Weighing The Pros & Cons Of Simulator Training, Computer-Based Training & Computer Testing & Assessment

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Introduction

This paper examines the use of simulators and other programs which are totally self contained requiring only a standard desktop or notebook computer for operation. These fall within Category III (Part task) and Category IV (single task) from the draft proposals for the use of simulators for training and assessment[1].

There are simulators of this type which are the vehicles of instruction, but don't themselves actually instruct.

This paper shows how CBT and simulation can be combined to provide the dual role of:

1. providing a learning system which delivers effective training on its own without requiring the customer to create exercises nor to supervise the learning process.
2. providing a tool for instructors to control, brief or debrief and assess the student's performance.

I am excluding simulators which are designed specifically for use in a formal training environment such as a Maritime College (Full Mission Simulators, ARPA Simulators, GMDSS Simulators) which are dependent on supporting hardware. Such simulators are provided on the basis that instructors control and monitor exercises. Transferring the same style to CBT & PC-based simulators can leave the student without focus, allowing him to "play" if he is unsupervised. It also imposes a large "hidden cost" on the customer who has to create and then supervise exercises.

Throughout the presentation I will use Officer of the Watch™ to provide examples of the points I am making.

What Is Available And What Can It Do?

CBT and Simulators are costly to develop. The industry is going through a substantial re-appraisal of training standards. Consequently, the programs currently available tend to cover universal topics where the benefits of simulation are well understood.

Simulators	*Tutorials & testers*	*Operational systems*
Bridge simulators	Collision regulations	Weather information systems (sat, fax etc)
Radar	Lights & shapes	Electronic chart systems
Engine	Buoyage systems	Loading & stability

I have included examples of operational programs which can perform a useful function within a training programme.

Key Requirements of CBT & Simulators

A key role for a PC-based training system is for use remotely - whether literally (on a ship or in another country) or just in a classroom where learning takes place without the active presence of an instructor. In other words, for distance learning. A PC is, after all, an individual workstation and this is the main difference between it and more costly hardware platforms. So the software to run on a PC should also be self-sufficient.

We remember	**10% of what we read**
	20% of what we hear
	30% of what we see
	50% of what we hear and see
	75% of what we say
	90% of what we say and do

For a program to be effective in this way there are some key requirements which it should satisfy.

reinforcement and feedback

Firstly I would like to briefly summarise why CBT is effective.

Well, this slide indicates that the best I can hope is that you will remember up to 50% of this presentation.

In fact most people learn best through a mix of learning methods: reading, lectures and tutorials, videos, computer programs and practice all combine to build comprehension and confidence. Simulation and CBT does not exclude or replace the need for these other components of learning. And, of course, actual performance of the job is a key part of the process.

I see CBT as being most effective for the following:

1. To replace the traditional "chalk and talk" lecture - once described as "the transfer of information from the notebook of the lecturer to the notebooks of the students without going through the minds of either". Many of the *facts* which have to be learned can be delivered informatively and interestingly by CBT. The retention of the material can be tested by the same programs. This releases instructor time for tasks at which he is more effective: debriefing, reviewing, discussing and directing.
2. To provide an environment for practise, at the student's own pace and in his own time.
3. To provide an environment for assessment, including self-assessment.

Learning theory has long established that students learn more effectively if they are actively involved in the learning process **(interaction)**, are given **feedback** on their progress and have the opportunity to repeat and practice (**reinforcement)**.

Control over the student

The natural function of a simulator is to model a complete environment. This can give the student the means to avoid the situations designed to test him.

But if the simulator forces the student to confront the situation designed to test him, he will be motivated to perform well and his attention will be focused on a satisfactory outcome to the exercise. A PC-based simulator should provide this control.

Focusing on a single learning objective

Say, for example, the training objective is to teach or test a single element of watchkeeping procedure. In this case the provision of the full capabilities of a simulator is distracting. It is desirable to limit the student's access to only those elements of the simulator which are relevant.

In Officer of the Watch™, the instructor can deny access to parts of the simulation (such as the visual view, the radar, the playback, the expert system the telegraph and the autopilot) which are not relevant to the learning objective of the exercise. For example, if the purpose of a lesson is to develop radar plotting skills, then access can be denied to the visual view.

This provides a system on which material with measurable training outcomes can be delivered and later assessed and discussed at debriefings.

Structured training material

As well as providing the simulator where the training material is delivered to the student, PC Maritime also offer a range of courses to run on the simulator. These cover elements of IMO model courses, ranging from the identification of lights and shapes to simulation case studies to build understanding of problem areas.

"Tell them what you're going to teach them, then teach them, then tell them what you taught them".

This overcomes a significant "hidden" cost associated with training and the use of simulators which is the effort and expertise required to produce course material.

In-built Intelligence

A simulator's use is limited if it performs the same every time a student runs it. One way to overcome this is to have an instructor on hand. The other PC-based way is build in a form of Artificial Intelligence, the *Expert System*. The engine of Officer of the Watch™ is a knowledge of the International Regulations for Preventing Collisions at Sea. This *Expert System* monitors the actions of all vessels and allows target vessels to be directed to obey the Rules, so that an exercise develops interactively with vessels responding to the student's decisions and actions. Hence the outcome of the exercise will not be the same each time it is run.

The benefits of in-built intelligence are:

1. It allows students to develop analysis and decision-making skills, to learn from mistakes and "*discover*" principles and concepts for themselves.
2. It *advises* the student. In the case of Officer of the Watch™ it is a "Captain Call" which interprets the Rules for the student and gives detailed information about targets including: aspect, constraints, CPA, TCPA and so on.
3. It allows the creation of realistic and truly interactive lessons. In Officer of the Watch™ , Expert System-controlled target vessels will alter course to avoid collision and resume course and speed as soon as they are passed and clear. (Rogue vessels can also be defined to follow pre-defined tracks and waypoints.)

I give this example as an approach that can be applied to many elements of the curriculum to provide effective CBT.

Assessment / Performance Analysis.

Information is required about the student's performance to assess his competency and understanding. This information must be stored for review.

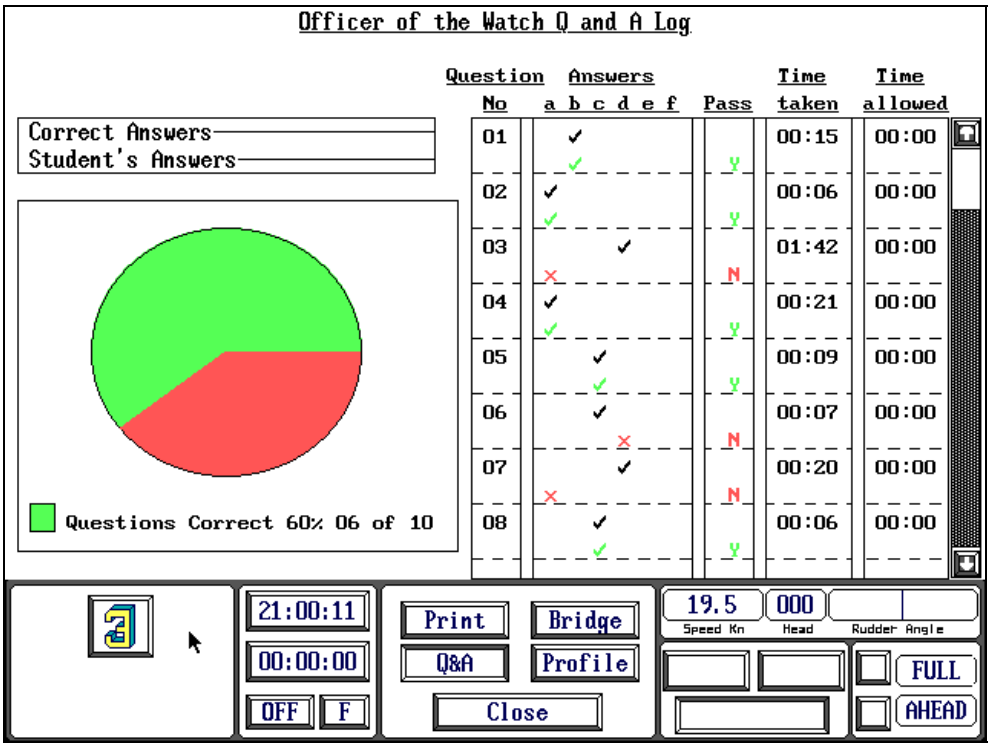

Figure 1

In the case of Officer of the Watch all actions taken by the student are recorded (use of radar, binoculars, change of course, results of questions etc). An instructor can review a series of logs to show watchkeeping procedures and the results of tests including

- A Bridge Log
- A Question and Answer Log (Figure 1) to record the student's answers
- A Profile Log (Figure 2) to provide the instructor with a graphical readout of the student's watchkeeping such as whether he is keeping a balanced visual lookout.

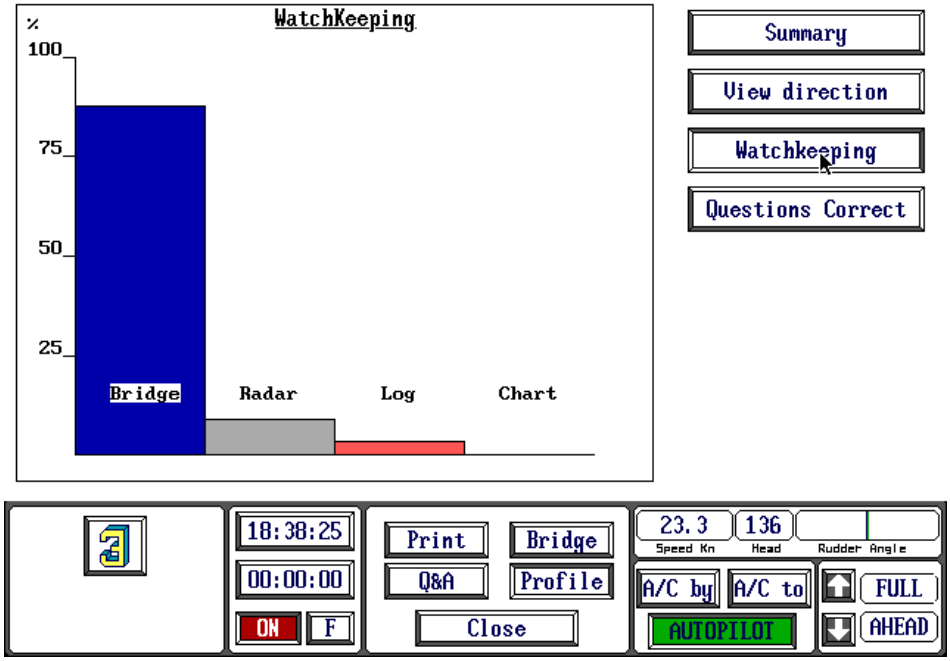

Figure 2

- A Playback view of the charted area (Figure 3). Buttons allow time-marked tracks of the vessels to be run forwards in slow or fast time or to be paused. Additional tools measure the range and bearing between any two points (such as between a specific time on the track of any two vessels), and to get information about the course, speed and constraints for any vessel at any time along its track.

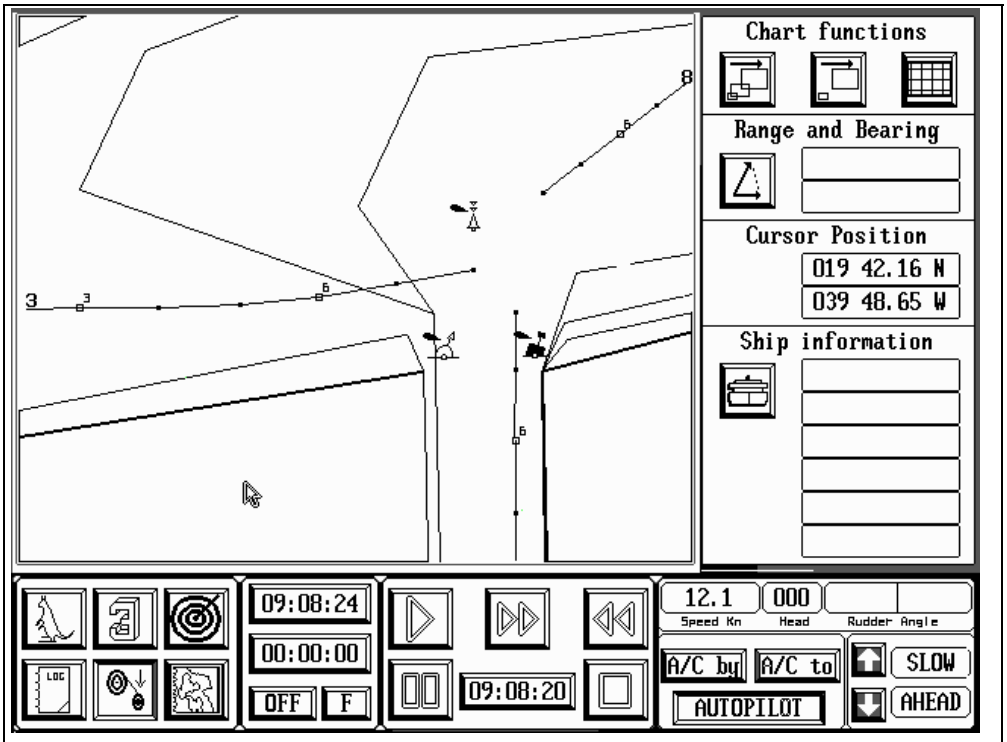

Figure 3

These facilities provide a forum for debate and debriefing. The actions of Own Ship and target ships can be analysed in depth. This facility is also useful in a straight teaching mode, where the instructor can use the program to illustrate his points.

Ease of use

Another hidden cost to a customer is the time the instructor needs to spend learning how to use a program and then teaching his students how to use it before training can begin. The user interface of a program must be intuitive so that new users or those with limited computer experience are not distracted or delayed by language or culture from attending to the learning objectives of their time on the system. This is particularly important in the less developed countries where exposure to computers may be limited.

In the case of our ROR simulator, **Officer of the Watch™**, customers have reported that with the aid of a 4-page graphic student reference card, students can start to use the program effectively in under one hour.

Using it to best effect:

We are currently in a transitional stage where the industry is re-examining training and assessment. The emphasis in the future is sure to be on the measurement of competency of

trainees rather than oral and written examinations which measure the retention of knowledge.

It is recognised that "many trainee watchkeepers and senior officers are not getting the opportunity to acquire the skills at the workface for a variety of reasons."[2] and that currently "assessments for certificates of competency continue to test the ability to retrieve information rather than to apply it to real tasks on a ship."[3]

The consultants to the review of the STCW convention have identified that the use of part-task training programs is an increasingly important resource "if simulators are to be used effectively to ensure that the relatively large numbers of officers required over the next decade possess the necessary operational skills".[4] and that "narrowing the job gap and that between the assessment at maritime academies and shipboard reality has become increasingly important"[5]

In the STCW review a number of factors have been specified for **effective simulator based training:**[6]

1. The development of specific training objectives
2. The selection of tasks relevant to the training purpose and operational skills needed onboard.
3. Exercise pre-briefing, control, monitoring and de-briefing techniques are understood and used effectively by the instructor.
4. The simulator provides a suitable operating environment for the selected objectives and training tasks.

Identifying training objectives and the tasks to which they can be applied is the province of the authorities and not commercial organisations such as PC Maritime.

Items 3 & 4 are partially dependent on manufacturers providing the necessary tools. The graphic displays and processing power of PCs are increasing rapidly and achievement of a high correlation between the simulated world and the real world is becoming increasingly satisfied.

I illustrate this point with a screen from the next version of Officer of the Watch™ (Figure 4), due out shortly, which will project real views from the ship, work in real navigation areas and provide more analysis and monitoring such as, for example, recording collision with other vessels or navigation marks for de-briefing.

Figure 4

The trend towards dual role cadets, who have to learn about the deck, the bridge and the engine room, places a greater burden of learning on them. It is one thing to absorb the knowledge required. To achieve competency that knowledge has to be practised and skills and confidence developed. Moreover there are stages in an officer's career where some aspect of his professional skills, such as watchkeeping, are under-used and he needs to refresh and practise them.

Part-task simulators such as Officer of the Watch™ are able to aid the learning of parts of the curriculum such as watchkeeping skills and testing of competency in this area.

As clear learning objectives are formalised by the authorities and training institutions then the PC-based simulator can play an increasing role in delivering the knowledge required for elements of the curriculum in an efficient and cost-effective way, supplementing and complementing courses at Colleges and on full-scale bridge simulators.

Profiting From Simulator Training Within Cost Constraints

The portability and flexibility of today's personal computer means that effective training and practice can be made available to the student onboard, at shore offices or at colleges.

The use of PC-based simulators is already benefiting many companies. They are being used in-house at training schools and onboard, for training and retraining and assessment. Feedback suggests that for onboard training, greater success is obtained where there is a training officer who is responsible for defining the use of the simulator, and then keeping in regular contact to monitor its use.

The Hanseatic Marine Training School have found that junior officers from South America and the Philippines have accepted Officer of the Watch™ very quickly and have asked for more lessons using it. Clearly training programs which motivate and stimulate the students are likely to produce time and cost savings.

The Course Modules that we have developed have been beneficial in getting customers up and running with the simulator very quickly without having to re-invent the wheel to create course material for training objectives which are similar for everyone. The current content of Officer of the Watch™ courses is listed in the appendix.

Conclusion

An aim often expressed is *remission of sea time*, but I wonder if a more realistic approach for shipowners and managers to get cost savings and quality training out of CBT and PC-based simulators is *reduction of college time*.

Some consider that sea time requirements are already short enough and that greater benefit should be obtained from making that time more effective, thus putting the training closer to the job. If onboard training with simulators takes place in the acquisition of competency, then there should be some means of recognising this.

However, much of the knowledge and skills which officers have to assimilate during the course of their training could be delivered as part of a distance learning programme which meet learning objectives and which, with today’s satellite communications, could be monitored and controlled by appropriate bodies ashore.

With liaison between manufacturers such as PC Maritime and the authorities and maritime colleges, I hope that further progress will be made in this direction. I believe this strategy can be cost-effective for the training providers, and motivating and effective for the learners.

Appendix

OOW COURSE MODULES

Each course consists of a number of lessons supplied on disk to load into OOW Simulator. The documentation for each course includes the following information for the instructor:

- Any materials required
- The expected time required by the student to complete each lesson
- References to IMO Model courses and standard textbooks
- A description of the course and lessons
- The learning objectives
- Comments for the instructor
- A plot of the correctly completed lesson if appropriate

A summary of the content and objectives of the course is provided for the student. At the start of each lesson, the student is told what the learning objective of the lesson is and what he is expected to do to complete the lesson successfully.

During any lesson the student may be asked questions about the material being taught. His answers will be recorded in the OOW Simulator Log so that the instructor can assess his performance in detail.

Although most lessons are designed for self-study and do not require instructor direction, many can be used as "visual aids" in a classroom or seminar.

Officer of the Watch™ Course Modules		
Introductory Course	(Familiarisation)	
Course 1	Visual identification (lights & shapes)	
Course 2:	Navigation Mark Identification	
Course 3:	Threat Analysis	
Course 4:	Conduct of vessels in sight of one another	
Course 5:	Responsibilities between vessels	
Course 6:	Basic Radar Plotting	The Basic Plot, observing vessel anchored One target vessel crossing One target vessel overtaking Two target vessels crossing Three targets observed Alteration of course to pass a set distance from a target Effect of own vessel altering course Effect of own vessel reducing speed Effect of alteration of course and speed by own vessel Effect of target vessel altering course Effect of target vessel altering speed Effect of target altering course and speed
OOW Course 8 :	Simulations and Case Studies	A general exercise Crossing situations Harbour exit Fog Boxed in Picking up a pilot Crossing a traffic separation scheme Case studies The cumulative turn Collision between the Toni and the Cardo the Allegro

NOTES

Further information on **Officer of the Watch** can be obtained from PC Maritime Ltd, Brunswick Road, Plymouth, Devon, UK. Tel +44 1752 254205 Fax +44 1752 253599

REFERENCES

[1] Prof Peter Muirhead, and Prof Gunther Zade, *Assessing Standards of Competence including the Use of Simulators*. The Development and Implementation of International Maritime Training Standards, World Maritime University, Malmo, Sweden, 15-16 March 1994

[2] Ibid

[3] Ibid

[4] Ibid

[5] Ibid

[6] Ibid