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THE USE OF SIMULATION TO REPLACE LIVE TRAINING FOR INITIAL PORT PILOTAGE TRAINING

Simulators have become important tools for training piloting skills that range from bridge resource management (BRM) skills (non-technical skills) to emergency response training (technical skills). As BRM is a non-technical skill, it makes it ideal for training with simulators, however the second skill, emergency response training, is partly a technical skill that relies on the simulator being able to predict forces that may or may not be correct. This position paper will discuss the merits of simulators and their deficiencies for developing non-technical and technical skills.

Indeed "some of the world's leading computational fluid dynamicists … generally acknowledge that simulators are not perfect and, no matter how advanced their programming, simulators simply cannot replicate the marine environment with all its chaotic complexity" [1] and as Professor Odd Faltinsen, who is one of the world's leading hydrodynamic theorists, put it, "computer prediction may be pretty good but it is not and cannot be, completely satisfactory" and "there is always likely to be a difference between computer modelling and reality, no matter how good the computer and models are". [2]

If simulation is to be expected to enable the rich complexity of real-world operations to be brought into a highly controlled training environment [3], it cannot be appropriately harnessed if it is to be used extensively in the development of technical skills that are required for marine piloting [3]. This is because simulations and simulators enable this rich complexity to exist by using mathematical constructs and algorithms and as such will convey a perfect electronic world that is capable of being replicated over the course of many simulations. This perfect world does not represent the real world of ship handling, however the reality is that simulators are starting to be seen as that. [1]

This reliance on the technical issues of simulation and not on the social issues of the simulation has led to differing approaches being taken by the engineers and computer scientists who focus on the technology and that of the psychologists who concentrate on understanding the acquisition of knowledge, skills and attitudes in a number of complex domains. [4] This has meant that whilst the simulations and simulators have evolved, the simulation training has not and thus there has been no consideration of what has been learned about individual and team training and cognition.

Dion, Smith, and Dismukes [5] once boldly stated that "the closer the similarity - the fidelity between the simulator and the aircraft - the more effective the instruction" [5]. Many believe in this statement and think that the higher the fidelity of the simulation the better the training will be. They work on the old adage that if it "looks and feels like the real thing, people learn." This is in fact putting the cart before the horse in some respects as they are allowing the state-of-the-art simulation to specify the training device [6] and ignoring the fact that just because the training is conducted in a high-fidelity simulator does not mean that successful training will take place. [4]

Flexman and Stark [7] have stated that "complete physical fidelity is rarely required for effective training and transfer" [7]. Fidelity then should be dictated by the cognitive and behavioural requirements of the task, not people's opinions. If this is done then there should be transference of learning.

One of the problems with simulation usage is in how the simulation is evaluated. If this is evaluated by trainees' reactions to the training there may be a bias in gaining a favourable evaluation for high fidelity simulation because the trainees typically like the "bells and whistles" of high fidelity simulation, so high fidelity simulation will appear to be highly effective for training. [4]

Training research clearly shows that there is not a significant relationship between trainee reactions and learning and subsequent performance [8]. Ideally, the determination that the training is effective should come from the trainee's performance rather than the performance of the simulation. However, many of the simulation evaluation techniques that are currently in use evaluate the "machine," that is, the system's characteristics and parameters and not the "person's" or the trainee's performance. As a result, because the simulation is judged favourably, the training it provides is judged to be good as well. [4]

One of the advantages of simulation though, is the ability for the trainee to learn through repetition to gain the required outcomes. These outcomes though also come from experience and not just simulated environments. This is because adults learn better through experience and also knowledge retention is better with experience. It is for this reason that initial training via a simulator is only part of the training process.

Simulation when used properly should enable effective training to take place in the marine pilotage environment and should be able to do the following:

1. Create a realistic simulation. This is sometimes difficult in ship simulators due to the vast array of outside influences that are at play when piloting ships. Realism in simulation is critical.
2. Enable an authentic learning environment to be created.
3. Allow learning in the same context of real-world operations which allows the transference of new knowledge and skill to effectively take place.
4. Allow skill development to take place in a suitable environment that carries no risk to the outside world. Simulation also allows below par performance and errors to occur without fear of consequence and the learning's from this can then be used to raise the performance level and prevent the re-occurrence of the errors, which as stated above is without risk to the equipment or participants as well as the general public.
5. Allow for the use of instructional techniques that are much more difficult to achieve in the real world. These techniques can be run time and time again to embed the techniques.

6. Allow for the use of scenarios, which will help in the development of non-technical skills such as decision-making and situation awareness. Non-technical skills are the cognitive and social skills that complement technical skills. There are also educational benefits in learning the importance of hazard identification and risk management.
   As BRM is critical in what pilots do, simulation should strive to create a team environment which can then be transferred to the outside world. Teamwork and the identification of each team member's areas of strength is also necessary as is the understanding of why effective communication must be used during the simulation in order to do it effectively on a bridge in the real world. [3]

There can be doubt that simulation has now become a crucial aspect of marine pilot training and to learn these piloting skills there must be an opportunity to learn and practice in an appropriate context. This context must not only provide essential performance cues but also ensure the safety of the trainee and the instructor, however, the best simulation in the world does not guarantee learning [9, 10]. It is of concern that "the way the context looks (i.e. the simulation) seems to have become more important than the instructional features embedded in the simulation to support learning" [4].

It is critical therefore that learning be enabled with regards to simulation training and this can be developed by promoting systems that allow this. This can only be achieved by shifting focus from the designing of simulation for realism and (hope that the learning occurs) to the design of human-centred training systems that support the acquisition of complex skills. [4]

In summary, liking the simulation does not translate to learning. Although user consideration is important it is not the only source of learning. In evaluating the effectiveness of our simulation-based training system, we have to go beyond reaction data and obtain data that allows the essential, diagnosis and evaluation of requisite Knowledge, Skills and Attitudes (KSA's). [4]

To determine if the simulation training has been effective then the decision must be based on whether the trainee has learned the required skills and then used them on the job [11]. By doing this an ongoing appraisal of the simulation training can be achieved which in turn will determine whether adjustments need to be made to the amount of training given.

This discussion paper has given the reader an insight to some of the issues that simulation and simulators have introduced to the world of marine pilot training. It would appear that the use of simulators is ideal for non-technical skill training as these skills are the cognitive and social skills that complement technical skills and are more easily replicated on a simulator. Technical skills whilst still replicable are not as easily managed due to the difficulty in being able to predict forces that may or may not be correct. There are also problems with learning transference, and it needs to be determined that the skills have actually been learned.

The problems in determining whether knowledge transference and skill learning have in fact occurred is probably partly the reason why **IMO A960 (M) (2004 Version) Section 5.2** in part

states that the practical experience gained by the trainee pilot "may be supplemented by simulation, both computer and manned model …" [12] and **IMPA Resolution 7.1 (2000): Use of Shiphandling Simulators** resolved that " … the use of simulators to evaluate or predict a pilot's performance in the real world for licensing purposes to be an inappropriate use of an otherwise valuable technology" [13] and **IMPA Resolution 7.2 (2002): Simulators** resolved that … "the sole use of simulators for training and certification to be inadequate in validating the appropriate levels of competence required for navigating in pilotage waters …" [14]

Still it has been determined that "there is no question that simulation can be an effective tool for training complex skills. … But it is only a tool. As with any tool, in order to be effective it must be used appropriately." [15]

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