

Training Issues in Current UK In-Service Military Equipment

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Summary

This paper presents the findings of a survey carried out during 2001/2002 to identify Human Factors issues and concerns associated with in-service equipment. Training was one of the topics under investigation and 15 of the projects interviewed out of a total of 24 projects highlighted specific training related concerns. The types of issues found were categorised as follows:

- Degree of trainer fidelity
- Maintainer training aids
- Trainer utility/utilisation
- Documentation support
- Training gaps/conflicts
- Scenario definitions

The paper will discuss the specific issues to determine which ones present future challenges in terms of training needs

Introduction

A 2-year study was carried out between 2000 and 2002 on behalf of QinetiQ CHS for UK MOD to investigate the status of HFI application in UK defence equipment procurement Management within the Defence Procurement Agency (DPA) and Defence Logistic Organisation (DLO) Integrated Project Teams. The overall aim of the study was to facilitate the allocation of HFI research budgets within the UK MOD Corporate Research Programme

The first year of the study investigated specifically the methods, techniques and organisational aspects associated with the planning of HFI within the IPTs. The 2nd year addressed HF issues associated with In-Service Equipment and it is the findings related to training matters of the 2nd year of the latter that are presented in this paper

The structure of the paper is as follows:

- Our approach
- Project Selection
- Taxonomy of HF Issues
- Overall findings
- Training Issues

The projects interviewed will not be named for military and commercial confidentiality reasons.

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Approach Summary

In order to scope the project within the available budget, careful selection of projects had to be made to provide a representative sample of the platforms and equipment in service. This was carried out using a 4-dimensional criteria space covering project capability, size, time in service and level of procurement control.

A semi-structured interview technique was determined to be appropriate for the assessment and a generic checklist was developed covering the full range of Human Factors topics. Each IPT received an outline of the topics that were going to be addressed during the interviews to ensure that the appropriate team members were available and fully briefed. The interviews were conducted with the aid of a recorder and the summary reports were sent to each IPT prior to the analysis being carried out. Further validation visits at service bases were carried out for about a third of the projects.

Project Selection

The down selection of the projects was based upon 4 criteria that were deemed to be significant following the first year of the study:

- Capability Area:
 - Strategic Deployment
 - Manoeuvre
 - Strike
 - Information Superiority
- Project Size:
 - Large – A, B (>£100M)
 - Small – C, D (<£100M)
- Length of Time in Service:
 - Mature – Post Mid life upgrade stage/long time in Service
 - Immature – Relatively short length of time in Service/Pre upgrade
- Level of Procurement Control
 - High – UK bespoke systems/high degree of specification control
 - Low Control – COTS, MOTS, upgrade of existing systems, international collaborative projects

It was recognised that the selection of 24 projects meant that there could not be a balanced sample of every criteria combination but it was agreed that there should be at least a split between high and low control and across all capability areas. The project selection within these categories is shown in table 1 below:

	Strategic Deployment (7)	Manoeuvre (6)	Strike (6)	Information Superiority (5)
Size 15 Large 9 Small	4 Large 3 Small	4 Large 2 Small	3 Large 3 Small	4 Large 1 Small
Maturity 10 Mature 14 Immature	5 Mature 2 Immature	2 Mature 4 Immature	2 Mature 4 Immature	1 Mature 4 Immature
Control 17 High 7 Low	5 High 2 Low	4 High 2 Low	5 High 1 Low	3 High 2 Low

Table 1 Summary of Numbers of Projects by Category

Taxonomy of Generic HF Issues

A checklist of HF issues was derived from a set of technical topics that had been successfully used on maritime projects (Sea System Publication SS10) and formed a good basis for discussion with the IPTs. The topics were:

- **Operational** – issues associated with operational procedures, role or scenario changes, task allocation etc
- **Organisation (Manpower)** – issues associated with manning (operation and support) and communication issues within and between teams etc
- **Personnel** – issues associated with user characteristics, skills, gender etc
- **Training** – issues associated with the effectiveness of training
- **Operability** – issues associated with the Human-Machine Interface affecting overall mission effectiveness
- **Layout** – issues associated with the physical layout of the working environment
- **Environment** – habitability issues (noise, heating, ventilation, lighting etc) that may affect overall human performance
- **Maintenance** – issues associated with equipment maintainability and availability
- **System Safety** – concerns about accidental damage to the user
- **Health Hazard** – concerns about human exposure to hazardous or unhealthy environments

In addition interviewees were invited to outline any additional topics/issues specific to the project/equipment that were not covered adequately by the topics/issues listed. The number and type of concerns raised reflected the knowledge and background of the interviewees and did not necessarily cover all of the topic areas. As most of the interviews were conducted within the Defence Logistics Organisation, where maintaining and sustaining capability is their primary focus, the concerns tended to be more support relate

Overall Findings

The issues were abstracted from the interviews and categorised within the 10 topic areas. Each topic area was further sub-categorised into root problem areas.

There were in total about 400 different concerns raised and the overall findings are shown here:

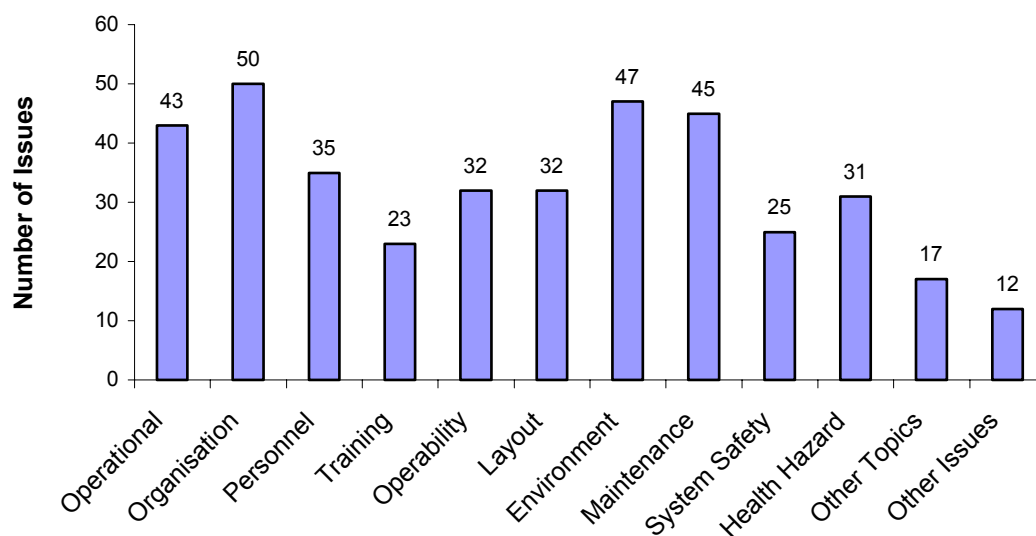


Figure 1 Number of Concerns within Topic areas

Each topic area was analysed against the highest number of reports of specific issues within each sub-category and table 2 below shows the top 3 issues within each of the topic areas:

Technical areas	Highest Issue and No of occurrences	2nd Highest Issue and No of Occurrences	3rd Highest Issue and No of occurrences	% of top 3 Issues Addressed
Operational	Role Change 11	Environment Change 5	Tactical Capability 5	62%
Organisation/Manpower	Comms Capability 14	Comms Quality 7	Human Performance 7	68%
Personnel	Personnel Availability 16	Skill Level 8	Physical Constraints 5	66%
Training	Trainer Representation 6	Maintainer Training Aids 5	Trainer Utility/Utilisation 5	25%
Operability	Control Operation 8	Display Viewability 6	Tactical Capability 5	58%
Layout	Workspace 9	Kit/clothing 5	Operability Compromised 4	22%
Environment	Temperature 14	Noise 10	Ventilation 5	28%
Maintenance	Maintainance Access 11	Availability of Spares 8	Workload 7	27%
System Safety	Unsafe Loads 6	Physical Accident Risk 4	Atmospheric Risks 4	86%
Health Hazard	High Risk Conditions 8	Toxic Substances 6	Sensory Degradation 5	68%
Additional Topics	Survivability 6	Vulnerability 3	Anthropometric Data Shortage 1	40%
Additional Issues	Operational Effectiveness 4	Can Do Attitude 3	Configuration Control 1	38%

Table 2 Summary of most frequent issues within each technical topic

The final column shows the percentage of concerns that were likely to be addressed during the life of the specific programmes. It can be seen from the table that the training concerns were one of the areas least likely to be addressed.

15 out of 24 of the projects highlighted specific concerns associated with training and the main areas of concerns were as follows:

- Trainer representation
- Maintainer training Aids
- Trainer Utility/utilisation
- Documentation support
- Training gaps and conflicts in training
- Scenario evolution

Together training facilities excluding documentation support amounted to over two thirds of the training issues raised. The diagram below shows the percentage of issues raised within each sub-category

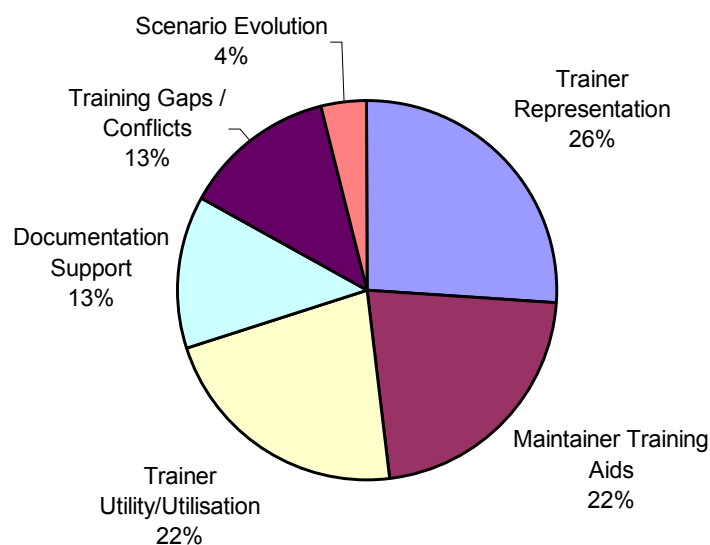


Figure 2 Relevant Training Issues

Trainer Representation

This area of concern was identified by 6 of the projects interviewed. Many of the training facilities appeared to be lacking in their operational representation and this increases the need for on-job training. The equipment was not flexible enough to give realistic training. Thus in some cases operational readiness only comes from expensive training exercises at sea or where the fidelity is lacking, live firings on ranges. There were particular issues associated with older programmes where enhanced capabilities were being provided to the platforms but not to the trainers in the same timescales. The view from the projects interviewed was ‘Front Line First’ ie get the capability to the front line and let the training catch up. In some cases but not all, the lack of fidelity did have operational repercussions. The lack of visual or motion cues on the simulators also reduced the effectiveness of the training.

Maintainer Training Aids

5 of the projects interviewed cited poor training aids for the support staff. In some cases there were no trainers for the maintainers leaving all the skills to be acquired via on-job training. Generally the equipment care training was ineffective and one IPT provided photographic evidence of complete lack of equipment care – e.g. optics cleaned with a wire brush. Another outcome of poor maintainer training was the tendency

to change LRUs without proper fault diagnosis. This was largely attributed to a complex system where the technicians lacked adequate knowledge and skills to make the correct diagnosis.

Trainer Utility/utilisation

There were significant issues associated with trainer utility with 5 IPTs highlighting issues associated with the effectiveness of their training aids. In addition the use of the simulators to gain a much deeper understanding of the capabilities of the system potentially provided a valuable tactics development tool but poor utilisation meant that they were not making the best use of a highly complex and capable system. There were no airborne multiple crew simulators for the projects interviewed that enabled multi-crew platforms to train and rehearse effectively. However the naval platforms did have good training facilities, which were used very effectively. In addition the operational load and staff shortages made dedicated training time limited but generally on-job training was found to be effective.

Documentation support

3 of the projects interviewed highlighted problems associated with documentation support. The type of problems encountered varied between the obsolescence of the documentation media and total absence of any training material. In one particular case the media was a micro-fiche reader of which insufficient were available. Thus there was a high dependability on paper versions that were not always up to date. This had a particular impact upon maintenance training. In another case there was a complete lack of training material for the training support staff. Therefore they had to spend time with the manufacturers familiarising with the kit.

Training gaps and conflicts in training

The issues associated with training gaps and training conflicts were all associated with vehicle systems where drivers were both operators and maintainers. The training for drivers and maintainers was carried out at different establishments and this occasionally gave rise to conflicts and overlaps between the respective manuals that lay down crew maintenance and maintainer tasks. Doctrine and training occasionally had to be updated after incorrect use of procedures. Refresher training was highlighted as a problem by one IPT as each regiment has only one suite of gunnery simulators to serve 4 squadron of 14 crews. The amount of dismantled 'other duties' often led to long gaps without refresher training which could lead to 'skill fade'.

Scenario evolution

In one particular example the scenarios on the simulator were difficult to change and the technicians lacked the skill or training to make the necessary changes thus once the scenarios become predictable the training becomes ineffective. This directly impacted upon simulator utilisation as discussed above

Impact of Type of Project

As discussed previously the projects were selected against 4 criteria to determine whether the capability area, size of project, maturity of project and level of control influenced the numbers or types of concerns. The results are shown in the diagram below. The percentage bars show each category normalised as a percentage of the total number interviewed within that category in order to take account of distribution differences.

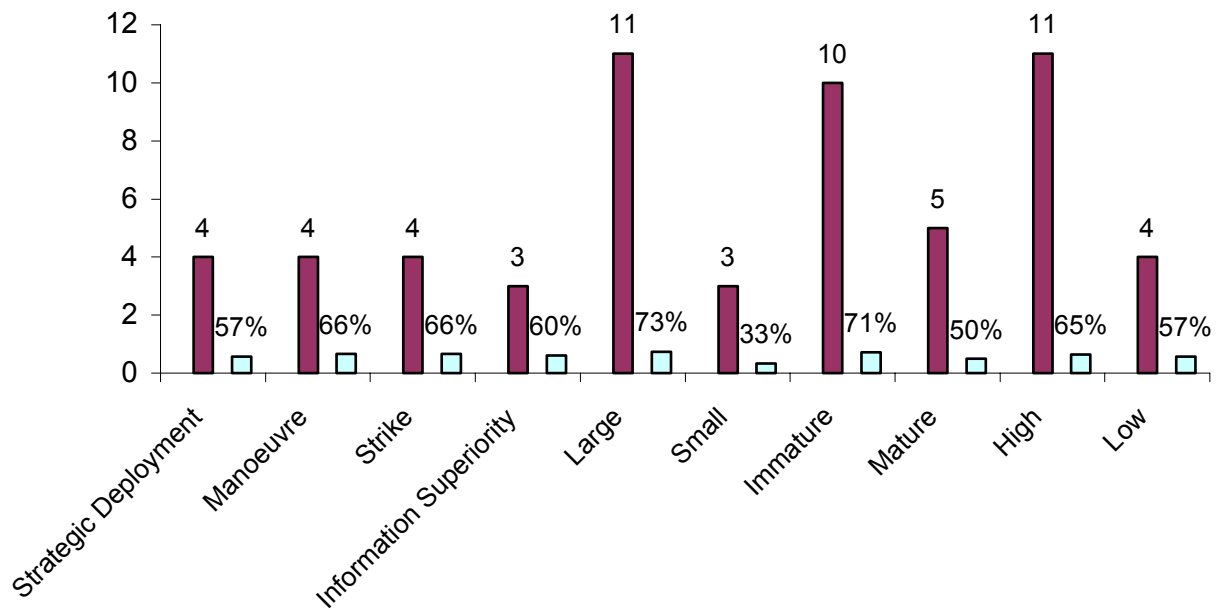


Figure 3 Summary of Issues against the project characteristics

This figure shows no significant differences in the number of training concerns across the 4 procurement areas but it does show that the majority of issues were those associated with large programmes within a pre-upgrade phase. The type of problem exhibited for immature programmes are mainly fidelity related. In addition the bespoke type systems (high control) yielded more problems than the COTS type systems (low control).

Conclusions

- Cost factors are driving the need for increased use of virtual training solutions. However the findings from the survey revealed that there is still a reliance on field-based training due to fidelity issues. These fidelity issues were affecting the utilisation of the simulators to the detriment of maximising the effectiveness of the systems.
- Achieving the right balance between simulator and field-based training continues to cause concern. Whilst the technology to create powerful graphic representations to give good visual feedback is available now and the processing capability enables this to be carried out in real time, it is likely that there will always be aspects of the task that cannot be trained in a simulator.
- Front Line First philosophy means that the upgrade to training devices may not provide the lead training time required. This could impact the operational effectiveness of the delivered capability.
- The advancement of highly complex IT systems is impacting upon selection and training of new skill areas. This may require novel approaches to training to acquire the level of knowledge and understanding of these complex systems.
- Lack of maintenance training aids is leading to ineffective and inefficient support to the front line. The focus on equipment care needs to be given more prominence.

- Maintenance of highly complex IT system trainers currently requires specialist technicians to ensure the systems can be fully exercised within the full range of threat scenarios. There are retention problems for these skill areas as there are lucrative contracts available within industry.

Recommendations

- The fidelity of the training device must not be compromised as this could result in negative training problems and impact upon operational effectiveness
- There needs to be greater consideration of embedded , on-job training facilities to compensate for shortage of personnel and off-job training time.
- Rapid augmentation of new capabilities into the training aids needs to be considered in the design of the simulators to ensure that they maintain the required lead training time.
- There needs to be much more emphasis on maintenance training and equipment care as this clearly impacts upon operational readiness of the equipment and platforms.
- The training of highly complex, multi modal systems needs further research to enable the level of mode awareness to be acquired although quite clearly the source of this problem is a design issue.
- Maintenance of simulators needs to be simplified to ensure ease of scenario update to enable full utilisation of the systems across a full range of scenarios.