were also gathered. Two primary hypothesis were postulated for the trial:

- The use of equipment emulation (VISTA) as a training media, supported by reference books, is more effective than use of real equipment supported by the same books.
- The use of the EPSS as a support tool, with minimal training, is more effective than the current course support by reference books.

To test these hypotheses, separate regimes were adopted for the two novel methods:

Equipment Emulation
Participants were given 1_ days of training using the emulation before their performance (supported by the normal reference books) was assessed on the 1007 equipment in the laboratory.

EPSS
Participants were given 90 minutes' safety and orientation briefing before their performance (supported by the EPSS) was assessed on the 1007 equipment on the laboratory.

In both cases identical metrics were taken as for the baseline course described above. In the test phase, each participant was presented with the radar in a faulted condition, and was expected to switch it on, diagnose the fault and rectify it in the most expedient manner. A total of nearly 100 such observations were taken with 36 participants involved. In the case of the VISTA and EPSS groups, the participants were not of a sub-specialisation that would normally be expected to maintain a radar – indeed, some were trained on radically different equipment, such as medium calibre guns or sonar sets.

As part of the trial, participants were also presented with 'attitude surveys' which were designed to ascertain their perception of the novel medium they were using. A significant qualitative evaluation of the two approaches was also undertaken during the course of the project.

TRIALS RESULTS

Following the completion of the trials programme, the collated results of both the performance assessment and attitude questionnaire were passed to the Defence Evaluation and Research Agency's Centre for Human Sciences for independent analysis (Munnoch, 2001). The numerical results of the initial analysis are shown in Table 1 below:

Training Method	Time to Diagnose Fault	Time to Repair Fault	No. Mistakes Made	No of Steps Omitted	No. Excess Parts Used
Course with books					
Mean	48.72	4.81	1.473	0.17	0.003
N	12	12	12	12	12
Std. Dev	27.15	3.11	1.235	0.58	0.01
EPSS					
Mean	33.62	4.15	0.92	0.46	0.21
N	17	17	17	17	17
Std. Dev	13.24	2.89	0.68	0.77	0.47
VISTA with books					
Mean	25.56	3.36	0.82	0.85	0.12
N	11	11	11	10	11
Std. Dev	4.3	1.34	0.85	1.21	0.34

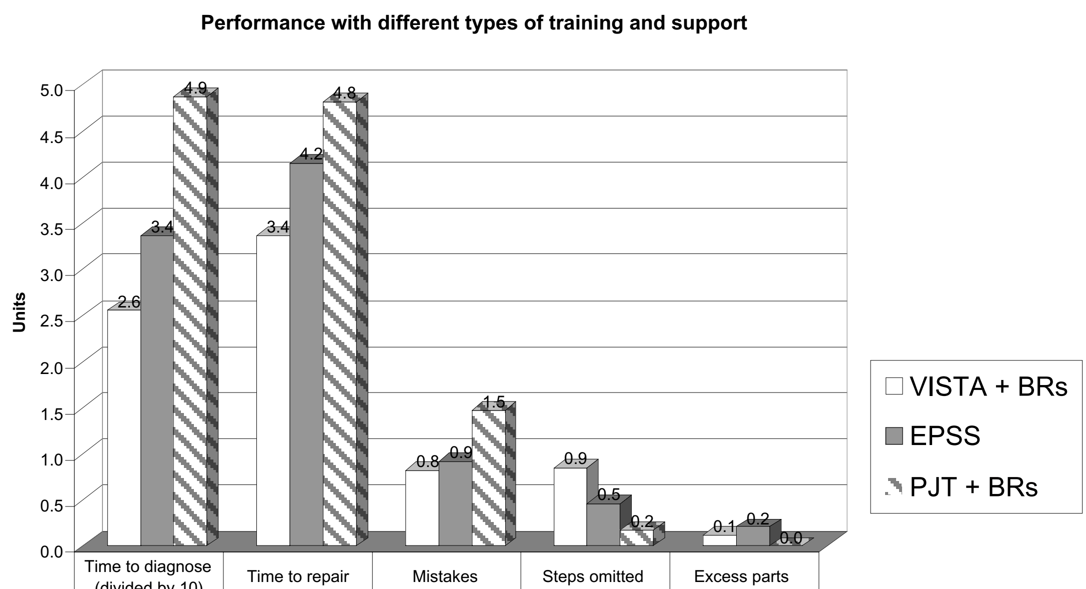
Table 1: Measures of Central Tendency for the 3 Training Methods

It can be seen from these results that the time taken to diagnose faults and repair them decreases steadily from the group on the standard course to the EPSS group to the VISTA group. This could suggest that the groups who are faster are simply trying to do the job as quickly as possible rather than being careful to get it right. However, this is not the case, as the number of mistakes made also increases as more time is taken. In other words, the EPSS group, and the VISTA group, are faster than the control group whilst also making fewer mistakes. They also miss out fewer steps.

These initial results suggest that even though they had received only 1.5 hours training, the EPSS group were already performing better than the traditionally trained and aided group. The group trained using VISTA performed even better even when supported with traditional tools. This suggests that a group trained using VISTA *and* supported with EPSS would achieve a very good level of performance. The only result which does not show an increase in performance from the standard course to EPSS to VISTA is the use of excess parts, where the EPSS group use slightly more, and number of steps omitted, where people trained using VISTA miss out more than those using EPSS. However, the number of excess parts used by any group was small, with the greatest number used in any test being three due to an error unrelated to the training method.

In addition to the mean differences it can be seen that the variability in time taken to diagnose and repair faults, measured by the standard deviation, increases from VISTA to EPSS to the standard course. This may reflect the fact that for people trained using the traditional methods and supported by reference books, performance is more dependent on the skills and experience of the individual, whereas the EPSS and VISTA systems level the playing field.

The results can be seen more clearly in graphical format (note that time taken to diagnose faults is represented in units of 10 to allow the results to be seen more clearly).



	Time to diagnose (divided by 10)	Time to repair	Mistakes	Steps omitted	Excess parts
VISTA + BRs	2.6	3.4	0.8	0.9	0.1
EPSS	3.4	4.2	0.9	0.5	0.2
PJT + BRs	4.9	4.8	1.5	0.2	0.0

Performance measure

Figure 2: Performance Measures for Different Experimental Groups

A statistical analysis was then carried out to test the two experimental hypotheses. As these are independent, two separate t-tests were used to test them, with the following results:

Equipment Emulation

All performance measures displayed inequality of variance as detected using Levine's test. After correcting for this, the statistics revealed that there was a highly significant difference between the VISTA group and the control group when comparing time taken to diagnose fault (t = -2.9, d.f. = 11.6, p = 0.01). None of the other performance measures were significantly different, probably due to the small sample size, and floor effects for mistakes, steps omitted, and excess parts (most people scored 0 whichever group they were in). The non-significant results are encouraging in themselves, as they demonstrate that training time can be reduced using VISTA without causing a decrease in performance. The evidence that performance in diagnosis improves despite decreased training time is an additional bonus.

EPSS

There were no significant differences between the groups on any performance variables, although after correcting for inequality of variance the difference in time taken to diagnose faults verged on significance ($t = -1.993$, d.f. = 14.7, $p = 0.096$) with the group using EPSS being faster than the control group. Although the results do not support the hypothesis that performance is better using an EPSS compared to using reference books on the standard training course, the results do suggest that using the EPSS can effectively replace the training course with no performance decrement. In addition, further increases in performance might be expected with increased familiarity with EPSS, and further development of the EPSS system design.

Data gathered from the training attitude survey was again largely positive. Although most participants were sceptical about the effectiveness of the new methods prior to trying them, post-assessment a large majority felt that the method they used was helpful (89%). A smaller majority felt that they would be able to apply what they learnt (66%) and the method used (67%) in an operational context. The majority also felt that they could see themselves performing more effectively after attending the program (66%). These encouraging results suggest that participants found the course and the method used to be effective. In particular the overall ratings were very positive.

EXTENSIONS TO THE CONCEPT – THE WINNING COMBINATION

The trial results show that either the use of equipment emulation or an EPSS can improve technicians' performance while shortening the formal training required. The performance of the VISTA group was best overall, but it must be remembered that this training is subject to 'skill fade' in the same way as traditional training. However, what would happen if the two approaches were combined?

The combination of equipment emulation and EPSS would enable the maintenance requirements of a warship to be met by a small number of skilled technicians who would be able to work effectively on a wide range of equipments. Prior to joining, they would receive short acquaints (much shorter than the current courses) on the equipments for which they were to be responsible, using an emulation such as VISTA as the vehicle. The acquaints would allow initial orientation and would introduce the maintainer to the EPSS application associated with the equipment.

Once at sea, each maintainer would use the EPSS hardware, which would also contain the emulation software, as a single point of access into a rich shared data environment. Connectivity to shore information repositories would be achieved as operational constraints allowed in order to maintain the currency of the information held locally and to permit feedback. A concept of how this tool could be used in an operational context is shown in figure 3 below.

Essentially, there are only two reasons why a maintainer should wish to work on a piece of equipment: either because the planned maintenance system indicates that some work is necessary, or because the equipment is exhibiting a fault. In the case of planned maintenance, the timing of the task will be indicated by the scheduling tool, which will be of increasing importance as fewer maintainers take responsibility for a wider range of equipments, and the procedure for the task can be provided by the EPSS.

In the case of a fault, empirical evidence suggests that approximately 75-85% of faults can be diagnosed correctly provided the existing diagnostic procedure is followed correctly. It is this area that the Intelliworxx EPSS addresses by making these procedures as usable as possible. The result of the diagnostic procedure will be a corrective procedure, which, if necessary, can also be embodied in the EPSS. For the remaining small proportion of faults a diagnostic procedure will not exist. In this case, an expert system within the EPSS may allow the maintainer to correctly diagnose the problem. For diagnosis, the most appropriate type is likely to be a case-based reasoning system, which allows intelligent query of the 'case history' not only of the maintainer's own equipment, but the entire population of equipments throughout the Fleet. A successful example of such a system is the 'Spotlight' software used for fault diagnosis on the entire population of Canadair Regional Jets (Hastings and D'Eon, 2001). If this approach fails, or is not present in the EPSS the maintainer will have to use whatever communication system is available to seek human assistance. Provided that a robust feedback loop exists, however, the proportion of 'unknown' faults for which no diagnostic procedure exists can be rapidly whittled down – as each 'new' fault appears, a diagnostic procedure to combat it can be authored and disseminated to all other EPSS users. The longer the system is established, therefore, the less often will maintainers have to resort to communication to the shore support authorities in order to rectify the fault.

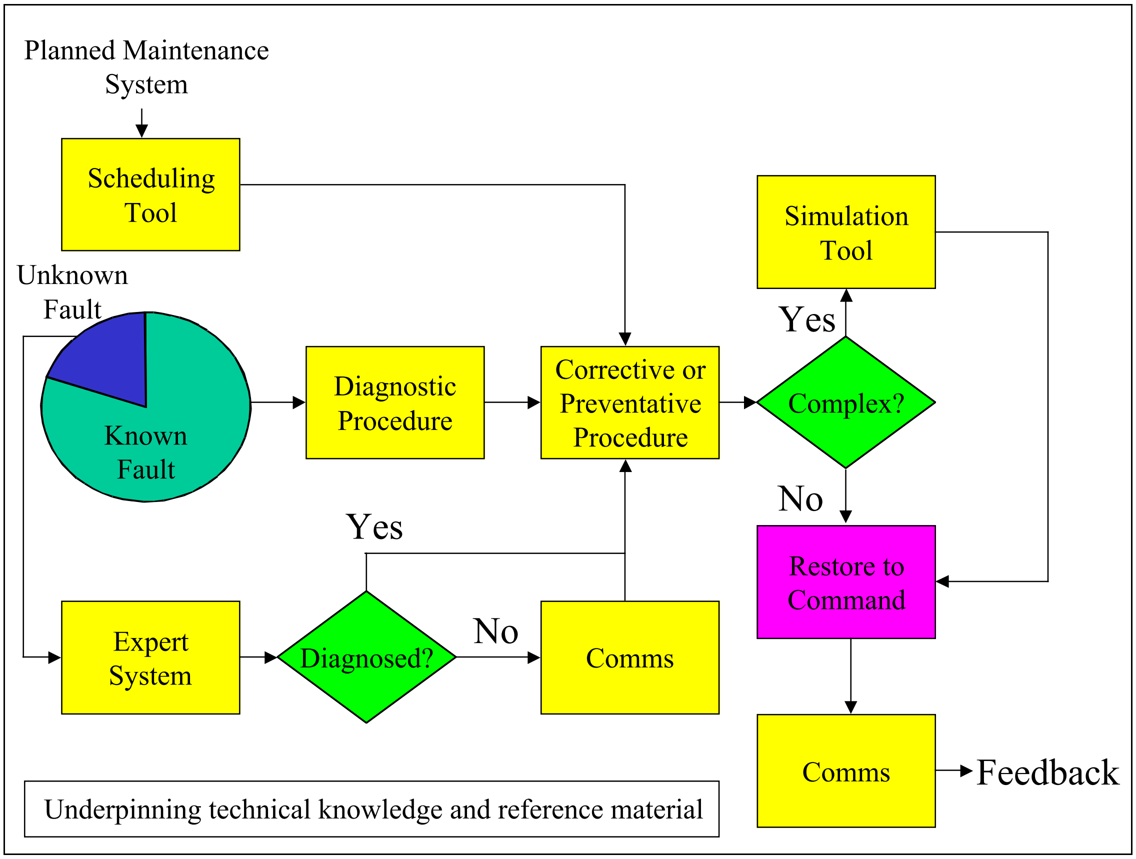


Figure 3: Use of the Generic EPSS in the Maintenance Context

Including a simulation tool, such as VISTA, within the EPSS will have a number of benefits. Firstly, it will permit the application to be used in a pure continuation training role in a similar manner to the way in which VISTA is used on board in the Canadian Navy. However, in the context of the requirement to carry out a genuine procedure on the equipment, the simulation may be used for 'maintenance mission rehearsal'. This will be particularly applicable where the maintainer is unfamiliar with the procedure, having not carried out for many months if at all. While use of the simulation could be viewed as increasing the interval before an equipment is restored to the Command, it may be that time invested in practice may actually reduce the overall time taken. In the scenario where equipment is operating in a reversionary mode, use of the simulation would allow the maintainer to *accurately* estimate how long the equipment must be taken down completely in order to restore full functionality. Currently, maintainers tend to provided a conservative estimate based on their experience – in the future this is likely to diminish as equipment becomes more reliable.

The importance of the feedback loop to maintaining the effectiveness of the EPSS cannot be over-emphasised. If correctly implemented, it will enable the EPSS to act as a vehicle for genuine knowledge management, ensuring that the latest fault modes and the procedures to deal with them are rapidly disseminated throughout the Fleet (Zolper, 1999). As maintainers see the results of their feedback, they will realise the worth of providing it, allowing the system to promulgate best practice throughout the population of equipments. However, if the feedback loop is either non-existent or too slow, the EPSS content will become rapidly out-of-date, leading to mistrust and apathy from its users.

Based on the experience of procuring the equipment for the assessment phase of the project, it should be noted that the costs of the individual components of the scheme described above reduce if procured together. Thus a synergy exists not only in effectiveness but also in terms of procurement and funding.

CONCLUSION

The current way in which maintainers are trained is not sustainable in the medium term. Modern and near-future equipments will not provide technicians with the practical experience which was an underlying assumption to the existing maintenance training paradigm. The Electronic Performance Support Project has objectively analysed two approaches to supporting maintainer's performance in the future, and determined that both provide a more effective and efficient solution when used individually. Used in concert, the future maintainer's performance, which will be key to improving equipment readiness, will be assisted by a winning combination.

REFERENCES

Arnold, R and Brandt, J. (2000). Mentoring the Development of Low-Cost, Web-Deliverable EPSS. *Proceedings of I/ITSEC 2000*. Orlando, Florida, Nov 27-30 2000.

Banerji, A. (1999). Performance Support in Perspective. *Performance Improvement*. August. Pages 6-9.

Cichelli, J. (2000). Supporting Shipboard Network Operations through EPSS. *Proceedings of I/ITSEC 2000*. Orlando, Florida, Nov 27-30 2000.

Gery, G. (1991). *Electronic Performance Support Systems: How and Why to Remake the Workplace Through the Strategic Application of Technology.* Gery Performance Press 1991. ISBN: 0-9649223-0-0.

Hastings, R and D'Eon, P, (2001). Cloning your best Aircraft Technicians. *Military Training and Simulation*. Issue 2 2001. Pages 18-21.

Hibbard, J. (1998). The Learning Revolution. *Information Week*. March. Pages 44-60.

Kiser, K. (2000). Wearable Training. *Inside Technology Training*. April.

McLachan J, and Jacobson S. (1999). Computer Based Maintenance Training in the Canadian Navy. *Proceedings of I/ITSEC 1999.* Orlando, Florida, Nov 29- Dec 2 1999.

McQuilter, S. (2000). Preparing for the Apache. *Equipment, Training & Support News*. Summer 2000. Pages 53-55.

Munnoch, K et al. (2001). *An Evaluation of the EPSS and VISTA Naval Maintenance Support Tools*. DERA/CHS/MID/WP010294 dated May 01.

Raybould, B. (1990). Solving Human Performance Problems with Computers. A Case Study: Building an Electronic Performance Support System. *Performance and Instruction*. Washington DC. National Society for Performance and Instruction.

Zolper, A. (1999). First Cousins Once Removed: Knowledge Management and Performance Support. *EPSS InfoSite* (www.epssinfosite.com).