ATTITUDES AND PERCEPTIONS OF INSTRUCTORS OPERATING MARINE SIMULATOR COURSES

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ABSTRACT

The purpose of this study was to gather information regarding methodologies used in marine simulator training. The focus of this study was on instructors who operated courses on ship manoeuvring simulators and on radar and navigation simulators. Since the study included subjects with varying professional and educational backgrounds, it was anticipated that areas of agreement and disagreement about training could be identified. The information gathered in this study helped to identify attitudes about training and program delivery methods commonly used by instructors of marine simulator courses. The study also provided information on the current status of simulator hardware as well as the qualifications of such instructors.

A review of the literature revealed that there were a number of issues to be investigated related to the use of simulation. The review identified five areas of simulator operation in which the attitudes and perceptions of the instructor could have an effect on training outcomes. These areas were: general simulator operation, exercise development, exercise briefing, exercise running and exercise de-briefing.

Data for the study were gathered by means of a single questionnaire specifically designed for this study. The content validity of the study was ensured by having three experts assess each item.

On the basis of the study it was concluded that, while there were statistically significant differences on a number of the individual statements, overall the attitudes and perceptions of instructors toward simulator training were very similar. In general, all groups reacted positively to the majority of statements in all five areas. Many responses from the various sub-groups investigated produced means close to the neutral value of 2.5 which indicated some degree of uncertainty. Such areas of uncertainty require clarification and could be addressed in a programme of study designed specifically to prepare marine simulator instructors.

Generally, it was found that the attitudes and perceptions of marine simulator instructors were remarkably similar based on most of the variables investigated. The findings of this study can be used to improve simulator training effectiveness at the Marine Institute and other simulator facilities through implementation of the recommendations contained within. It was recommended that further studies be conducted to identify effective teaching methodologies, attitudes and perceptions of trainees and ship owners toward simulator training and learning theories which could be applied to improve simulator training effectiveness. There is also a need for a longitudinal study into the transfer of skills achieved through simulation to real world ship operation.

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CHAPTER I

INTRODUCTION

Introduction to the Study

In September 1993 the Institute of Fisheries and Marine Technology of Memorial University of Newfoundland (Marine Institute) completed installation of the Centre for Marine Simulation (CMS). In addition to a 4 own ship blind pilotage radar and navigation simulator, a propulsion plant simulator, a ballast control simulator, a liquid cargo handling simulator and a global marine distress and safety system simulator, this facility includes the largest, most technologically advanced full mission ship manoeuvring simulator in the world. The demand for simulator training within the marine industry is high and the CMS is well positioned to compete for a share of the local, national and international simulator training business.

The focus of this study was on instructors who operated courses on ship manoeuvring simulators and on radar and navigation simulators. At the Marine Institute, these simulators are used for the delivery of courses which offer mariners training in navigation and ship manoeuvring. Courses offered on the radar and navigation simulator include Simulated Electronic Navigation I and II (SEN I and SEN II) which are mandatory courses required by the Canadian Coast

Guard as part of the mariner certification process. Courses offered on the ship manoeuvring simulator are not a mandatory part of mariner training and are almost always tailored to meet specific training needs of the marine industry. These courses include advanced ship manoeuvring, bridge resource management and marine pilot training.

The use of simulators in the marine industry is relatively new, although, radar and navigation simulators have been in use since the end of World War II (Berger 1991) when radar became available to merchant ships. The first ship manoeuvring simulator was built by the Japan Radio Company in 1966 (Puglisi 1987) but was never fully commissioned. Since that time, marine simulator technology has undergone tremendous improvement and is now among the most sophisticated applications of full scale simulation currently in use. There is an increasing number of ship manoeuvring simulators available for the training of mariners; and virtually every major maritime nation can boast at least one radar and navigation simulator.

The applications for marine simulators can be grouped under two main headings: (a) the training of marine personnel for various occupations related to the operation of ships; and (b) research and development applications related to human behaviour, ship design and the design of ports and waterways. Training courses which are offered on both radar and navigation simulators and ship manoeuvring simulators tend to be of short duration, usually one week, while research and development activities are usually longer and tend to be done outside of normal training hours.

Ship manoeuvring simulators are either operated as private corporations or as a part of educational institutions, while radar and navigation simulators are almost exclusively within the domain of educational institutions. Instructors who operate these simulators tend to have professional qualifications as ship navigating officers and ship Masters. However, since there is no international requirement to undergo teacher training, it is possible that many of these instructors have no formal qualifications as teachers. Ship manoeuvring simulator facilities which are associated with educational institutes would likely employ instructors who hold marine qualifications as ship Masters and would require that the instructors enrol in a programme of teacher training. In addition, national marine authorities, such as the Coast Guard in Canada, may require that instructors who teach mandatory radar and navigation simulator courses have marine qualifications and have also completed an acceptable programme of teacher training.

The International Maritime Organization (IMO) is the branch of the United Nations which is responsible for maritime matters, including the training of mariners. The convention on the Standards of Training Certification and Watchkeeping (STCW) is concerned with setting minimum training standards which will guide member nations in matters of marine education. A recent revision to the STCW code has, for the first time, included a section on simulator instructor training. This will likely have a significant impact on the way in which marine simulator instructors are recruited and trained.

In the period leading up to the commissioning of the CMS simulator at the Marine Institute, the author had the opportunity to attend a number of courses at various simulator facilities around the world. In addition to a wealth of technical and operational information, the courses provided an insight into a number of educational aspects related to marine simulator training. The approach to simulator training differed among the various facilities and indeed among individual instructors at each facility.

Purpose / Significance of the Study

The purpose of this study was to gather information regarding training methodologies used in marine simulator training. Since the study included subjects with varying professional and educational backgrounds, it was anticipated that areas of agreement and disagreement about training could be identified. The information gathered in this study also helped to identify training and program delivery methods commonly used by instructors of marine simulator courses along with the qualifications of such instructors. The study also provided information on the current status of simulator hardware used in the training of mariners.

A specific section of the study surveyed the attitudes and perceptions of simulator instructors regarding various elements of simulator training including, but not limited to, basic instruction, simulator exercise preparation, exercise briefing procedures, running of simulator exercises and exercise debriefing procedures.

Comparisons were also made using a number of identified variables which included instructors who held both professional and educational qualifications with those who held only professional qualifications; and between instructors who operate only radar and navigation simulators, those who operate only ship manoeuvring simulators and those who operate both types of simulators.

An anticipated future benefit of this study was the potential use of the results to contribute to the basis of a training plan outline for marine simulator instructors which would satisfy the requirements of the STCW code, including the content of a training module on effective simulator training methodology. Further, the results of this study can be used to make recommendations on, and to potentially improve, simulator training both at the Marine Institute and other simulator facilities around the world. They can also be made available to other agencies such as the International Maritime Organization (IMO) and the Canadian Coast Guard, both of which may make recommendations from time to time regarding the training and upgrading of marine simulator instructors. Finally, the survey instruments developed for this study may be useful to other researchers when conducting further investigations into simulator training within the marine industry.

Research Questions

The following research questions were addressed in this study.

1. Are there any differences in the general perceptions of simulator use for training: (a) between instructors who operate only radar simulators, those who operate only ship manoeuvring simulators and who operate both types of simulator; (b) between instructors who hold a Master Unlimited certificate of competency and those who hold other qualifications; (c) between instructors who have served as Master on a ship and those who have not served as Master on a ship; (d) between instructors who hold a teaching certificate and those who do not hold a teaching certificate; (e) between instructors who are certified as a marine simulator instructor by their country and those who are not certified by the government of their country;

(f) between instructors who use simulator equipment that has a visual system and those who work on simulator equipment that does not have a visual system; and (g) between instructors who work at privately funded facilities and those who work at publicly funded facilities?

2. Are there any differences in perceived training procedures between instructors who operate only radar simulators, those who operate only ship manoeuvring simulators and those who operate both types of simulator?

3. Are there any differences in perceived training procedures between instructors who hold a Master Unlimited certificate of competency and those who hold other qualifications?

4. Are there any differences in perceived training procedures between instructors who have served as Master on a ship and those who have not served as Master on a ship?

5. Are there any differences in perceived training procedures between instructors who hold a teaching certificate and those who do not hold a teaching certificate?

6. Are there any differences in perceived training procedures between instructors who are certified as a marine simulator instructor by their country and those

who are not certified by the government of their country?

7. Are there any differences in perceived training procedures between instructors who use simulator equipment that has a visual system and those who work on simulator equipment that does not have a visual system?
8. Are there any differences in perceived training procedures between instructors who work at privately funded facilities and those who work at publicly funded facilities?
9. Is there a relationship between the number of years served at sea before becoming a marine simulator instructor and the attitudes and perceptions of marine simulator instructors toward perceived training procedures?
10 Is there a relationship between the number of years served as a marine simulator instructor and the attitudes and perceptions of marine simulator instructors toward perceived training procedures?
11 Is there a relationship between the age of the simulator equipment used by marine simulator instructors and the attitudes and perceptions of marine simulator instructors toward perceived training procedures?
12. Is there a relationship between optimum simulator exercise length and the attitudes and perceptions of marine simulator instructors toward perceived training

procedures?

13. Is there a relationship between time spent briefing trainees and the attitudes and perceptions of marine simulator instructors toward perceived training procedures?
14. Is there a relationship between time spent de-briefing trainees and the attitudes and perceptions of marine simulator instructors toward perceived training procedures?
15. Is there a relationship between time spent on exercise development and the attitudes and perceptions of marine simulator instructors toward perceived training procedures?

Need for the Study

Ship manoeuvring simulators and radar and navigation simulators can be used effectively as a means of training personnel involved in the operation of ships. The training provided will be affected, to some extent, by the attitudes and perceptions of instructors as well as their ability to use simulator equipment effectively. While it may be argued there are many ways to achieve educational goals, it is important to look to the commonly accepted methods in use within the marine simulator community and supported by learning theories, in order to gain insight into what contributes to effective simulator instruction.

A review of the literature revealed that there have not been any studies of a similar nature conducted, even though literally thousands of mariners are trained at simulator facilities around the world each year. While it is not the intention of this study to criticize existing marine simulator instructors, it is necessary to look at their attitudes toward various aspects of simulator training and their perceptions of what constitutes effective simulator instruction in order to help improve the effectiveness of the training delivered through this medium. In fairness, past practices have indicated that many marine simulator instructors have had to find their own way in the absence of a clear and concise training programme. It is hoped that the wealth of on-the-job experience they have accumulated can contribute to the basis of training programmes for future marine simulator instructors, as well as improve current practice, through the results of this research.

Scope and Limitations of the Study

The questionnaire used in this study was developed by the author. The study is therefore limited by the validity and reliability of the individual items contained in the questionnaire. This limitation was minimized by having a panel of experts review the items before the final version of the questionnaire was prepared.

The target population for this study was relatively small since the number of marine simulators in existence worldwide is limited. In addition to a limited population, the sub-groups within the population (radar and navigation simulator and ship manoeuvring simulator) were very different in terms of the number of individuals in each group. The results of comparisons made between these groups must therefore be interpreted with some caution.

Definition of Terms

The following terms were defined for the purpose of this study:

Instructors include persons who operate radar navigation simulators and/or ship manoeuvring simulators.

Radar and navigation simulators include all marine simulators which are used primarily in the training of basic navigation and collision avoidance for mariners as a mandatory part of the certification process. **Radar and navigation simulators** may also have limited research applications. Radar simulator programs which are intended to run solely on personal computers were not included.

Ship manoeuvring simulators include all marine simulators which are used primarily for advanced training in ship manoeuvring and bridge resource management. **Ship manoeuvring simulators** often have a wide range of research applications. Ship simulator programs which are intended to run solely on personal computers were not included.

CHAPTER II

REVIEW OF LITERATURE

Introduction

Simulation and gaming in education represent a growing area of educational interest. Simulations can be simple or complex, and can be used to illustrate simple principles, shape complex behaviours or train individuals to operate complex systems such as a Boeing 747 aircraft or a ship such as a Very Large Crude Carrier (VLCC).

Simulations can be carried out in a regular classroom environment using role-playing and gaming techniques or through other means that utilize the recreation of real world situations through case studies and physical models. In recent years the rapid advances in computer technology have made significant contributions to the advancement of simulation as an educational tool. Computer simulations can be run on a wide range of computer equipment. For example, Drown and Lowry (1993) point out that, in the marine education field, "computer technology allows ship motion and operational characteristics to be simulated on personal "desk-top" computers through to elaborate "full-mission" representations of the real world" (p. 103).

Much of the literature related to marine simulation focuses on the technological aspects of simulation rather than the pedagogy of its use. Such literature is reviewed along with that pertaining to educational theories which support simulation and on methodologies which are used effectively with simulation. The nature and definitions of simulation are also reviewed along with discrete elements of simulation such as exercise development, briefing, running and de-briefing.

Background

In December 1993 the Institute of Fisheries and Marine Technology of Memorial University of Newfoundland (Marine Institute) completed installation of the Centre for Marine Simulation (CMS). In addition to a *4 own ship radar and navigation simulator*, this facility includes one of the largest, most technologically advanced *full mission ship manoeuvring simulators* in the world. The demand for simulator training at similar facilities around the world is high and it is anticipated that this will prove to be the case at the CMS.

The use of simulators for training in marine related industries is relatively new. Radar and navigation simulators have been in use since the end of World War II when radar became available to merchant ships (Berger 1991). The first ship manoeuvring simulator was built by the Japan Radio Company in 1966 but was never fully commissioned (Puglisi 1987). Marine simulator technology has undergone tremendous improvement since 1966 and is now among the most sophisticated applications of full scale simulation in use today.

Although marine simulators can be used for research and development applications related to human behaviour, ship design and the design of ports and waterways, they are most often used for the training of marine personnel for various occupations related to the operation of ships. Training courses which are offered on radar navigation simulators tend to be mandatory courses which are required for mariner certification, while courses offered on ship manoeuvring simulators are rarely mandatory and tend to be tailored to industry demand. A recent study by Hesp (1994), which surveyed a wide range of marine industry personnel on training uses for ship simulators, resulted in a number of recommendations regarding the type of simulator training courses suitable for delivery using a ship simulator.

Ship manoeuvring simulators are either operated through a private corporation structure or as part of an educational institution. Instructors who operate these simulators tend to have professional qualifications as ship Masters, however, there is often no requirement for these instructors to hold formal qualifications as educators. Individual simulator facilities may require that instructors hold both professional qualifications as ship Masters and as educators.

Simulation Defined

There are a number of definitions of simulation found in the literature. The Random House Dictionary (1987) states that simulation is:

> the representation of the behaviour or characteristics of one system through the use of another system, especially a computer program designed for the purpose (p. 1783).

This broad definition, while covering the essential points, provides few details regarding the degree to which a system is simulated, or the reasons why simulation is used. According to Jones (1995) the Society for the Advancement of Games and Simulations in Education and Training (SAGSET) and the International Simulation and Gaming Association (ISAGA), define simulation as:

> a working representation of reality; it may be an abstracted, simplified or accelerated model of the process. It allows students to explore systems where reality is too expensive, complex, dangerous, fast or slow (p. 11).

Jones points out that, while this definition may be suitable for systems analysis, it does not reflect the human interaction element of simulation.

While simulations of mechanical and control processes are often performed in order to gain a more precise understanding of functionality, educational applications constitute the greater usage of simulation. Educational applications of simulation may take various forms, such as role playing or classroom games and activities, or more advanced forms of full mission simulation in such areas as aeronautical and marine training.

The rapid advances in technology have made the computer a central component of simulation applications used by many educators. If, as the Random House definition above suggests, simulation is especially related to a computer program, then computers are, by default, a prominent component of simulation, especially for the more complex applications.

The Random House Dictionary also provides a definition of a simulator (versus simulation) as:

> a machine for simulating certain environmental and other conditions for the purposes of training or experimentation (p. 1784).

It is clear from the above definitions that simulation, from an educational perspective, can be defined as a machine or activity designed to allow human interaction with the system being simulated. Further, simulation and simulators can be used for both research and training, and can be employed in a number of ways to represent systems, particularly through the use of computer technology.

Realism in Simulation

A further step toward understanding simulation is related to the degree to which the behaviour or characteristics of a system need to be simulated. Ideally, all behaviours and characteristics should be simulated, however, this is not always practical nor is it always possible. The question of realism in simulation has been addressed by a number of authors. Bratley (1983) maintains that:

> most forces that impinge on the system must be neglected on a priori grounds to keep the model tractable, even when there is no rigorous proof that such neglect is justified (p. 1).

The model referred to by Bratley is the representation of the system being studied. The model may be either mathematical in nature, or it may be a physical model of the system. In either case, the term "model" is almost universally accepted in simulation.

Simulation models, according to Bratley, must be deliberately kept simple in order to ensure that the simulation process remains manageable. While this may be true in some cases, there may be other cases where the model may become too manageable and therefore may not produce valid results.

As in any training, simulation must produce results which can be validated. In order to validate a simulation model, even when only a part of the real system is being modelled, all variables which have an impact on the outcome must be a part of the model. Neelamkavil (1987) warns that a less definitive approach and over simplification of the simulation model may lead to loss of accuracy and generality, while too many details may make the model more complex than the real system.

Although both Bratley (1983) and Neelamkavil (1987) have made an attempt at answering the question, there is still no clearly defined level of required realism for simulation models. This is likely to be dependent on two related issues which must be addressed before the simulation model is developed. These related issues are, the purpose for which the system is being simulated and the degree of complexity inherent in the real system. The first issue can be addressed in general terms by looking at some applications of simulation while bearing in mind that a particular system may be simulated for one or more purposes. The second issue is case specific. The more detailed a model is, the greater are the opportunities for studying different systems design and possible configurations and their implications (Dogramaci & Adam, 1979). It is evident that the more information required about a system, the greater the detail that must be built into the model.

Range of Simulators

The complexity of the machines employed in simulation ranges from scale models and personal computer applications designed to simulate specific functions of the real system, to elaborate systems designed to replicate all functions of the real system. There are two terms in common use which help to loosely categorize simulators. Drown and Lowry (1993) use the terms "full mission" and "multi task" to describe simulators which are designed to replicate all functions of a real system in as realistic a manner as possible; while the terms "limited task" and "special task" are used to describe simulators which replicate parts of the real system to a lesser degree of realism.

For example, there are a number of flight simulator programs available for personal computers which allow the user to "fly" a number of different aircraft types. There are also a number of manufacturers who produce highly complex commercial flight simulators used in the training of pilots. The differences between these simulators serves to illustrate the degree of separation between limited task / special task and full mission / multi-task as applied to simulation.

Some industries which use simulation as a means of training, such as the airline industry, are subject to classification systems for simulators. For example, in the United States the Federal Aviation Authority (FAA) has referred to several categories of training devices (FAA, 1992). This system classifies flight simulators according to the functions which are simulated. Other industries, such as marine transportation, have no classification system in place for ship simulators. Drown and Lowry (1993) have pointed out that organizations such as the International Marine Simulator Forum (IMSF) do not have a classification system for the very product which their members represent.

The degree of user interaction with the simulation is also a consideration. Some simulated systems do not require any input, other than initial conditions, to produce valid output. This situation is typical of simulations of manufacturing processes where human intervention is limited to decisions in the feedback loop between output and input. This type of simulation is almost invariably run totally inside the computer with the operator seeing the output in numerical or graphical form.

At the opposite end of the spectrum there are the simulators which require almost constant human intervention in order to produce valid output. These are the so called "human in the loop" simulators such as flight simulators, ship simulators and radar navigation simulators in which human operators must interact with the simulation on a constant basis in an effort to control the vehicle or situation being simulated. The operator receives feedback on the validity of decisions and actions through the behaviour of the simulated vehicle during real-time simulation.

Philosophy of Simulation

It is not always evident why simulation is the method of choice as an educational tool. Several authors who have written on the subject of simulation have attempted to present personal philosophies regarding its use. An understanding of the philosophy of simulation is essential for those who use simulation as a tool for research and development or as an educational tool. According to Fahley and Colley (1989) the main benefits of simulation for research and development purposes are realized as time and cost savings. While this may be a deciding factor in the decision to use simulation there are other, more far reaching benefits to be gained from simulation.

Neelamkavil (1987) has stated a number of circumstances where simulation may be the method of choice for problem solving or training. Among the reasons given, two stand out as perhaps the most comprehensive. These are:

> a) the real system does not exist and it is expensive, time consuming, hazardous, or impossible to build and experiment with prototypes (new design of a computer, solar system, nuclear reactor); and
>
> b) experimentation with the real system is expensive, dangerous, or likely to cause serious disruptions (transport systems, nuclear reactor, manufacturing system) (p. 12).

The first of these reasons is obviously based on the requirement to keep development costs at a minimum. A prime example of this situation arises in the development of, or modifications to, sea-port facilities. As Van den Brug (1987) has observed, "ship simulators are increasingly being used as a research tool for harbour and waterway design" (p. 2).

The second reason is the requirement to maintain high levels of public safety. Airline passengers would become highly upset if subjected to forced participation in the on-the-job training of flight crews. It is for this reason that simulation has become widely accepted as the only feasible method for training aircraft pilots for emergency situations.

The use of simulation in research and development work can lead to an increased awareness of safety concerns particularly where new design specifications are a direct result of the simulation. Bacca (1988) and others have described such simulation applications which have been incorporated into nuclear power plant simulators.

In a recent report on marine simulator training in the United States, the National Research Council (1996) put forward the following rationale for using simulators in education and training.

> The theoretical rationale for the use of simulators for training is based on the concept of skill transfer--that is, the ability to adapt skills learned in one context to performance or task execution in another.... It is assumed that skills and knowledge learned in a classroom can be applied effectively to relevant situations outside the classroom (p. 37).

Simulator training is effective where errors of judgement can endanger life or property. Simulator training, according to Boer and Breda (1984), can increase an individual's efficiency where a number of tasks must be undertaken by one person, particularly where priorities among these tasks may change with varying circumstances. Accidents resulting from human error are often attributed to bad decisions and lack of knowledge. The latter can be provided in several ways, however decision making can best be improved by providing experience and training. Thus, effective simulator training can reduce accident rates and improve operational efficiency.

Simulator training provides experiences that help build an individual's judgement skills thereby allowing that individual to make better decisions. The effectiveness of the simulation training can, according to Giles and Salmon (1978), be measured by monitoring the decisions made by trainees in unusual, difficult or confusing situations. They further explain that a simulator reproduces life-like experiences in which decisions are required. Each learning experience must challenge the trainee at all levels. The trainee must be stressed beyond the limits of their current experience in order to gain more experience. Forced decision making allows the trainee to build better judgement skills. Further, simulation highlights human reactions in stressful situations and only the esteem of the trainee suffers when mistakes are made. With the proper attitudes toward learning and encouragement, the experiences gained through simulation can help to prevent the same mistakes from being repeated.

As pointed out by the Marine Board (1996), "opportunities for repetition are very limited during actual at sea operations". Simulator training, on the other hand, can provide the trainee with repetitions of the same experience that may take weeks or months to accumulate in a job training situation. Also, as pointed out by Mercer (1990), the quality of simulation training can often be more consistent than on-the-job training. This is partly attributable to the fact that on-the-job training is often delivered by persons who are rarely trained as educators.

Lack of experience is an underlying factor in accidents. This statement is not unreasonable since the type of experience required in an accident situation is experience that is potentially dangerous to accumulate and is therefore undesirable. Simulation can provide a trainee with the experience required to make sound decisions in emergency situations without ever putting life or property at risk. Applying the Law of Exercise (Thorndike, 1971), multiple repetitions of the same scenario may be used to strengthen the trainee's responses to the emergency thereby improving the ability to respond to the emergency in real life using a calm rational approach.

Uses of Simulation

Simulation has been used as a means of predicting outcomes of human behaviour under conditions that would expose subjects to extreme danger. This type of simulation makes use of data taken from real life situations where the same conditions have occurred and allow investigators to vary the behaviours or conditions to improve, or determine appropriate responses, to a new or existing system or situation. Ozel (1992) describes a simulation model that is capable of representing behaviour of people involved in fires. He points to investigations which have determined that the efficiency of even the most modern of protection systems may be a function of human behaviour within the confines of a burning building. This type of simulation allows investigators to design safer buildings and to develop more efficient evacuation plans.

Industries often need to improve the quality of their output, while at the same time improving the efficiency of the plant. Simulation can also contribute to finding the answers in this type of investigation by modelling the physical plant and then controlling the inputs and processes which determine the plant output. An example of this type of simulation application is provided by Jones (1987). He describes the modelling of a paper-making process and concludes that this particular application of simulation "will provide a significant new tool for research, marketing and manufacturing in the pulp and paper industry" (p. 161). He further states that these techniques are equally applicable to a wide range of manufacturing industries where quality is of prime importance.

The question of proficiency for personnel involved in the operation of equipment has long been regulated through a process of either revalidation or licensing. The role of simulation in this area is to allow the system and equipment to be modelled for the purpose of assessing individual competence. Simulation allows the assessment to proceed without placing either life or property at risk. This particular application of simulation has provided the motivation for the development of, for example, a simulator to be used to assess the driving ability of brain-damaged individuals. According to Svoboda (1990) the system:

> promises not only a unique solution to the problem of assessing brain-damaged individuals for driving, but also a basis of engineering and human factors simulator research and development that can be generalized to any type of vehicle/operator situation (p. 125).

The simulator used is not only capable of determining readiness to resume driving, but also helps in determining whether the individual is or is not capable of being retrained. Clearly this use of simulation has far reaching implications for future methods of determining competency in a wide range of occupations and circumstances.

Accident investigation using simulation has become an increasingly popular means of attempting to discover causes of accidents and for determining preventative measures. This use of simulation is relatively new, however it has been employed in several areas. In the marine field, radar simulation has been used to investigate the grounding of the vessel "Euplecta" in Hong Kong harbour (Singh 1990); while a ship simulator has been used by Hwang (1989) to investigate the grounding of the "Exxon Valdez" in the Prince William Sound in Alaska. In both of these cases, an attempt was made to reconstruct the incident from known and reported facts in order to determine probable causes for the incident.

Simulation has been in use for some time in the nuclear industry for training purposes; and, in recent years, has demonstrated it's usefulness in accident investigation. The causes of a 1988 incident at the Lasalle-2 Nuclear Power Plant were investigated by Cheng (1989) using simulation. The simulation was instrumental in isolating the causes of the accident, and was also used to identify appropriate responses to minimize the impact of future accidents of this type.

The most widely used application of simulation is for the purposes of training. Simulation is used as a training tool in the aviation industry, the marine industry and various other industries in which on-the-job training could prove to be disastrous if errors were made by trainees. Flight simulation has earned the acceptance of pilots, industry and the general public regarding it's role in training. The acceptance of flight simulators is so wide spread that, according to the Marine Board (1996), "the commercial air carrier industry is able to conduct transition training to a new aircraft entirely in simulators" (p. 54).

Nullmeyer and Rockway (1985) reported one simulator study, carried out by the United States Air Force, That determined that trainee pilots who pre-qualified on a flight simulator required far less instructor input during flight training on the actual aircraft than the control group, which did not receive the simulator training.

Simulation is also gaining popularity in the medical field where it is used for a number of different purposes. A recent newspaper article (Evening Telegram, 1996) related how surgeons use simulation to practice complex operations using computer simulations that convey actual pictures of a patient's diseased organs. The article further described how medical students can use simulation to learn, among other things, basic anatomy. The latter was accomplished through the use of a software program called the "Virtual Cadaver" which contains digitized data from two human bodies that had been donated for use in scientific research.

In reviewing the above simulation applications from the literature, it becomes evident that the range of applications is extremely diverse. Each example requires some degree of realism in the simulation model which would then vary depending on the purpose for which the simulation was created. In some cases, such as the investigation of nuclear accidents, the modelling of the system is critical to the validity of the outcomes. In other cases, such as the assessment of the driving ability of brain-damaged individuals, the modelling of the system is less important since it is the response of the individual which is being studied.

Simulation and Learning Theories

The use of simulation in education and training has increased rapidly over the last decade. In education, the question of when to use simulation, and indeed whether to use simulation, is governed by the learning situation. The main reason for the increase in the use of simulation can be attributed to the accessibility of micro computers and the cost effectiveness of using simulation rather than the real systems. The strongest argument for using simulation in training is that of repeatability of experience. According to the Marine Board (1996):

> using simulation, the instructor can terminate a training scenario as soon as its point has been made or repeat it until the lesson has been well learned. In contrast, opportunities for repetition are very limited during actual at sea operations; the opportunity to repeat an exercise in on-the-job training aboard ship may not occur for weeks or months.

Educational methodologies have a basis in the various learning theories used to inform teaching and learning processes. Computer simulation, as an educational tool, is relatively new. Simulation is rarely specifically referred to in these theories of development and learning, however, educational theories which support simulation as an educational tool can be found in the literature. Some of these theories were developed over a century ago, while others are more recent. In general, theories which support "learning by doing" give credibility to simulation as an educational tool.

In discussing the theories of Jean Jacques Rousseau, Thomas (1985) highlights the belief in what is now known as discovery learning. The latter encourages the student to discover for themselves, rather than to memorize what has been presented to them by others. Experiential learning theorists believe that a learner's past experience will guide the learning process. This point of view is supported by Kolb (1993) who defines learning as "the process whereby knowledge is created through the transformation of experience" (p. 155). For learners using simulation, experience is gained as a direct result of interaction with the simulation. By applying a pedagogical process this experience can be transformed into learning.

Simulation, as an educational tool, is well suited for this type of learning. Veenman, Elshout and Hoeks (1993) have indicated that simulation environments allow for learning by discovery under restricted realistic conditions. They state that "due to its exploratory nature, learning with simulation involves complex problem solving and inductive reasoning, which put high cognitive demands on the student" (p. 235).

Simulators are frequently used in education in a modified version of discovery learning. However, time and cost constraints often prevent simulator instructors from allowing learners to fully discover all the principles which may apply in any one particular situation. In such instances, principles will have to be presented to the learners by some other means which may include memorization. Muirhead and Tasker (1991) have stated that:

> the shiphandling simulator is a complex and expensive training medium. It is inefficient and costly as a means to train mariners in simple basic skills. Students should have a fundamental grasp of the collision avoidance rules, watchkeeping procedures, the operation and use of radar and other navigational aids, and of basic ship manoeuvring principles, etc, before proceeding to skill enhancement training on the simulator (p. 5.15).

Learners who possess basic skills and knowledge can benefit from using simulation at a higher level to practice the application of the principles and, more importantly, discover whether the principles actually work in practice.

Early educational theorists such as Johann Heinrich Pestalozzi (Thomas 1985) have, as a central theme, espoused the concept that learners will learn best by actually completing the required tasks rather than simply learning about them. While it may be argued that on-the-job training is the preferred method of providing learning experiences, the fact remains that this type of training, in some industries, is too dangerous to allow learners to practice on the real system. Simulation is the only practical means of providing the critical knowledge and skills which the learner will require when interacting with the real system.

More recent conceptualizations, such as social learning theory, have taken a different stand on the role of the trainee in terms of actual "hands-on" training. Social learning theorists believe that individuals, as observers, can learn from the direct experiences of others. This vicarious form of learning has been observed in many situations where the learner has been either a casual observer or deliberately exposed to a particular situation. Bandura (1969) has stated that " the capacity to learn by observation enables people to acquire large, integrated patterns of behaviour without having to form them gradually by tedious trial and error" (p. 32-33). Muirhead and Tasker (1991) partially support social learning theory when discussing the training of shiphandling skills using a ship simulator. They state that:

> Whilst practical shiphandling skills will not be acquired by standing on the bridge as part of the back up team, keen observation will allow such students to acquire perceptions of the approach to be taken for successful task outcomes. (p. 5.22)

Clearly, social learning theory has implications for some simulator based training situations, particularly those where a team approach is used in the operation of the system being simulated. Flight simulation and ship simulation are two examples where individuals are exposed directly to the experiences of others while occupying a subordinate position within the team structure. Social learning theory does not deny that the team leader learns from direct experience, but raises the point that the other team members, as observers, will also experience some degree of learning from the direct experience of the team leader.

Simulator Trainees

The majority of trainees on marine simulator courses are adult learners. They range from those who have just completed high school to individuals with 30 or more years experience in the workforce. As learners, these trainees will have learning needs and exhibit learning characteristics typical of adult learners in other areas of education.

Fitzpatrick (1992) identifies a number of adult learning theories that are applicable to marine training in general and marine simulator training specifically. In general, adult learning theories do not specify any particular area of education however, they do imply that, if the learners are adults, teachers must be cognisant of the methodologies that will work best with adult learners.

Knowles (1970) characterizes the adult learner as follows:

> his self-concept moves from one of being a dependent personality toward one of being a self-directed human being; he accumulates a

> growing reservoir of experience that becomes an increasing resource for learning; his readiness to learn becomes oriented increasingly to the development tasks of his social roles; and his time perspective changes from one of postponed application of knowledge to immediacy of application, and accordingly his orientation toward learning shifts from one of subject-centeredness to one of problem-centeredness (p. 39).

This profile of the adult learner supports simulation as a teaching methodology for adult learners.

Caffarella (1993) has stated that "what differentiates self-directed learning from learning in more traditional formal settings is that the learner chooses to assume the primary responsibility for planning, carrying out, and evaluating those learning experiences" (p. 28). This is characteristic of simulation courses where the instructor acts as a facilitator, assisting the trainees to discuss and analyze the experiences provided by the simulation rather than simply pointing out mistakes.

Simulator training in the marine industry is closely linked to learner experience. In many of the mandatory courses offered, minimum requirements or recommendations for sea service exist as a prerequisite for course entry. For example, the Canadian Coast Guard (no date) has recommended that a candidate for the Simulated Electronic Navigation II simulator course should have at least nine months sea service as a ship's deck officer before being admitted to the course.

This implies a belief that mariners will benefit more from simulator training if they possess relevant experience prior to taking the course. This belief in the role of experience in learning is also supported by Brookfield (1983) who further stated that "experiential learning is used to describe the kind of learning undertaken by students who are given a chance to acquire and apply skills and knowledge in an immediate, relevant and meaningful setting" (p. 16). Clearly the learning environment provided through simulation meets all of the above criteria.

Mariners take simulation courses to obtain certification, in the case of radar navigation simulator courses, and to upgrade skills in the case of ship simulator courses. These reasons are among those listed by Daines, Daines and Graham (1993) in their discussion of adult motivation toward learning. Apps (1991) also points out that most adult learners have a practical reason for their learning. He further states that adults carry out praxis as a natural approach to their learning. Apps defines praxis as "the process where people learn something, try it out in a practical situation, reflect on what happened, refine the learning, try it again, reflect, and so on" (p. 42). Simulation offers adults the ideal medium to apply praxis in a learning situation.

It is clear from the literature that adults have different learning needs from those of children and that adult learning preferences must be understood by the teacher of adults. Children often look to the teacher to provide everything necessary for learning whereas adults need to assume more self-direction. Marine simulator instructors must allow mariners to experience the learning opportunities provided by simulation courses through the understanding and application of adult learning theory. Fitzpatrick (1992) points out that experienced mariners, when faced with a learning situation that does not value their experience, have reported feeling that their personal worth is of no value.

Simulation and Learning

According to Thorndike (1932/1971), there are three basic elements which must be satisfied in order for learning to take place. One of the conditions which must be present is some form of reinforcement. In his Law of Effect, he stated:

> when a modifiable connection between a situation and a response is made and is accompanied by a satisfying state of affairs, that connection's strength is increased: When made and accompanied or followed by an annoying state of affairs, its strength is decreased (p. 176).

Thorndike was referring to two forms of reinforcement which have evolved over the years and which are in common use today. Positive reinforcement occurs when a behaviour is continuously paired with favourable consequences, which leads in turn, to an increase in the behaviour. The second form, negative reinforcement, is the continuous withholding of an undesirable consequence when a desirable behaviour occurs. This will also lead to an increase in the behaviour. The two forms of reinforcement, although applied in a different way, may both be used to assist in the learning process.

Generally speaking, a simulator has a built in set of reinforcers which are presented in the form of feedback directly related to the action or decisions of the user. The reinforcement is inherent in the simulator, not as positive or negative reinforcers, but as success or failure in a particular task. Success is directly linked to satisfaction while failure is linked to discomfort. Success or failure, in the context of a simulator, can be either partial or complete but in either case is seen as the direct result of user actions. According to White and Bednar (1986), it is the perception of the user which ultimately determines whether the consequences experienced as the result of their actions or decisions are positive or negative.

The second required learning element is the opportunity to practice what has been learned. Thorndike (1932/1971) also proposed the Law of Exercise which stats that:

> other things being equal, the oftener a situation connects with or evokes or leads to or is followed by a certain response, the stronger becomes the tendency for it to do so in the future (p. 6).

Thorndike believed that this law applied when forming new behaviours or when modifying existing behaviours. By way of explanation, he stated:

> if, for example, by some means R2 is somehow made to follow closely upon S1 a hundred times, the tendency for S1 to evoke R2 will become stronger than it was and may become stronger than some other tendency, which was originally stronger than it (p. 6).

Simulation training employs the law of exercise by making use of the repeatability features of the simulator. A simulator exercise (the stimulus) can be repeated as often as required. Trainee actions (the response) during each running of the exercise can be monitored by the instructor who can, through careful observation and de-briefing at the end of each run, shape or modify the trainee response to the exercise. This response, in turn, can be transferred from the simulated stimulus to a similar stimulus in the real world. The Marine Board (1996) has stated that "because no situation is ever identical to a previous experience, the fact that an individual becomes more skilled with each repetition of a similar task attests to the fact of transfer" (p. 37).

The third element which must be present for learning to take place is the desire to learn. Thorndike referred to this as the Law of Readiness, however, more recently it has been referred to as learner motivation. Daines et. al. (1993) have listed a number of reasons why adults are motivated to learn which include learning or developing a skill and to obtain a work qualification. As previously stated, marine simulators are most often used for skill development for certification of ship's officers. Daines et. al. go on to list a number of things which serve as disincentives to learning including failure to achieve, unrealistic goals and an uncomfortable environment. They further state that:

> if students are to maintain an optimum level of learning motivation, they must identify and work to realistic goals that are within their capabilities and then experience some ongoing success in attaining them (p. 10).

The implications for marine simulator use in the above statement are twofold. First, students must have some input into the identification of course goals and, second, the course must be structured to build on prior successes rather than simply present a number of situations to which the student must react.

Simulation and Learning Styles

In current learning theories, much attention has been devoted to individual learning styles. Smith (1982) defines learning style as "the individual's characteristic ways of processing information, feeling and behaving in learning situations" (p. 24). A number of learning style inventories have been developed to assist teachers in selecting methods for the delivery of course material that address the different learning styles of class members. Course material may be presented in a variety of ways including lectures, through print material and by audio-visual means. The more varied the methods of presentation, the more likely that the majority of class members will learn the material. Kunz (1993) further added that:

> educational research has indicated that learning increases as more senses are involved in the learning process. For example, information that is seen and heard is better retained than if it is only heard. On-the-job training is often considered the best method of training because it offers both retention and transference of training (p. 1).

It has been stated previously that simulation is often used as a substitute for on-the-job training where the latter does not exist or is too dangerous for training purposes. Simulation is also used in many other circumstances where the application of course material is to be practised under realistic conditions. Learning theories tell us that not all people have the same learning styles and that a particular method will not work, to the same degree, for all people. If this is true of all teaching methods, then the same must be true of simulation as a teaching method.

Simulation however, in the context of at least one learning style inventory, may be one of the few teaching methods preferred by most learners.

This learning style inventory places learners into one of four categories. The categories and associated learning style are:

> The Concrete Experience learning style represents a receptive, experienced-based approach to learning that relies heavily on feeling-based judgements. Individuals learn best from specific examples in which they can become involved.
>
> The Abstract Conceptualization learning style is an analytical, conceptual approach that relies on logical thinking and rational evaluation. Individuals learn best in authority-directed, impersonal learning situations that emphasize theory and systematic analysis.
>
> The Active Experimentation learning style is an active "doing" orientation to learning that relies heavily on experimentation. Individuals learn best in small group discussions or working on projects.
>
> The Reflective Observation learning style indicates a tentative, impartial and reflective approach to learning. Individuals rely heavily on careful observation in making judgements, and prefer learning situations that allow them to take the role of impartial objective observers.

There are many types of simulations each of which have specific applications to which they are suited as a teaching method. Clearly not all learners will benefit equally from each application of simulation techniques, however, simulation can be used as an effective teaching method that addresses each of the learning styles outlined above.

The Concrete Experience learners will be at home in large scale simulations such as flight simulation and ship simulation. As pointed out by the Marine Board (1996), "from a technical perspective, in a high fidelity, full-mission ship-bridge simulator, the training environment is expected to approach equivalency with the actual operating environment being simulated" (p. 43). In these simulations, trainees are exposed to a replica of the real system which is complete in nearly every detail. By interacting with the simulation they are accumulating experiences which will allow them to build their responses to real world stimuli. As these simulations usually involve a team approach, individuals will also benefit from feedback and discussions with their peers.

Abstract Conceptualization learners will be able to interact well with role playing type simulations. In this type of simulation there is no one single answer to the problem and successive runs of the simulation will produce different results when different decisions are made during the simulation. Individuals are able to draw on their theoretical knowledge of the problem area and analyze data produced by the simulation.

Active Experimentation learners by nature like to learn from their mistakes. As pointed out by Drown and Mercer (1995), this can be costly in the real world of shipping in terms of material and damage to the environment. Simulations which involve the "human in the loop" are ideal for experimental learning. These simulations provide the trainee with complete control of the simulation outcomes through control of the vehicle being simulated. When used in the context of education these simulations adapt very readily to use as a teaching method.

Reflective Observation learners will benefit from the learning experiences of other individuals who take the role of team leader in large scale simulations. This has been supported by Bandura (1969) and Muirhead & Tasker (1991). These learners may prefer minor roles within a team structure where they will be in a position to observe and have limited input into the process without having total control over the decisions or outcomes. When called upon to assume a lead role in the simulation, these individuals will be able to draw on what they have learned through observation to base their judgements, decisions and actions taken during the simulation.

Simulation in Marine Training

Of all of the applications to which simulation is suited, training is by far the most common. In the Marine Industry, simulation is being used to train Deck Officers to navigate and manoeuvre ships, operate ballast and liquid cargo systems, manage bridge resources effectively and operate satellite based communication equipment. Engineroom simulators are also used in the training of ship's engineering officers. The wide range of applications in the marine industry makes simulation a valuable training tool. The Marine Board (1996) reports that the United States Coast Guard will now grant remission of sea time for mariners who attend simulator training courses.

This will effectively recognize simulator training as a partial replacement for at least some of the "on the job" training that mariners are currently required to complete.

Simulator training in the marine industry is not standardized in terms of either content, methodology or equipment. The capability of simulator equipment varies considerably and, in particular, differences between older simulators and more modern simulators can be very large. The International Maritime Organization (1996) has recommended general performance standards for simulators used in training courses. These courses are included in the Standards of Training, Certification and Watchkeeping for Seafarers (STCW) convention and are mandatory for the certification of deck officers. In Canada, the Canadian Coast Guard has responsibility for setting the minimum standards for radar and navigation simulator training. The Canadian Coast Guard publication TP4958 (no date) contains broad learning objectives for Simulated Electronic Navigation Courses (SEN) levels I and II, however they do not specify content.

The Canadian Coast Guard has set specific guidelines which must be met in order to become certified as a SEN I or SEN II instructor. These guidelines specify the professional qualification which must be held and the minimum acceptable teacher training which is required to become a simulator instructor. According to Theedom (1996), the only required simulator training is in the form of "on the job" training. This training is done under the supervision of a certified instructor with a final audit by a Coast Guard examiner near the end of the training period. Theedom further points out that, for consistency across the country, the audits are done by an examiner from the head office rather than the regional office. A few countries have established some guidelines and procedures to be followed in order to become certified as a simulator instructor; and the International Maritime Organization (1996) has also addressed the question of instructor training in the latest revision to the STCW convention.

The Simulator Instructor

The quality, preparation and background of the instructor is very important to the outcomes of a simulator based training program. Mercer (1993) has stated that the simulator operator (instructor) has one of the greatest influences on the interaction between the simulator and the trainee because it is that person who controls the implementation of the curriculum. The literature reveals a strong belief that a marine simulator instructor should be a mariner. Some authors believe that not only should a marine simulator instructor be a mariner, but that he or she should also be an effective teacher. Carpenter (1991) states that "the instructor must be an excellent practioner of the skills he is seeking to impart and have the ability to pass on that knowledge" (p. 63). This perspective is also supported by Rosengren (1992) who stated that "it is absolutely necessary that such a person has a nautical background with a lot of experience from the real situations of the same type we try to build up in the simulator" (p. 19.1).

A study conducted into simulator training effectiveness by Gynther, Hammell, Grasso and Pittsley (1982) also highlighted the importance of the instructor. The report stated:

> the most important finding was that, of the variables investigated, the instructor had the greatest impact on the effectiveness of training, thus implying that the instructor, not the simulator elements, is the most important element of the training program (p. 2).

It is evident from this work that the instructor's role in simulation goes far beyond simply operating the equipment. The instructor must be proficient in all areas of simulator training in order to be effective.

Components of Simulator Instruction

Other than classroom teaching, there are four separate and distinct aspects of simulator training in which the instructor has a major role to play. These four consist of exercise development, exercise briefing, exercise running and exercise de-briefing. The attitudes of the instructor in each of these areas will have an influence on the effectiveness of the training.

Exercise Development

The initial development of a simulator exercise is critical to the eventual outcome of the simulation training. In a recent report on marine simulation in the United States, the Marine Board of the National Research Council (1996) stated that scenario creation is crucial to optimizing the training value of individual exercises. While there does not appear to be any one recognized framework for exercise design in marine simulator training, there are common elements throughout the literature.

The process of designing a simulation exercise is not an easy one. According to Jones (1995) the simulation design process "involves a great deal of appraisal, discarding, selecting, and altering, and sometimes changing things around completely because of some new idea" (p. 60). This simulation development process clearly requires that a simulator instructor gain considerable experience with exercise development to become proficient.

Good exercise development starts with the formulation of clear objectives. Smith (1990) identifies the need for "a clear specification of the aims and objectives" (p. 153) as the first principle of marine simulator exercise design. This is supported by Robinson and Thatcher (1986) who stated that:

> the selection of the most appropriate

> structure to accommodate and relate to the purpose of the planned learning experience is crucial to the success of the enterprise. This means that the designer must be quite clear what he wishes the game or simulation to do., whether he wishes it to enable the participant to rehearse or learn factual information, enhance concepts or skills, or to identify processes or indeed to bring to consciousness one or many of these types of learning (p. 18).

However, a dissenting view is offered by Jones (1995) who implies that sometimes simulation designers "find out what they have created and add the objectives on afterwards to fit the likely achievements"(p. 84). Regardless of when the objectives are created, there appears to be agreement that the exercise must be consistent with the stated objectives.

The second step in exercise creation is to identify the criteria for successful completion of the exercise. In discussing the instructional design process, Kemp (1985) stated that:

> it is customary to derive test items from the objectives, with subject content or task items being used for details. Once you are satisfied with the extent and completeness of the learning objectives, you are ready to develop ways for evaluating them (p. 161).

The process of developing evaluation criteria is often left until after the exercise has been created, which in turn, often results in evaluation criteria not being related directly to the exercise objective. By deciding on the evaluation criteria before the exercise is created, the instructor ensures that the required elements for evaluation will be included in the simulation exercise.

Simulator Exercise Briefing

Briefing occurs prior to the start of a simulator exercise. There may be a number of reasons to hold a briefing session, but the most prominent one is to inform the participants about the simulation, and if necessary, allow them time to make preparations. Pedersen (1990) states that before a simulator exercise starts the instructor must "explain the starting conditions" and "describe what actions you expect during the exercise"(p. 146). He also implies that it is the student who decides when the simulation is to begin by reporting to the instructor when the exercise description, charts and manuals have been studied. Muirhead and Tasker (1991), in outlining the requirements for a standardized training methodology using marine simulators, offer the following:

> Prior to the commencement of each exercise, students will be fully briefed on the objectives of the exercise, the roles they will play and the standards of performance expected of them (p. 34).

It is clear from the above sources that a briefing is a desirable part of simulation training. The instructor's role in briefing is to facilitate information exchange and to ensure that all participants are fully prepared to take an active role in the simulation. Jones (1995) maintains that briefing is easy, providing it is based on personal participation by the instructor, and on careful preparation. He further states that "the facilitator will enter the briefing primed with explanatory notes, diagrams, maps, timetables, deadlines, or whatever else is necessary" (p. 113).

Trainees must be given sufficient information during the briefing to enable them to function within the simulation however, Jones believes that facilitators should be cautious about giving too much information to the participants during the briefing. In most simulations, it is one of the functions of the participant to obtain relevant information either through preparation prior to the start of the simulation, through interaction with the simulation, or through both. This is supported by Bole (1986) who maintains that "simulator exercise briefings should, in general, be simple. However, more complex exercises may require time for students to familiarize themselves with the charts etc. and, where appropriate, prepare a passage plan"(p. 4-5).

The briefing process as described in the literature, does not appear to conform to any clearly defined rules. The briefing is usually carried out by the instructor or facilitator but, as Jones (1995) observes, some facilitators may give students the opportunity to act as the facilitator. In the Canadian Navy Officer of the Watch Training Program

(1995), and in the Australian Navy (1992) equivalent, it is common practice for the trainee to conduct the briefing for the instructor.

Oral briefing appears to be the most common method of passing on information, but as Bole (1986) points out, written briefing cards allow the student to refer to the card rather than have to remember the details of what may have been a complex oral briefing.

Simulator Exercise Running

Running a simulation may require very little intervention on the part of the instructor, or it may require constant intervention. This will depend on the structure of the simulation and whether or not the instructor's role has been planned to include interventions. Mercer (1990) has stated that, in some simulator exercises, the instructor will be required to take on roles which are external to the roles of the trainees who are participating in the simulation. This may include taking on the role of the "captain" of various other ships in the simulation exercise or the role of a shore based radio operator who provides traffic information when port entry is being simulated.

It is difficult to control simulation outcomes without instructor intervention simply because trainees have usually been given the autonomy to act according to their perceptions and understanding of the situation presented to them in the simulation. Caillou, Percier and Wagemannt (1992), in discussing the need for video and audio monitoring on a ship simulator, state as a benefit of close monitoring that "once a typical wrong behaviour is detected, the exercise can be frozen, mistakes pointed out by the instructor, and the exercise started again either from the beginning or from the actual situation" (p. 11.7). A more moderate view of instructor intervention is taken by Beadon (1992) who maintains that "the instructor should be able to add, delete or modify conditions (such as weather and traffic ships) to assist in meeting the training objectives" (p. 35.4). Jones (1995) believes that the facilitators role is to ensure that drastic interventions are avoided. He states that:

> It is rarely the case that the unexpected arises unexpectedly. There are usually warning signals and the facilitator should watch out for them. In this way, drastic intervention can often be avoided by taking minor remedial action. Even if a major disruption occurs, the facilitator will have had time to work out some contingency plans (p. 116).

Each of the above sources agree that instructor intervention is necessary to varying degrees. Kerr (1977), on the other hand maintained that instructor interventions in a simulation can only serve to disrupt the students train of thought and cause the student to block out the instructors explanations. He maintained that it is better to sit in the background and take notes for use in a remedial teaching session or in a de-briefing session at the end of the simulation.

It is clear from the literature that the instructors main function during the simulation is to monitor and collect data which will be used during the de-briefing to follow. Any intervention in a simulation should be planned in advance and should only be initiated by the instructor if the foreseen (or planned) situation develops. Spontaneous intervention to force a participant to make a particular decision or to make an error should be strictly avoided.

Simulator Exercise De-briefing

There are many who believe that all other elements of simulation training are merely a lead in to the de-briefing segment, where almost all of the learning takes place. Crookall (1990) places the importance of de-briefing to simulation and gaming into context by stating "if there is one thing that gamers have always spoken of as being vital, and that forms one of the mainstays in Kolb's theory of experiential learning, it is the preeminent role of de-briefing - of reflecting on experience" (p. 3).

The literature identifies a number of de-briefing practices, all of which have some merit. It is evident that most, if not all, descriptions outline a methodology which works in particular individual circumstances. Jaques (1985) identifies a series of events in the Experiential Learning

Cycle as follows:

1. Experience - of events or series of events
2. Description - of event sharing and collecting observations
3. Interpretation - making sense, interpreting and finding relationships
4. Generalizing - bringing in past events, relating to future
5. Application - preparing for next experience (p. 59)

Of the five items in the cycle, Jaques maintains that the last four items constitute de-briefing.

Most properly conducted de-briefing sessions generally tend to follow the above pattern, however, the methods used by individual instructors may differ. For example, Jones (1995) states that it may be a good idea to let participants conduct the debrief, particularly if the simulation itself involved this sort of function for the participants. Others, such as Bole (1986), believe that the instructor must lead the debrief and attempt to bring the participants to the appropriate conclusions.

The debrief should focus on all aspects of the simulation. According to Pedersen (1990), the instructor should take advantage of the debrief to reinforce both positive and negative aspects of the simulation. It may be necessary for the instructor to revert to the role of teacher, rather than facilitator, during the debrief in order to ensure principles and facts are clearly understood by participants.

However, participants in a simulation must be accountable for their actions during the simulation. This is reinforced by Meurn and Sandburg (1993) who describe one simulation course where the debrief usually "lasts at least one hour with the student doing most of the talking, explaining step by step how and why he or she performed each evolution" (p. 401). Clearly there is also evidence that suggests that a time limit on de-briefing is undesirable.

Summary

The use of simulation as a teaching tool is relatively new in the marine industry. Since the late 1960's there have been a considerable number of improvements in the technology, especially in recent years, due to the rapid advances in computer technology. Teaching methodologies used with simulation in the marine industry have evolved over the years, mainly through trial and error by practising instructors.

There is a clear indication in the literature of the strong belief in the importance of the role of the simulator instructor with regard to simulator training effectiveness. Until recently, marine simulator instructor qualifications and training requirements were often left to the discretion of individual marine administrations and, or marine training facilities. In the latest revision to the STCW, the IMO has addressed the issue of qualifications and training for simulator instructors.

This review has highlighted some of the many issues which must be addressed regarding the training of marine simulator instructors. The underlying learning theories which support simulation and, indeed, the many applications for which simulation is suitable are important to the understanding of how simulation supports learning. An understanding of adult learning theory and educational psychology are also important to instructors using simulators for training mariners. The instructor's role in each of the learning processes of exercise development, exercise briefing, exercise running and exercise de-briefing, as part of a simulation exercise, is evident from the literature. The study which follows looks at the attitudes and perceptions of existing marine simulator instructors toward simulation and attempts to identify current practice and training needs for this group.

CHAPTER III

THEORETICAL FRAMEWORK AND RESEARCH DESIGN

Introduction

In recent years there has been some concern about the preparation received by instructors who train mariners using marine simulators. While there are national marine authorities which require instructors to hold mariner qualifications, and in some cases, teacher qualifications, there are no international training standards for marine simulator instructors. The International Maritime Organization (IMO) has recently revised the Standard of Training Certification and Watchkeeping for Seafarers Code (STCW) and, for the first time, have included a section on the training of simulator instructors. Section A-I/6 of the Code states that "any person conducting the in-service training of a seafarer using a simulator shall have received appropriate guidance in instructional techniques involving the use of simulators; and have gained practical operational experience on the particular type of simulator being used."

Since the Code is somewhat vague on which instructional techniques may be appropriate for use with simulators, it is necessary to identify educational methodologies in common use. The data collected for this study helped to identify the attitudes and perceptions about training which are held by practising marine simulator instructors. It is anticipated that this, in turn, will lead to a more complete understanding of marine simulator training, the practices which have evolved through experience, and also for changes based on several recommendations.

Although marine simulator instructors will have a variety of related tasks to perform depending on the type of courses they deliver and the type of equipment that they use, it is typical to organize the tasks associated with the actual usage of simulators into four categories:

1. **Simulator Exercise Development.** In order for trainees to have a meaningful interaction with the simulation, the instructor must carefully prepare and validate the simulator exercise well in advance of the training. The simulator exercises must be developed to meet clearly defined learning objectives and must be of an appropriate difficulty level for the trainees for which it is intended.

2. **Simulator Exercise Briefing.** The briefing prior to the running of the simulator exercise is important for the successful completion of the exercise by the trainee. The briefing may be either oral or written but, in any case, must include all information necessary for the trainee to prepare and execute the exercise. The briefing session usually includes sufficient time for the trainees to prepare the exercise.

3. **Simulator Exercise Running.** The instructor will

interact with the trainee by playing the role of other ship and shore based personnel. The instructor will normally allow the exercise to run as programmed unless it becomes apparent that intervention is necessary to preserve the exercise objective. The instructor must monitor all exercise parameters to ensure that trainees obtain the maximum benefit from the simulator.

4. **Simulator Exercise Debrief.** The debrief session following the exercise run should be a candid analysis of the trainee performance during the exercise. The debrief should cover both the positive and negative aspects of trainee performance. The instructor must draw from observations made during the exercise run to ensure that the process is both comprehensive and effective.

These four areas related to simulator training, combined with a general section on simulator related issues, formed the basis of the questionnaire used for this study. The attitudes and perceptions of marine simulator instructors toward these responsibilities likely have a considerable impact on training outcomes.

Population

The population for this study consisted of marine simulator instructors who conduct courses at selected simulator facilities around the world. The author could not locate a complete list of all existing simulator facilities nor was a complete list of marine simulator instructors available. It was therefore necessary to consult a number of sources in order to compile an appropriate list.

Attendance lists from the three most recent International Radar and Navigation Simulator Lecturers Conference (IRNSLC6, IRNSLC7 and IRNSLC8) were used to obtain addresses of facilities which have radar and navigation simulators. The International Marine Simulator Forum (IMSF) membership list was used to obtain addresses of ship manoeuvring simulator facilities. The author also wrote to a number of marine simulator manufacturers who consented to provide lists of simulator facilities which they had installed. The manufacturers provided addresses of both radar and navigation simulators and ship manoeuvring simulators. Finally, a partial list of marine school addresses was identified in an international marine directory of services.

Separate mailing lists were compiled of simulator facilities identified as either operating radar navigation simulators or ship manoeuvring simulators. Facilities that operated both types of simulator were included in both mailing lists. A total of 223 radar navigation simulator facilities and 36 ship manoeuvring simulator facilities were identified. Two questionnaires were sent to each of the identified simulator facilities. Overall 518 questionnaires were distributed to 259 simulator facilities.

Design of the Study

In order to investigate the attitudes and perceptions of marine simulator instructors, a questionnaire was developed by the author, a copy of which is included in Appendix A. It was necessary to develop the questionnaire after a literature review failed to identify any instruments which could be used, or modified for use, to study the attitudes and perceptions of marine simulator instructors toward simulator training.

The questionnaires were mailed to the identified simulator facilities in September 1995. The questionnaires were completed between October and December of 1995 at the various facilities. The analysis was conducted between February and May of 1996 at Memorial University of Newfoundland using the Statistical Package for the Social Sciences (SPSS).

Hypothesis of the Study

The following hypothesis were formulated from the research questions in Chapter 1 to identify similarities and differences in the attitudes and perceptions of the marine simulator instructors who responded to the questionnaire.

Hypothesis 1: There are no differences in the general perceptions of simulator use for training: (a) between instructors who operate only radar simulators, those who operate only ship manoeuvring simulators and who operate both types of simulator; (b) between instructors who hold a Master

Unlimited certificate of competency and those who hold other qualifications; (c) between instructors who have served as Master on a ship and those who have not served as Master on a ship; (d) between instructors who hold a teaching certificate and those who do not hold a teaching certificate; (e) between instructors who are certified as a marine simulator instructor by their country and those who are not certified by the government of their country; (f) between instructors who use simulator equipment that has a visual system and those who work on simulator equipment that does not have a visual system; and (g) between instructors who work at privately funded facilities and those who work at publicly funded facilities.

Hypothesis 2: There are no differences in perceived training procedures between instructors who operate only radar simulators, those who operate only ship manoeuvring simulators and those who operate both types of simulator.

Hypothesis 3: There are no differences in perceived training procedures between instructors who hold a Master Unlimited certificate of competency and those who hold other qualifications.

Hypothesis 4: There are no differences in perceived training procedures between instructors who have served as Master on a ship and those who have not served as Master on a ship.

Hypothesis 5: There are no differences in perceived training procedures between instructors who hold a teaching certificate and those who do not hold a teaching certificate.

Hypothesis 6: There are no differences in perceived training procedures between instructors who are certified as a marine simulator instructor by their country and those who are not certified by the government of their country.

Hypothesis 7: There are no differences in perceived training procedures between instructors who use simulator equipment that has a visual system and those who work on simulator equipment that does not have a visual system.

Hypothesis 8: There are no differences in perceived training procedures between instructors who work at privately funded facilities and those who work at publicly funded facilities.

Hypothesis 9: There is no relationship between the number of years served at sea before becoming a marine simulator instructor and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

Hypothesis 10: There is no relationship between the number of years served as a marine simulator instructor and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

Hypothesis 11: There is no relationship between the age of the simulator equipment used by marine simulator instructors and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

Hypothesis 12: There is no relationship between optimum simulator exercise length and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

Hypothesis 13: There is no relationship between time spent briefing trainees and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

Hypothesis 14: There is no relationship between time spent de-briefing trainees and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

Hypothesis 15: There is no relationship between time spent on exercise development and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

Instrumentation

A single questionnaire was designed and developed to investigate the attitudes and perceptions of marine simulator instructors toward the areas of simulator training previously identified in this chapter. The questionnaire consisted of 10 personal information items, 13 simulator equipment operation items, 30 general items, 15 exercise development items, 13 exercise briefing items, 9 exercise running items and 12 exercise de-briefing items.

The questionnaire items were designed so that a number of questions were worded in a positive manner while others were worded negatively. This was done to ensure that the responses were not influenced by the general wording of the items. A four point Likert scale was used to solicit responses which either (1) strongly agreed, (2) agreed, (3) disagreed, or (4) strongly disagreed with each statement. Blank spaces were provided for items which called for individuals to provide other information in the form of open-ended responses.

Instrument Validity

A review of the literature was undertaken in order to identify areas where a valid investigation should be conducted. While the literature search did not produce a large volume of material on the subject, it was evident that there were five main areas of simulator operation which needed to be addressed. This was especially apparent from papers written by marine simulator instructors for various International Navigation Simulator Lecturers Conferences and International Marine Simulator Forum MARSIM conferences. One of the areas identified related to the attitudes and perceptions of instructors in general, while the remaining areas were directly related to the four key aspects of simulator operation, namely, simulator exercise creation, simulator exercise briefing, simulator exercise running and simulator exercise de-briefing.

A number of statements, which, in the opinion of the author, would provide data on the attitudes and perceptions of marine simulator instructors in the identified areas, were developed. In order to validate the statements, and ensure that they were placed in the appropriate categories, a table containing all the statements was provided to a panel of experts. Two of these were in the field of marine simulation while the third was an expert in the field of Industrial Education. A covering letter (Appendix B) was included to ensure that the nature of the study was fully explained. The experts were asked to review the instrument for content relevance and identify items which, in their opinion, should be excluded from the instrument. The experts were also asked to add items which, in their opinion, would strengthen the instrument; and to also make any suggestions with regard to content and wording which, in their opinion, would further clarify and strengthen the instrument. The experts were also asked to comment on the appropriateness of the category in which each item had been placed.

The final questionnaire was developed after a review of the experts' comments. While the wording of some items was changed on the basis of individual comments from only one of the experts, no item was included in the final questionnaire unless at least two of the three experts had agreed on retaining that item and the category in which it fitted.

Procedures

In order to proceed with this study, it was necessary to have the cooperation of the various marine simulator facilities which had been identified for inclusion in the research. This was accomplished by sending a package containing two questionnaires and a covering letter (Appendix B) addressed to the attention of either the Director of the radar navigation simulator or the Director of the ship manoeuvring simulator as appropriate. Where facilities were identified as having both types of simulator, two separate packages were sent. The packages were distributed by mail on September 11, 1995 with the intention that they should arrive at the simulator facilities, be completed and returned by December 31, 1995.

The Director at each facility was asked to cooperate with the study by administering the questionnaire to two of the instructors at the facility. They were informed that the questionnaires were coded to allow for follow up purposes only. It was also indicated that individual instructors would not be identified, nor would any simulator facility or other individual be identified in the study. They were informed that participation in the study was voluntary and limited to the completion of the questionnaire. No instructions were given as to the selection criteria of the instructors who would be given the questionnaire other than a covering letter (Appendix D) included with the questionnaire. This letter explained the purpose and nature of the study to the selected instructors. They were also informed that participation was voluntary and that they could refrain from answering any question which they chose to omit. Instructions for completing the questionnaire were included.

Analysis of Data

All data were analyzed using the Statistical Package for Social Sciences (SPSS) version 6.1 for Windows. Analysis was completed on the responses to all questionnaire items.

Descriptive statistics were generated from questions 1 to 23. These were then used to compile a profile of the questionnaire respondents and the nature of the equipment they operated. A number of groups and sub-groups were identified and further analyzed on an individual basis.

The remaining items on the questionnaire employed a four point Likert scale which required respondents to indicate they 1) strongly agreed, 2) agreed, 3) disagreed or 4) strongly disagreed with the statement. A frequency count was completed for each of these items on the questionnaire.

Analysis of variance procedures were used to address hypotheses one through eight which sought to identify differences between various groups and sub-groups of simulator instructors. Items were grouped into clusters that represented attitudes and perceptions related to each of simulator exercise development, briefing, running and de-briefing. Cronbach's test of alpha reliability was conducted on each cluster. This process was used to eliminate any possible weaker items in each cluster thereby improving the overall reliability of the instrument and making the tests of significance more meaningful. An analysis of variance was conducted on each cluster to further determine whether significant differences existed.

In order to determine whether any relationships existed between the groups and sub-groups identified in the study hypotheses, a Spearman's Rho correlation matrix was created. The null hypothesis was either accepted or rejected based on the results of this analysis.

Description of Respondents

Overall, 136 responses to the questionnaire were received. Questions 1 through 23 enabled the author to compile a descriptive profile of the respondents and the simulator equipment they operate.

Simulator Type Used

In question 1, respondents were asked to indicate the approximate percentage of their time spent using radar navigation simulators, ship manoeuvring simulators or other types of simulators. As can be seen in Table 1, the 104 instructors who indicated that they operated radar navigation simulators spent a mean of 62% of their time using this type of equipment. A total of 74 instructors who operated ship manoeuvring simulators did so about 45.5% of their time. The 36 instructors who operated other types of simulators indicated that 30% of their time was spent doing this.

From the responses, it was evident that a number of instructors operated more than one type of simulator. Since the focus of this study was specific to radar and navigation simulator and to ship manoeuvring simulator operation, further analysis of the responses to this question was necessary to determine the number of instructors who operated only radar navigation simulators, only ship manoeuvring simulators or a combination of both types of simulator. The results of this further analysis are presented in Table 2 which shows that 44 respondents operated only radar navigation simulators, 14 operated only ship manoeuvring simulators and 56 operated both types of simulator.

Use of Simulator Equipment

Question 2 asked the respondents to indicate the number of hours per week spent using a simulator for teaching and preparation. Responses are shown in Table 3.

Table 1

Percentage of Time Spent Using Various Simulator Types (n = 136)

Simulator Type	Respondents		Percent of Time	
	Freq.	Percent	Range	Mean
Radar/Navigation	104	76.47	2 - 100	61.99
Ship Manoeuvring	74	54.41	5 - 100	45.47
Other	36	26.47	3 - 100	30.08
No Response	22	16.18	NA	NA

Table 2

Number of Instructors Operating Each Simulator Type (n = 136)

Simulator Type	Respondents	
	Freq.	Percent
Radar/Navigation	44	32.35
Ship Manoeuvring	14	10.29
Both Types	56	41.18
No Response	22	16.18

It can be seen that 126 instructors (92.6% of respondents) use a simulator for teaching for an average of 15.71 hours a week. The 115 instructors who indicated that they use a simulator for preparation purposes spend a mean time of 5.83 hours a week engaged in this activity. Such mean times imply that the ratio of teaching to preparation is approximately one hour preparation for every three hours of teaching. It also should be noted that while 115 respondents spent some time using the simulator for preparation each week, most of these (80 respondents) indicated that they spent five hours or less per week using the simulator for this purpose.

Table 3

Hours per Week Spent in Teaching and in Preparation Using a Simulator (n = 136)

Activity	Respondents		Hours per Week		
	Freq.	Percent	Range	Mean	SD
Teaching[1]	126	92.65	2 - 40	15.71	12.7
Preparation[2]	115	84.56	1 - 30	5.83	7.5
No Response Teaching	10	7.35	NA	NA	
No Response Preparation	21	15.44	NA	NA	

[1] Two respondents indicated that they used a simulator for teaching 80 and 84 hours per week respectively. These responses were not included as it was felt that the number of hours indicated was unreasonable.

[2] One respondent indicated that a simulator was used in preparation for 60 hours per week. This response was not included as it was felt that the number of hours indicated was unreasonable.

Work Experience of Instructors

Questions 3 to 6 were designed to determine each respondent's level of mariner certification, number of years at sea prior to becoming an instructor, number of years working as a simulator instructor and whether the respondent had been in command of any ship. The responses to these items are reported in Table 4.

Table 4

Marine Qualification and Experience of Marine Simulator Instructors (n = 136)

Certification	Holders		Mean Sea Time (Yr)	Mean Inst Time (Yr)	Served as Master	
	Freq.	%			Freq.	%
Master Unlimited	84	61.76	16.0	8.4	58	42.65
Master Limited	17	12.50	15.7	8.4	13	9.56
Commander (Navy)	4	2.94	8.5	14	3	2.21
Chief Officer	12	11.76	10.4	3.6	2	1.47
Other	17	12.50	8.2	6	4	2.94
No Response	2	1.47	NA	NA	1	0.74

Of the five groups identified in Table 4, only Master Unlimited, Master Limited and Commander (Navy) are considered to hold a command level certificate enabling them to serve as Master on large ships. Those in the Chief Officer and "other" groups, who indicated that they had served as Master, may have held minor qualifications which entitled them to serve as Master on small vessels. However, this was not readily apparent from the data.

As can be seen from Table 4, 84 (61.76%) of respondents held a Master Unlimited certificate. This group had the highest mean sea time experience (16.0 years); the greatest mean time as instructors (8.4 years); and the highest number (58) who had served as a Master. A total of 17 (12.50%) of the instructors held a Master Limited certificate. This group had a mean of 15.7 years at sea and 8.4 years as a simulator instructor. Thirteen of them had served as Master. Only four (2.94%) of the instructors held qualifications as Commander (Navy). The mean sea time for this latter group was 8.5 years, while the mean time as an instructor was 14 years. Of this group, three indicated that they had served as Master of a ship. Overall this data supports the notion that mariners with command level certification and experience as a ship Master are typical candidates for recruitment as marine simulator instructors.

The 12 (11.76%) instructors who held certification as Chief Officer reported a mean sea time of 10.4 years and a mean time as an instructor of 3.6 years. Of the 12 instructors in this group, two had served as Master. The group designated "other" contained 17 (12.50%) instructors. This group indicated a mean of 8.2 years sea time and a mean time as an instructor of 6.0 years. Four indicated they had served as Master.

Academic Qualifications

While the study did not specifically establish the precise academic qualifications of the respondents, Question 7 did address academic qualifications in general. Table 5 shows the breakdown of such qualifications held by level of respondent professional mariner certification. A total of 182 instructors indicated that they had some level of postsecondary education. Some also indicated they had more than one of the listed academic qualifications. The high number of instructors that responded as having a Master's degree may be due to confusion on the part of the respondents between a Master's Certificate and a Master's Degree. However, the most important factor in Table 5 relates to the fact that only about 30% of the respondents indicated that they hold a teaching certificate.

A further question related to academic qualifications was included to establish whether or not the respondents were currently enrolled in a programme of educational studies. Table 6 shows the breakdown of this by professional mariner certification held.

A total of 24 persons indicated that they were in the process of obtaining one of the additional qualifications listed in Table 6. The total number of instructors with a teaching certificate will, according to the data, be increased by only seven, should those enrolled be successful.

Place of Work

Question 9 asked respondents to indicate whether they worked at a private institution, a public institution (government funded) or some other type of institution. Of the 134 responses to this item, 22 (16.4%) respondents indicated that they worked at a private institution, 99 (73.9%) indicated they worked at a public institution and 13 (9.7%)

Table 5

Academic Qualification by Professional Mariner Qualification Held (n = 136)

Mariner Qualification	PhD		Masters Degree		Baccalaureate		Diploma		Teaching Cert	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Master Unlimited	2	1.47	33	24.26	28	20.59	30	22.06	22	16.18
Master Limited	1	0.74	2	1.47	7	5.15	6	4.41	10	7.35
Commander (Navy)	0	0.00	2	1.47	2	1.47	1	0.74	2	1.47
Chief Officer	0	0.00	3	2.21	4	2.94	4	2.94	3	2.21
Other	0	0.00	3	2.21	6	4.41	7	5.15	4	2.94
Totals	3	2.21	43	31.62	47	34.56	48	35.30	41	30.15

Table 6

Enrolment in a Programme of Studies by Professional Mariner Qualification Held (n = 136)

Mariner Qualification	PhD		Masters Degree		Baccalaureate		Diploma		Teaching Cert	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Master Unlimited	2	1.47	6	4.41	4	2.94	2	1.47	2	1.47
Master Limited	1	0.74	1	0.74	0	0.00	0	0.00	0	0.00
Commander (Navy)	0	0.00	0	0.00	0	0.00	0	0.00	1	0.74
Chief Officer	0	0.00	0	0.00	0	0.00	1	0.74	2	1.47
Other	0	0.00	0	0.00	0	0.00	0	0.00	2	1.47
Totals	3	2.21	7	5.15	4	2.94	3	2.21	7	5.15

indicated they worked at some other type of institution. It is apparent from these responses that the majority of marine simulators are operated in government sponsored institutions.

Instructors were also asked to indicate whether they were certified by the government of their respective countries as marine simulator instructors. Of the 133 responses to this item, 60 (45.1%) indicated that they were certified by their government, while 73 (54.9%) indicated that they were not certified. This is an indication that many national governments have already begun to put some emphasis on the qualification and training of marine simulator instructors.

Those who responded positively to the certification question were asked to describe the sequence of requirements necessary for them to actually become certified. The resulting responses were categorized as shown in Table 7. As can be seen, the hiring of instructors is most often based on professional mariner certification, sea time accumulation and teaching simulator courses under the supervision of a previously approved simulator instructor. It is rare that completion of teacher training is a requirement.

It is possible that institutions with simulator facilities may have internal requirements for teacher training. However, as can be seen in Tables 5 and 6, many instructors do not have teacher training qualifications and are not actively engaged in obtaining them. It is evident that the majority of simulator instructors are recruited directly from industry and are trained within a loosely structured mentoring system, after which, they gain experience on-the-job while delivering simulator courses.

Table 7

Requirements Necessary to Become Certified as an Instructor (n = 136)

Requirements	Freq.	Percent
Obtain acceptable qualifications.	26	19.1
Teach or assist in teaching the course.	16	11.8
Obtain sea time/experience requirements	12	8.8
Observe course / courses for which approval is sought or take course as student.	10	7.4
Attend course in simulator operation.	10	7.4
Get approval from appropriate authority	8	5.9
Meet requirements (not specified) of approving body	7	5.1
Obtain teaching certificate or equivalent.	6	4.4
Accumulate teaching experience.	3	2.2
Included in other qualification held.	1	0.7
Meet requirements of simulator facility / school.	1	0.7
Examined / interviewed by appropriate authority.	1	0.7
No Response	88	64.7

Running Simulator Exercise

Questions 11 to 14 asked respondents to indicate what they felt was the optimum running time of a simulator exercise and the average time spent on briefing, de-briefing and developing a typical simulator exercise. The term "typical" was deliberately not defined since it was felt the responses would not reflect the true opinions of respondents if any parameters were set by the researcher.

Table 8

Optimum Running Time of a Typical Simulator Exercise and the Time Spent by Instructors for Briefing, De-briefing and Development of a Typical Simulator Exercise

Activity	Responses		Time (Min)		
	Freq.	Percent	Range	Mean	SD
Running	128	94.12	10-300	63.38	44.90
Briefing	134	98.53	2-90	17.57	15.52
De-briefing	134	98.53	5-60	23.05	12.74
Developing	119	87.50	3-640	143.10	135.79

Table 8 reveals that instructors consider the optimum running time for a simulator exercise to be just over one hour, as indicated by the mean time of 63.38 minutes. Instructors spend an average of 17.57 minutes briefing before a simulator exercise and an average of 23.05 minutes de-briefing at the completion of the exercise. On average, the development of a one hour simulator exercise requires 143.10 minutes.

It should be noted that simulator exercises can range from simple collision avoidance requiring as little as 10 minutes to complete to complex navigation exercises requiring several hours to complete. The development time required for simulator exercises will be directly related to the complexity of the exercise. This accounts for the wide range of responses for exercise running time and exercise development time.

Simulator Equipment Characteristics

Question 15 on the questionnaire asked respondents to indicate the number of ship cubicles that were included with their simulator. Note, cubicles are the commonly accepted term for the simulated bridges which form a part of marine simulators. While there may be exceptions, radar navigation simulators usually have multiple cubicles however, ship manoeuvring simulators usually have only one cubicle. The number of cubicles reported ranged from 1 to 25. A total of 21 respondents (15.44%) indicated that their simulator had only one cubicle. The majority of respondents (63.24%) indicated that their simulator had two, three or four cubicles.

Question 16 was included to determine the age of the simulator equipment currently in use. Table 9 summarizes the results. The data support the notion that simulator use in marine education has rapidly increased in recent years. Although it is unknown whether the 52 simulators between one and three years of age were replacements of older simulators or if new installations, it is clear that considerable resources have been put into simulation equipment very recently.

In order to determine the purposes for which simulator equipment was being used, respondents were asked to indicate in question 17 whether their simulator was used as a radar navigation simulator, a ship manoeuvring simulator or for some other purpose. The respondents were not provided with definitions of what constituted either type of simulator.

Table 9

Simulator Equipment Age
(n = 136)

Age of Simulator	Frequency[1]	Percent
1 - 3 years	38	38.24
4 - 6 years	15	13.24
7 - 9 years	12	11.03
10 years or more	34	33.09
No Response	3	4.41

[1] The frequencies represent the number of institutes rather than the number of respondents.

In total, 121 (88.9%) respondents indicated that their simulator was used as a radar navigation simulator, 79 (58.1%) reported that their simulator was used as a ship manoeuvring simulator and 32 (23.5%) indicated that their simulator was used for other types of training. Other uses reported included Automatic Radar Plotting Aid (ARPA) simulation, Vessel Traffic Services (VTS) simulation and Global Marine Distress and Safety System / Communications training.

The extent to which visual systems were employed on the marine simulator equipment used by respondents was determined. Those who responded positively to this question were asked to indicate the number of cubicles that were equipped with such systems. A total of 68 (50%) respondents indicated that their simulator had visual displays in at least one cubicle. The number of cubicles having visuals ranged from 1 to 25, with 26 facilities reporting multiple cubicles with visual systems. Overall, a total of 162 cubicles having visual systems were reported. This indicates that 32% of simulator cubicles are equipped with a visual system. It should be noted, however, that 37 of these cubicles were reported at two facilities. It is also possible that these facilities may have included desktop simulators in the total.

In an effort to further evaluate the capability of simulator equipment in current use, the respondents were asked to indicate if their simulators were fitted with selected systems. These selected systems included motion systems that reproduce ship motions in the sea, sound systems that reproduce sounds such as wind and ship whistles, Automatic Radar Plotting Aids that track other ships, Electronic Chart Display and Information Systems that are used in navigation and simulator exercise record and playback systems. Responses to this question are shown in Table 10.

Table 10

Number of Selected Systems Installed on Marine Simulators (n = 136)

System	Frequency	Percent
Motion	50[1]	36.76
Sound	88	64.71
ARPA	125	91.91
ECDIS	31	22.79
Record/Playback	124	91.18

[1] The high number of motion systems reported does not coincide with the number of motion systems known to exist. There may have been some confusion on the part of some respondents as to the type of motion system they were being asked to indicate.

Question 20 was included to determine the extent to which respondents wished to upgrade or add to the systems available on their simulator equipment. Table 11 contains the responses to this question. Most would like to add a number of systems to their existing simulator including a visual system, an Electronic Chart and Information Display System (ECDIS) and a sound system. Visual systems, sound systems, ARPA systems and ship mathematical models were among the highest priority for upgrades.

Respondents were also asked to indicate if their organization had any plans to upgrade their simulator or purchase a new simulator. A total of 80 (58.8%) respondents

Table 11

Systems That Instructors Would Like to Upgrade or Add to Existing Simulator Installations
(n = 136)

System	Add		Upgrade		No Response	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Visual	45	33.09	50	36.76	41	33.82
Motion	23	16.91	12	8.83	101	74.26
Sound	31	22.79	31	22.79	74	54.41
ARPA	9	6.62	33	24.26	94	69.12
ECDIS	67	49.26	19	13.97	50	36.76
Navigation Instruments	22	16.18	32	23.53	82	60.29
Ship Math Models	24	17.65	39	28.68	73	53.68
Record /Playback	12	8.83	33	24.26	91	66.91
Other	11	8.09	5	3.68	120	88.24

indicated that their organizations had plans to upgrade simulator equipment within the next two years, while 53 (39%) indicated that their organizations had plans to purchase new simulators within the same time frame. This supports a planned growth in simulator use.

Question 23 asked respondents to indicate whether their organization had the services of a full-time technician to maintain and trouble shoot the simulator equipment. A total of 73 (53.7%) respondents indicated that their organization had full-time technicians on staff. This may be an indication of the increasing level of technology being employed in the field of marine simulation and the resultant need for support services.

The Marine Simulator Instructor

Based on the data collected in this research, a marine simulator instructor can be described, in general terms, as being a mariner who holds a command level certificate of competency and who has probably been in command of at least one ship. This person served at sea for approximately 15 years before becoming a simulator instructor for approximately eight years. The instructor has likely completed some additional academic studies, however, it is unlikely that current academic upgrading is taking place. The instructor may have completed a programme of teacher training, however, if such a programme has not already been completed, it is unlikely that the instructor is enrolled in a teacher training programme.

Instructors will most likely work with simulator equipment that is less than three years old or more than 10 years old. In general, the simulator equipment contains similar features, and similar upgrades and additions are required. The instructor will use the simulator equipment for approximately 22 hours a week, 16 of which are teaching and the remainder for preparation. A typical instructor will spend 17 minutes briefing before an exercise, 60 minutes running the exercise and 23 minutes de-briefing after completion of the exercise. Development of a 60 minute exercise will take approximately 140 minutes to complete.

CHAPTER IV

ANALYSIS OF DATA

Introduction

The analysis of the data collected for the study is reported in this chapter. Tables consisting of descriptive statistics for each of the hypothesis are included. F values, which indicate the degree to which the relationships are statistically significant are also included. Additional statistical analyses were undertaken as required and are included in this chapter as appropriate. A significance level of .05 was considered acceptable for testing each hypothesis.

A total of 518 questionnaires were distributed to simulator facilities in 64 countries. A total of 136 responses were received representing 35 countries. The author attempted to identify and include as many simulator facilities as possible therefore some countries had a number of facilities identified while others had as few as one facility identified.

It should be noted that very little literature related to attitudes and perceptions of marine simulator instructors exists. The lack of literature makes this study, in effect, unique and it can therefore be considered exploratory. Respondents were given four choices on each of the attitude items on the questionnaire. The choices were Strongly Agree, Agree, Disagree and Strongly Disagree. For analysis purposes, each choice was assigned a value as follows; Strongly Agree (1), Agree (2), Disagree (3) and Strongly Disagree (4).

Test of Hypothesis 1

Hypothesis 1: There are no differences in the general perceptions of simulator use for training: (a) between instructors who operate only radar simulators, those who operate only ship manoeuvring simulators and who operate both types of simulator; (b) between instructors who hold a Master Unlimited certificate of competency and those who hold other qualifications; (c) between instructors who have served as Master on a ship and those who have not served as Master on a ship; (d) between instructors who hold a teaching certificate and those who do not hold a teaching certificate; (e) between instructors who are certified as a marine simulator instructor by their country and those who are not certified by the government of their country; (f) between instructors who use simulator equipment that has a visual system and those who work on simulator equipment that does not have a visual system; and (g) between instructors who work at privately funded facilities and those who work at publicly funded facilities.

In order to address this hypothesis, 14 items were individually analyzed and reported for each of the above variables (see Tables 12 to 18) using means and the analysis of variance procedure. Although these items did not fit into a single construct, it was felt that they would each individually contribute to the overall validity of the thesis.

Table 12 contains the 14 items related to the general perceptions of instructors toward simulator training. An analysis of variance was completed for each item. The means in columns 3, 4 and 5 indicate that the instructors in all three groups (radar navigation simulators, ship manoeuvring simulators and both types of simulator) reacted positively to 9 of the statements, negatively to 2 of the statements and had a mixed reaction to the remaining 3 statements.

Instructors who operated only radar navigation simulators had a tendency to disagree more strongly with the statement that trainees do not expect simulator training to be realistic as compared to the real world. Instructors who operated only ship manoeuvring simulators significantly disagreed (p=.01) with the statement that radar navigation simulators were really ship manoeuvring simulators without the visual scene.

Instructors who operated only radar navigation simulators significantly disagreed (p=.02) that a trainee must make mistakes in order to learn from a simulator exercise while the other two groups agreed with this statement. Instructors who operated both types of simulator significantly agreed (p=.03) with the statement that instructors who understand technical aspects of the simulator are more effective than those who do not understand technical aspects.

Table 12

Attitudes and Perceptions of Marine Simulator Instructors Who Operate Either Radar Simulators, Ship Manoeuvring Simulators or Both Types of Simulator Toward Simulator Training in General

	Item	Means			F	Sig F
		Rad	Ship	Both		
24.	A marine simulator should be used primarily to practice skills which have been acquired elsewhere.	2.50	2.14	2.29	1.58	.21
25.	Instructors will make more effective use of simulators in marine education if they have been in command of a ship.	2.15	1.75	2.16	1.31	.27
27.	Trainees generally accept simulator training as being representative of the real world.	2.02	1.94	2.11	0.56	.57
31.	Trainees do not expect simulator training to be realistic as compared to the real world.	3.13	2.81	2.87	2.31	.10
32.	In order to learn from a simulator exercise, trainees must make mistakes.	2.68	2.13	2.35	4.29	.02
35.	Simulator instructors who understand the technical aspects of the simulator are more effective than instructors who do not understand the technical aspects.	2.23	2.00	1.84	3.65	.03
36.	Radar and navigation simulators are really ship simulators without a visual scene.	2.07	2.65	2.23	4.66	.01

Table 12 continued

	Item	Means			F	Sig F
		Rad	Ship	Both		
37.	The use of simulation for training in the marine industry is far behind the use of simulation for training in other industries.	2.29	2.06	2.24	0.52	.59
38.	Simulator training can replace much of the "on the job" training which a mariner is currently required to do.	2.40	2.56	2.43	0.28	.76
40.	Simulation requires that instructors use specialized teaching techniques that are not used in other areas of education.	2.18	2.25	2.07	0.52	.60
42.	Simulator training is most effective if it comes before required periods of onboard training.	2.28	2.41	2.46	0.69	.50
45.	Some marine simulator instructors are unsure of themselves when operating marine simulators.	2.83	2.71	2.67	0.43	.65
48.	Marine simulator instructors must be able to trouble shoot and correct simulator problems in order to minimize course disruptions.	2.21	2.19	2.07	0.51	.60
49.	A marine simulator instructor needs to understand how humans learn in order to be an effective teacher.	1.68	1.53	1.63	0.45	.64

Columns 6 and 7 in Table 12 indicated that the three groups had significantly different reactions to only 3 of the 14 items as mentioned above. The null hypothesis 1 (part a) was therefore accepted and it was concluded that, overall, differences between these three groups of instructors with respect to general perceptions of simulator use for training were not significant.

Table 13 contains the 14 items related to the general perceptions of instructors toward simulator training. An analysis of variance was completed for each item. The means in columns 3 and 4 indicate that the instructors in both groups (Master Unlimited qualification and other qualification) reacted positively to 11 of the statements, negatively to 2 of the statements and had a mixed reaction to the remaining statement.

Instructors who held a Master Unlimited qualification had a tendency to agree more strongly that trainees generally accept simulator training as being representative of the real world. Instructors who held a Master Unlimited qualification significantly agreed ($p=.04$) with the statement that instructors who have been in command of a ship will make more effective use of a marine simulator. Instructors who held other qualifications significantly agreed ($p=.04$) with the statement that radar and navigation simulators were really ship simulators without the visual scene.

Table 13

Attitudes and Perceptions of Marine Simulator Instructors Who Hold a Master Unlimited Certificate of Competency and Those who Hold Other Qualifications Toward Simulator Training in General

	Item	Means			
		Master	Other	F	Sig F
24.	A marine simulator should be used primarily to practice skills which have been acquired elsewhere.	2.45	2.29	1.37	.24
25.	Instructors will make more effective use of simulators in marine education if they have been in command of a ship.	1.95	2.30	4.22	.04
27.	Trainees generally accept simulator training as being representative of the real world.	1.95	2.16	3.53	.06
31.	Trainees do not expect simulator training to be realistic as compared to the real world.	3.06	2.88	2.36	.13
32.	In order to learn from a simulator exercise, trainees must make mistakes.	2.47	2.41	0.19	.67
35.	Simulator instructors who understand the technical aspects of the simulator are more effective than instructors who do not understand the technical aspects.	2.05	2.00	0.12	.73
36.	Radar and navigation simulators are really ship simulators without a visual scene.	2.34	2.09	4.29	.04

Table 13 continued

	Item	Means		F	Sig F
		Master	Other		
37.	The use of simulation for training in the marine industry is far behind the use of simulation for training in other industries.	2.27	2.23	0.07	.79
38.	Simulator training can replace much of the "on the job" training which a mariner is currently required to do.	2.36	2.56	2.23	.14
40.	Simulation requires that instructors use specialized teaching techniques that are not used in other areas of education.	2.19	2.16	0.03	.87
42.	Simulator training is most effective if it comes before required periods of onboard training.	2.32	2.46	0.99	.32
45.	Some marine simulator instructors are unsure of themselves when operating marine simulators.	2.72	2.60	0.68	.41
48.	Marine simulator instructors must be able to trouble shoot and correct simulator problems in order to minimize course disruptions.	2.14	2.14	0.00	.99
49.	A marine simulator instructor needs to understand how humans learn in order to be an effective teacher.	1.65	1.62	0.07	.79

Columns 5 and 6 in Table 13 indicated that the two groups had significantly different reactions to only 2 of the 14 items as mentioned above. The null hypothesis 1 (part b) was therefore accepted and it was concluded that, overall, differences between these two groups of instructors with respect to general perceptions of simulator use for training were not significant.

Table 14 contains the 14 items related to the general perceptions of instructors toward simulator training. An analysis of variance was completed for each item. The means in columns 3 and 4 indicate that the instructors in both groups (have served as Master and have not served as Master) reacted positively to 11 of the statements, negatively to 2 of the statements and had a mixed reaction to the remaining statement.

Instructors who had not served as Master had a tendency to agree more strongly with the statement that simulation requires that instructors use specialized teaching techniques not used in other areas of education. Instructors who had served as Master significantly agreed (p=.00) that instructors who have been in command of a ship will make more effective use of simulators in marine education.

Columns 5 and 6 in Table 14 indicated that the two groups had significantly different reactions to only 1 of the 14 items as mentioned above. The null hypothesis 1 (part c) was

Table 14

Attitudes and Perceptions of Marine Simulator Instructors Who Have and Have Not Served as Master on a Ship Toward Simulator Training in General

	Item	Means		F	Sig F
		Yes	No		
24.	A marine simulator should be used primarily to practice skills which have been acquired elsewhere.	2.41	2.36	0.11	.74
25.	Instructors will make more effective use of simulators in marine education if they have been in command of a ship.	1.77	2.54	24.52	.00
27.	Trainees generally accept simulator training as being representative of the real world.	1.96	2.13	2.31	.13
31.	Trainees do not expect simulator training to be realistic as compared to the real world.	3.03	2.94	0.48	.49
32.	In order to learn from a simulator exercise, trainees must make mistakes.	2.47	2.40	0.32	.57
35.	Simulator instructors who understand the technical aspects of the simulator are more effective than instructors who do not understand the technical aspects.	2.06	1.95	0.75	.39
36.	Radar and navigation simulators are really ship simulators without a visual scene.	2.25	2.22	0.05	.82
37.	The use of simulation for training in the marine industry is far behind the use of simulation for training in other industries.	2.24	2.30	0.16	.69

Table 14 continued

	Item	Means		F	Sig F
		Yes	No		
38.	Simulator training can replace much of the "on the job" training which a mariner is currently required to do.	2.50	2.32	1.89	.17
40.	Simulation requires that instructors use specialized teaching techniques that are not used in other areas of education.	2.26	2.02	3.39	.07
42.	Simulator training is most effective if it comes before required periods of onboard training.	2.42	2.31	0.62	.43
45.	Some marine simulator instructors are unsure of themselves when operating marine simulators.	2.68	2.72	0.06	.81
48.	Marine simulator instructors must be able to trouble shoot and correct simulator problems in order to minimize course disruptions.	2.14	2.19	0.15	.70
49.	A marine simulator instructor needs to understand how humans learn in order to be an effective teacher.	1.63	1.67	0.21	.65

therefore accepted and it was concluded that, overall, differences between these two groups of instructors with respect to general perceptions of simulator use for training were not significant.

Table 15 contains the 14 items related to the general perceptions of instructors toward simulator training. An analysis of variance was completed for each item. The means in columns 3 and 4 indicate that the instructors in both groups (teaching certificate and no teaching certificate) reacted positively to 12 of the statements and negatively to the remaining 2 statements.

Instructors who hold a teaching certificate had a tendency to agreed more strongly with the statement that a simulator should be used primarily to practice skills which have been acquired elsewhere. This group also had a tendency to agree more strongly with the statement that marine simulator instructors must be able to trouble shoot and correct simulator problems in order to minimize course disruptions.

Instructors who do not hold a teaching certificate significantly agreed ($p=.00$) with the statement that trainees generally accept simulator training as being representative of the real world. Instructors who hold a teaching certificate significantly agreed ($p=.04$) with the statement that instructors who understand the technical aspects of a

Table 15

Attitudes and Perceptions of Marine Simulator Instructors Who Hold and Do Not Hold a Teaching Certificate Toward Simulator Training in General

	Item	Means			
		Yes	No	F	Sig F
24.	A marine simulator should be used primarily to practice skills which have been acquired elsewhere.	2.20	2.46	3.15	.08
25.	Instructors will make more effective use of simulators in marine education if they have been in command of a ship.	2.00	2.11	0.37	.54
27.	Trainees generally accept simulator training as being representative of the real world.	2.26	1.94	8.30	.00
31.	Trainees do not expect simulator training to be realistic as compared to the real world.	2.93	3.01	0.45	.51
32.	In order to learn from a simulator exercise, trainees must make mistakes.	2.46	2.43	0.05	.82
35.	Simulator instructors who understand the technical aspects of the simulator are more effective than instructors who do not understand the technical aspects.	1.80	2.11	4.50	.04
36.	Radar and navigation simulators are really ship simulators without a visual scene.	2.20	2.27	0.31	.58
37.	The use of simulation for training in the marine industry is far behind the use of simulation for training in other industries.	2.23	2.28	0.10	.75

Table 15 continued

	Item	Means		F	Sig F
		Yes	No		
38.	Simulator training can replace much of the "on the job" training which a mariner is currently required to do.	2.31	2.49	1.72	.19
40.	Simulation requires that instructors use specialized teaching techniques that are not used in other areas of education.	1.98	2.24	3.96	.05
42.	Simulator training is most effective if it comes before required periods of onboard training.	2.46	2.35	0.63	.43
45.	Some marine simulator instructors are unsure of themselves when operating marine simulators.	2.86	2.61	2.45	.12
48.	Marine simulator instructors must be able to trouble shoot and correct simulator problems in order to minimize course disruptions.	1.98	2.23	3.40	.07
49.	A marine simulator instructor needs to understand how humans learn in order to be an effective teacher.	1.53	1.69	2.56	.11

simulator will be more effective than those who do not understand the technical aspects. This same group also significantly agreed ($p=.05$) with the statement that simulation requires that instructors use specialized teaching techniques that are not used in other areas of education.

Columns 5 and 6 in Table 15 indicated that the two groups had significantly different reactions to only 3 of the 14 items as mentioned above. The null hypothesis 1 (part d) was therefore accepted and it was concluded that, overall, differences between these two groups of instructors with respect to general perceptions of simulator use for training were not significant.

Table 16 contains the 14 items related to the general perceptions of instructors toward simulator training. An analysis of variance was completed for each item. The means in columns 3 and 4 indicate that the instructors in both groups (certified as simulator instructors and not certified as simulator instructors) reacted positively to 10 of the statements, negatively to 2 statements and had a mixed reaction to the 2 remaining statements.

Instructors who are government certified had a tendency to agree more strongly with the statement that radar and navigation simulators are really ship simulators without a visual scene. Instructors who are government certified significantly agreed ($p=.01$) with the statement that a marine

Table 16

Attitudes and Perceptions of Marine Simulator Instructors Who Are and Are Not Certified By the Government of Their Country Toward Simulator Training in General

	Item	Means		F	Sig F
		Yes	No		
24.	A marine simulator should be used primarily to practice skills which have been acquired elsewhere.	2.18	2.54	6.44	.01
25.	Instructors will make more effective use of simulators in marine education if they have been in command of a ship.	2.05	2.13	0.20	.66
27.	Trainees generally accept simulator training as being representative of the real world.	2.08	2.00	0.57	.45
31.	Trainees do not expect simulator training to be realistic as compared to the real world.	2.81	3.14	8.22	.00
32.	In order to learn from a simulator exercise, trainees must make mistakes.	2.43	2.46	0.06	.81
35.	Simulator instructors who understand the technical aspects of the simulator are more effective than instructors who do not understand the technical aspects.	2.00	2.03	0.04	.84
36.	Radar and navigation simulators are really ship simulators without a visual scene.	2.14	2.34	2.86	.09
37.	The use of simulation for training in the marine industry is far behind the use of simulation for training in other industries.	2.30	2.22	0.35	.55

Table 16 continued

	Item	Means		F	Sig F
		Yes	No		
38.	Simulator training can replace much of the "on the job" training which a mariner is currently required to do.	2.62	2.30	6.44	.01
40.	Simulation requires that instructors use specialized teaching techniques that are not used in other areas of education.	2.24	2.10	1.11	.29
42.	Simulator training is most effective if it comes before required periods of onboard training.	2.29	2.44	1.21	.27
45.	Some marine simulator instructors are unsure of themselves when operating marine simulators.	2.77	2.63	0.86	.36
48.	Marine simulator instructors must be able to trouble shoot and correct simulator problems in order to minimize course disruptions.	2.14	2.15	0.02	.90
49.	A marine simulator instructor needs to understand how humans learn in order to be an effective teacher.	1.58	1.69	1.47	.23

simulator should be used primarily to practice skills which have been acquired elsewhere. This group also significantly disagreed (p=.00) with the statement that trainees do not expect simulator training to be realistic as compared to the real world.

Instructors who are not government certified significantly agreed (p=.01) with the statement that simulator training can replace much of the "on the job" training which a mariner is currently required to do.

Columns 5 and 6 in Table 16 indicated that the two groups had significantly different reactions to 3 of the 14 items as mentioned above. The null hypothesis 1 (part e) was therefore accepted and it was concluded that, overall, differences between these two groups of instructors with respect to general perceptions of simulator use for training were not significant.

Table 17 contains the 14 items related to the general perceptions of instructors toward simulator training. An analysis of variance was completed for each item. The means in columns 3 and 4 indicate that the instructors in both groups (work with visual systems and do not work with visual systems) reacted positively to 11 of the statements, negatively to 2 statements and had a mixed reaction to the remaining statement.

Instructors who do not work with a visual system

Table 17

Attitudes and Perceptions of Marine Simulator Instructors Who Work With a Visual System and Those Who Do Not Work With a Visual System Toward Simulator Training in General

	Item	Means			
		Yes	No	F	Sig F
24.	A marine simulator should be used primarily to practice skills which have been acquired elsewhere.	2.33	2.44	0.58	.45
25.	Instructors will make more effective use of simulators in marine education if they have been in command of a ship.	2.12	2.03	0.27	.61
27.	Trainees generally accept simulator training as being representative of the real world.	1.99	2.09	0.96	.33
31.	Trainees do not expect simulator training to be realistic as compared to the real world.	2.91	3.06	1.71	.19
32.	In order to learn from a simulator exercise, trainees must make mistakes.	2.34	2.56	2.63	.11
35.	Simulator instructors who understand the technical aspects of the simulator are more effective than instructors who do not understand the technical aspects.	1.97	2.08	0.64	.43
36.	Radar and navigation simulators are really ship simulators without a visual scene.	2.41	2.06	8.78	.00
37.	The use of simulation for training in the marine industry is far behind the use of simulation for training in other industries.	2.23	2.29	0.20	.66

Table 17 continued

	Item	Means		F	Sig F
		Yes	No		
38.	Simulator training can replace much of the "on the job" training which a mariner is currently required to do.	2.46	2.42	0.08	.78
40.	Simulation requires that instructors use specialized teaching techniques that are not used in other areas of education.	2.17	2.16	0.01	.94
42.	Simulator training is most effective if it comes before required periods of onboard training.	2.46	2.30	1.29	.26
45.	Some marine simulator instructors are unsure of themselves when operating marine simulators.	2.63	2.75	0.67	.41
48.	Marine simulator instructors must be able to trouble shoot and correct simulator problems in order to minimize course disruptions.	2.10	2.18	0.38	.54
49.	A marine simulator instructor needs to understand how humans learn in order to be an effective teacher.	1.62	1.67	0.20	.65

significantly agreed (p=.00) with the statement that radar and navigation simulators are really ship simulators without a visual scene.

Columns 5 and 6 in Table 17 indicated that the two groups had significantly different reactions to only 1 of the 14 items as mentioned above. The null hypothesis 1 (part f) was therefore accepted and it was concluded that, overall, differences between these two groups of instructors with respect to general perceptions of simulator use for training were not significant.

Table 18 contains the 14 items related to the general perceptions of instructors toward simulator training. An analysis of variance was completed for each item. The means in columns 3 and 4 indicate that the instructors of both groups (employed at public simulator facilities and employed at private simulator facilities) reacted positively to 10 of the statements, negatively to 2 statements and had a mixed reaction to the remaining 2 statements.

Instructors who are employed at private facilities had a tendency to disagreed more strongly with the statement that trainees do not expect simulator training to be realistic as compared to the real world. This group also had a tendency to agreed with the statement that, in order to learn from a simulator exercise, trainees must make mistakes while those instructors who were employed at a public facility disagreed

Table 18

Attitudes and Perceptions of Marine Simulator Instructors Who Are Employed at Private and Public Simulator Facilities Toward Simulator Training in General

	Item	Means			
		Public	Private	F	Sig F
24.	A marine simulator should be used primarily to practice skills which have been acquired elsewhere.	2.42	2.33	0.19	.66
25.	Instructors will make more effective use of simulators in marine education if they have been in command of a ship.	2.23	2.02	0.90	.35
27.	Trainees generally accept simulator training as being representative of the real world.	2.18	2.01	1.31	.25
31.	Trainees do not expect simulator training to be realistic as compared to the real world.	2.76	3.05	3.44	.07
32.	In order to learn from a simulator exercise, trainees must make mistakes.	2.75	2.41	3.66	.06
35.	Simulator instructors who understand the technical aspects of the simulator are more effective than instructors who do not understand the technical aspects.	2.00	2.02	0.01	.91
36.	Radar and navigation simulators are really ship simulators without a visual scene.	2.27	2.23	0.06	.80
37.	The use of simulation for training in the marine industry is far behind the use of simulation for training in other industries.	1.95	2.35	5.00	.03

Table 18 continued

	Item	Means		F	Sig F
		Public	Private		
38.	Simulator training can replace much of the "on the job" training which a mariner is currently required to do.	2.45	2.42	0.03	.86
40.	Simulation requires that instructors use specialized teaching techniques that are not used in other areas of education.	2.36	2.10	2.30	.13
42.	Simulator training is most effective if it comes before required periods of onboard training.	2.55	2.39	0.68	.41
45.	Some marine simulator instructors are unsure of themselves when operating marine simulators.	2.55	2.72	0.74	.39
48.	Marine simulator instructors must be able to trouble shoot and correct simulator problems in order to minimize course disruptions.	2.41	2.09	3.36	.07
49.	A marine simulator instructor needs to understand how humans learn in order to be an effective teacher.	1.68	1.61	0.32	.57

with the statement. Instructors who are employed at private facilities had a tendency to disagreed more strongly with the statement that marine simulator instructors must be able to trouble shoot and correct simulator problems in order to minimize course disruptions.

Instructors who were employed at public facilities significantly agreed (p=.03) with the statement that the use of simulation for training in the marine industry is far behind the use of simulation for training in other industries.

Columns 5 and 6 in Table 18 indicated that the two groups had significantly different reactions to only 1 of the 14 items as mentioned above. The null hypothesis 1 (part g) was therefore accepted and it was concluded that, overall, differences between these two groups of instructors with respect to general perceptions of simulator use for training were not significant.

Test of Hypothesis 2

Hypothesis 2: There are no differences in perceived training procedures between instructors who operate only radar simulators, those who operate only ship manoeuvring simulators and those who operate both types of simulator.

In order to address this hypothesis, four clusters of questions were developed and analyzed. The clusters dealt with simulator exercise development (cluster A), simulator exercise briefing (cluster B), simulator exercise running (cluster C) and simulator exercise de-briefing (cluster D). Each of the four groups was investigated separately.

Cluster A

Cluster A concerned simulator exercise development. Table 19 contains a correlation matrix of the nine items in this cluster. The correlation coefficients, means and standard deviations are contained in this table. The overall Chronbach's alpha reliability coefficient of 0.737 for these items was considered acceptable for this exploratory research. All nine items were used to investigate exercise development.

An analysis of variance was completed for each item, the results of which are contained in Table 20. The means in columns 3, 4 and 5 indicate that instructors in all three groups reacted positively to all items with the exception of a slightly negative reaction to one item (concerning trainee performance evaluation) by instructors who operated only ship manoeuvring simulators. Instructors who operated both types of simulator had the most positive reaction to four items. Instructors who operated only ship manoeuvring simulators had the most positive reaction to three items while those who operated only radar navigation simulators reacted most positively to two items.

Instructors who worked with only ship manoeuvring simulators had a slight tendency to disagree with the statement that it was easy to evaluate trainee performance during a simulator exercise while the other two groups had a tendency to agree with the statement.

Columns 6 and 7 in Table 20 indicated that the three groups did not have significantly different reactions to any of the nine items.

An overall analysis of variance for Cluster A was completed. The results of this analysis are presented in Table 21. This analysis indicated no significant difference between the three groups. This section of the null hypothesis was therefore accepted and it was concluded that radar and navigation simulator instructors, ship manoeuvring simulator instructors and instructors who use both types of simulator had similar attitudes and perceptions toward simulator exercise development.

Cluster B

Cluster B concerned simulator exercise briefing. Table 22 contains a correlation matrix of the 11 items in this cluster. The correlation coefficients, means and standard deviations are contained in this table. The overall Chronbach's alpha reliability coefficient of 0.632 for these items was considered acceptable for this exploratory research. All 11 items were used to investigate exercise briefing.

An analysis of variance was completed for each item, the results of which are contained in Table 23. The means in

Table 19

Correlation Matrix for the Attitudes and Perceptions of Simulator Instructors Toward Simulator Exercise Development

	51	52	53	54	55	60	61	63	65
51	1.000								
52	.285	1.000							
53	.460	.260	1.000						
54	.156	.103	.039	1.000					
55	.214	.247	.165	.474	1.000				
60	.146	.210	.071	.222	.293	1.000			
61	.227	.222	.328	.330	.295	.470	1.000		
63	.300	.091	.278	.122	.304	.252	.351	1.000	
65	.240	.200	.354	.064	.282	.106	.217	.272	1.000
X	2.220	1.932	2.186	1.381	1.619	1.661	1.644	1.890	1.907
SD	.7967	.5185	.7274	.4878	.5980	.5732	.5315	.5667	.5990

Alpha reliability = .7367

Table 20

Attitudes and Perceptions of Marine Simulator Instructors Who Operate Either Radar Simulators, Ship Manoeuvring Simulators or Both Types of Simulator Toward Simulator Exercise Development

	Item	Means			F	Sig F
		Rad	Ship	Both		
51.	It is easy to evaluate trainee performance during a simulator exercise.	2.17	2.60	2.16	2.20	.11
52.	Evaluation of simulator exercises is best achieved through a mixture of subjective and objective evaluation techniques.	2.00	2.00	1.87	0.88	.42
53.	Marine simulator instructors have a good understanding of evaluation techniques.	2.10	2.40	2.25	1.08	.34
54.	The first step in good exercise development is for the instructor to clearly define the objective of the exercise.	1.51	1.35	1.37	1.10	.34
55.	Good exercise development is the most important part of simulator training.	1.74	1.65	1.58	0.93	.40
60.	Marine simulator exercise development includes validation and testing of all aspects of the exercise.	1.70	1.47	1.74	1.59	.21
61.	Simulator exercises should be consistent with the exercise objective.	1.64	1.71	1.68	0.15	.86
63.	It is important that the instructor develop a list of essential tasks that the trainee must perform during a simulator exercise.	1.96	2.00	1.91	0.19	.83

Table 20 continued

	Item	Means			F	Sig F
		Rad	Ship	Both		
65.	Success in simulator exercises, especially in the early stages of a course, is important to the self esteem and confidence of all trainees.	1.91	1.88	1.91	0.02	.98

Table 21

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Operate Either Radar Simulators, Ship Manoeuvring Simulators or Both Types of Simulator Toward Simulator Exercise Development

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	2	4.0234	2.0117	.2216	.8016
Within Groups	102	925.9385	9.0778		
Total	104	929.9619			

Means:

radar navigation simulator instructors	16.80
ship manoeuvring simulator instructors	16.46
both type instructors	16.38

columns 3, 4 and 5 indicate that all three groups of instructors reacted negatively to four of the items and positively to six of the items. The remaining item produced a slightly negative reaction from instructors who operated only ship manoeuvring simulators while the other two groups had a positive reaction to this item.

Instructors who operated only ship manoeuvring simulators had a tendency to disagree more strongly with the statement that a briefing process is not necessary for most marine simulator exercises. This group also had a tendency to agree more strongly with the statement that exercise briefings usually include sufficient time for the trainees to prepare a passage plan for the simulator exercise.

Columns 6 and 7 in Table 23 indicated that the three groups had significantly different reactions to only one of the 11 items. Ship manoeuvring simulator instructors did not agree (p=.05) as strongly as the other two groups with the statement that simulator exercise briefing should provide additional instruction, as necessary, to strengthen any areas of weakness that the trainees may have.

An overall analysis of variance for Cluster B was completed. The results of this analysis are presented in Table 24. The analysis of variance indicated no significant difference between the three groups. This section of the null hypothesis was therefore accepted and it was concluded that radar and navigation simulator instructors, ship manoeuvring simulator instructors and instructors who use both types of simulator had similar attitudes and perceptions toward simulator exercise briefing.

Cluster C

Cluster C concerned simulator exercise running. Table 25 contains a correlation matrix of the 12 items in this cluster. The correlation coefficients, means and standard deviations are contained in this table. The overall Chronbach's alpha reliability coefficient of 0.614 for these items was considered acceptable for this exploratory research. All 12 items were used to investigate exercise running.

An analysis of variance was completed for each item, the results of which are contained in Table 26. The means in columns 3, 4 and 5 indicate that all three groups of instructors reacted negatively to four of the items and positively to the eight remaining items.

Instructors who operated only ship manoeuvring simulators had a tendency to disagree more strongly than the other two groups with the statement that simulators were most effective where large groups of trainees were involved.

Columns 6 and 7 in Table 26 indicated that the three groups had significantly different reactions to only one of the 12 items.

An overall analysis of variance for Cluster C was

Table 22

Correlation Matrix for the Attitudes and Perceptions of Simulator Instructors Toward Simulator Exercise Briefing

	69	70	71	72	73	74	75	76	77	78	80
69	1.000										
70	.315	1.000									
71	.280	.158	1.000								
72	.097	.246	.190	1.000							
73	.059	.195	.200	.408	1.000						
74	.046	.182	.038	.189	.227	1.000					
75	.282	.073	.163	.127	.099	.243	1.000				
76	.087	.132	.101	.121	.124	.079	.053	1.000			
77	-.077	.106	.017	.133	.253	.148	.087	.262	1.000		
78	.035	-.016	.198	.180	.185	.065	-.136	.075	.039	1.000	
80	-.016	-.008	.144	.104	.359	.280	.060	.209	.258	.141	1.000
X	2.173	1.634	2.713	1.783	2.009	1.991	1.878	2.443	2.174	2.817	2.539
SD	.6657	.5972	.6457	.5891	.6282	.6141	.5796	.6240	.6657	.6153	.6392

Alpha reliability = .6324

Table 23

Attitudes and Perceptions of Marine Simulator Instructors Who Operate Either Radar Simulators, Ship Manoeuvring Simulators or both types of Simulator Toward Simulator Exercise Briefing

	Item	Means				
		Rad	Ship	Both	F	Sig F
69.	A trainee should be given only the minimum amount of information necessary to complete the simulator exercise.	2.66	2.88	2.91	2.16	.12
70.	A briefing process is not necessary for most marine simulator exercises.	3.15	3.47	3.37	2.74	.07
71.	The most effective way to brief a simulator exercise is with oral instruction.	2.33	2.57	2.23	1.85	.16
72.	Exercise briefing requires careful preparation by the instructor.	1.87	2.00	1.74	1.65	.20
73.	Exercise briefings usually include sufficient time for the trainees to prepare a passage plan for the simulator exercise.	2.17	1.81	1.95	2.92	.06
74.	During the briefing, the instructor should review all relevant information necessary for the successful completion of the simulator exercise.	2.00	2.19	1.95	1.02	.36
75.	Simulator exercise briefing should provide additional instruction, as necessary, to strengthen any areas of weakness that the trainees may have.	1.85	2.24	1.89	2.99	.05
76.	Simulator exercise briefings should be conducted in a formal manner.	2.36	2.40	2.47	0.50	.61

Table 23 continued

	Item	Means				
		Rad	Ship	Both	F	Sig F
77.	Marine simulator instructors have a good understanding of effective briefing techniques.	2.13	2.06	2.23	0.71	.50
78.	The most effective way to brief a simulator exercise is with written instruction.	2.83	2.67	2.75	0.41	.66
80.	Trainees should be given as much time as they need to prepare for a simulator exercise.	2.57	2.53	2.51	0.14	.87

Table 24

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Operate Either Radar Simulators, Ship Manoeuvring Simulators or both types of Simulator Toward Simulator Exercise Briefing

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	2	12.2061	6.1031	.6787	.5096
Within Groups	100	899.2308	8.9923		
Total	102	911.4369			

Means:		
	radar navigation simulator instructors	24.69
	ship manoeuvring simulator instructors	23.92
	both type instructors	24.00

completed. The results of this analysis are presented in Table 27. The analysis of variance indicated no significant difference between the three groups. This section of the null hypothesis was therefore accepted and it was concluded that radar and navigation simulator instructors, ship manoeuvring simulator instructors and instructors who use both types of simulator had similar attitudes and perceptions toward simulator exercise running.

Cluster D

Cluster D concerned simulator exercise de-briefing. Table 28 contains a correlation matrix of the 13 items in this cluster. The correlation coefficients, means and standard deviations are contained in this table. The overall Chronbach's alpha reliability coefficient of 0.650 for these items was considered acceptable for this exploratory research. All 13 items on the questionnaire were used to investigate exercise de-briefing.

An analysis of variance was completed for each item, the results of which are contained in Table 29. The means in columns 3, 4 and 5 indicate that all three groups of instructors reacted positively to nine of the items and negatively to the remaining five items.

Instructors who operated both types of simulator had a tendency to agree more strongly than the other two groups with the statement that the debrief should start with a review of

Table 25

Correlation Matrix for the Attitudes and Perceptions of Simulator Instructors Toward Simulator Exercise Running

	26	30	33	34	41	43	44	83	84	85	88	89A
26	1.000											
30	.193	1.000										
33	.082	.036	1.000									
34	.387	.037	.211	1.000								
41	.238	-.105	.213	.244	1.000							
43	.103	.123	.279	.112	.099	1.000						
44	.203	.176	.195	.091	.131	.049	1.000					
83	.030	-.016	.143	-.002	.040	.129	.090	1.000				
84	.226	-.010	.185	-.001	.239	.086	.192	.099	1.000			
85	.191	.047	.059	.044	-.040	.221	.286	.127	.054	1.000		
88	.125	.184	.111	.094	-.015	.019	.066	-.003	-.002	.007	1.000	
89A	.220	.115	.186	.144	.176	.186	.133	.151	.226	.185	.156	1.000
X	1.735	1.897	1.573	1.410	1.470	1.812	2.000	2.086	2.043	2.265	2.214	1.821
SD	.6485	.7472	.6062	.5747	.7019	.5403	.6565	.7260	.5476	.7812	.5993	.6900

Alpha reliability = .6137

Table 26

Attitudes and Perceptions of Marine Simulator Instructors Who Operate Either Radar Simulators, Ship Manoeuvring Simulators or both types of Simulator Toward Simulator Exercise Running

	Item	Means			F	Sig F
		Rad	Ship	Both		
26.	Simulators are most effectively used in teaching situations when large groups of trainees are involved.	3.24	3.65	3.27	2.66	.07
30.	The objective of a simulator exercise need not be identified for trainees.	2.98	3.24	3.23	1.58	.21
33.	Simulator training can be an effective learning experience for all trainees who take simulator courses.	1.54	1.50	1.58	0.12	.89
34.	Simulators are most effectively used in teaching situations when small groups of trainees are involved.	1.51	1.24	1.40	1.48	.23
41.	It is not necessary for a marine simulator instructor to be a mariner to effectively make use of a marine simulator for training.	3.57	3.53	3.61	0.13	.88
43.	It is important that there are enough learning materials available during the course for trainees to review basic knowledge required for marine simulator training courses.	1.82	1.82	1.75	0.23	.80
44.	Trainees often know more about new marine technology than marine simulator instructors.	2.91	3.00	3.11	1.18	.31

Table 26 continued

	Item	Means			F	Sig F
		Rad	Ship	Both		
83.	The trainee should always have the freedom to determine the speed of Own Ship, even if it means that the planned scenario will be spoiled.	2.38	2.00	2.02	3.40	.04
84.	The instructor should stop the simulator as soon as the exercise objective has been met, even if further learning can take place.	2.91	3.12	2.98	0.83	.44
85.	The instructor should not manoeuvre target ships in order to prevent a collision with Own Ship.	2.64	3.00	2.78	1.32	.27
88.	The exercise should be allowed to continue even when the trainee has no chance of achieving the exercise objective.	2.83	2.82	2.72	0.51	.60
89a	Simulator instructors should force trainees into making mistakes during simulator exercises.	3.13	3.41	3.19	1.02	.36

Table 27

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Operate Either Radar Simulators, Ship Manoeuvring Simulators or both types of Simulator Toward Simulator Exercise Running

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	2	60.2646	30.1323	2.7324	.0697
Within Groups	104	1146.8942	11.0278		
Total	106	1207.1589			

Means:		
	radar navigation simulator instructors	23.13
	ship manoeuvring simulator instructors	21.00
	both type instructors	21.90

the positive aspects of trainee performance.

Columns 6 and 7 in Table 29 indicated that the three groups had significantly different reactions to four of the 13 items. Radar navigation simulator instructors disagreed to a lesser extent (p=.02) than the other two groups that only the trainee in a lead role will gain experience and knowledge; and did not agree to the same extent as other instructors (p=.05) that trainees should help each other during simulator courses. The ship manoeuvring simulator instructors disagreed significantly more (p=.03) than radar simulator instructors that the debrief session is a good time for trainees to relax. This group were also significantly less convinced (p=.03) than the other two groups that trainees must be more accountable for their actions during a simulator exercise.

An overall analysis of variance for Cluster D was completed. The results of this analysis are presented in Table 30. The analysis of variance indicated that significant differences existed between group 1 and group 2 and between group 1 and group 3. This section of the null hypothesis was therefore rejected and it was concluded that radar and navigation simulator instructors and instructors who use both types of simulator had different attitudes and perceptions toward simulator exercise de-briefing than did ship manoeuvring simulator instructors.

Table 28

Correlation Matrix for the Attitudes and Perceptions of Simulator Instructors Toward Simulator Exercise De-briefing

	28	29	39	46	50	91	92	93	95	96	99	100	101
28	1.000												
29	.215	1.000											
39	.122	.216	1.000										
46	.038	.238	.217	1.000									
50	-.101	-.131	.008	.252	1.000								
91	.133	.300	.114	.209	.069	1.000							
92	.208	.085	.086	.113	-.076	.188	1.000						
93	.258	.057	.044	.154	.250	.378	.405	1.000					
95	.185	.095	.031	.045	.069	.021	.283	.242	1.000				
96	.016	.014	.032	.341	.324	.216	.132	.347	.138	1.000			
99	.017	-.086	-.043	.175	.108	.307	-.051	.126	-.042	.283	1.000		
100	.031	.095	.193	.081	.045	.371	.151	.137	.002	.287	.209	1.000	
101	-.022	.080	-.113	.219	.339	.060	-.016	.254	-.004	.214	.233	.104	1.000
X	2.144	3.036	2.640	3.018	3.234	3.324	2.874	3.135	2.946	3.333	3.207	3.171	3.306
SD	.712	.797	.711	.572	.602	.559	.740	.694	.749	.528	.507	.520	.536

Alpha reliability = .6499

Table 29

Attitudes and Perceptions of Marine Simulator Instructors Who Operate Either Radar Simulators, Ship Manoeuvring Simulators or both types of Simulator Toward Simulator Exercise De-Briefing

	Item	Means				
		Rad	Ship	Both	F	Sig F
28.	Trainees who benefit most from simulator exercises tend to also be those who are most active in other classroom activities.	2.13	2.50	2.12	2.03	.14
29.	During simulator exercises which involve a group of trainees, only the trainee in the lead role (Master or Watch Officer) will gain experience or knowledge.	2.78	3.35	3.13	4.35	.02
39.	Trainees in a given group can learn almost as much from each other as they can learn from the instructor.	2.48	2.24	2.25	1.65	.20
46.	A good marine simulator instructor will make use of trainees to help other trainees during a simulator course.	2.11	1.71	1.98	3.04	.05
50.	Simulation can be an effective teaching tool for all trainees, regardless of their learning style.	1.77	1.88	1.68	0.89	.41
91.	The focus of a simulator exercise debrief should be only on mistakes that were made during the run.	3.18	3.47	3.32	1.56	.21
92.	The debrief is a good time for the trainees to relax before the next simulator exercise.	2.76	3.29	2.95	3.57	.03
93.	The debrief should be done quickly so as not to waste valuable simulator time.	3.09	3.18	3.16	0.19	.83

Table 29 continued

	Item	Means				
		Rad	Ship	Both	F	Sig F
95.	The debrief is the most important part of simulator training.	2.05	1.93	2.04	0.13	.88
96.	The instructor should take advantage of the debrief to provide additional instruction in areas where the trainees have demonstrated a weakness.	1.70	1.59	1.71	0.39	.68
99.	The debrief should start with a review of the positive aspects of the trainees performance during the simulator exercise.	1.93	1.93	1.72	2.39	.10
100	Trainees must be accountable for their actions during a simulator exercise.	1.76	2.13	1.81	3.75	.03
101	Playback of all or a part of a simulator exercise can be useful in exercise de-briefing.	1.80	1.71	1.60	2.13	.12

Table 30

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Operate Either Radar Simulators, Ship Manoeuvring Simulators or both types of Simulator Toward Simulator Exercise De-Briefing

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	2	122.5439	61.2720	4.9645	.0089
Within Groups	95	1172.4867	12.3420		
Total	97	1295.0306			

Means:

radar navigation simulator instructors	38.00
ship manoeuvring simulator instructors	41.17
both type instructors	39.94

Test of Hypothesis 3

Hypothesis 3: There are no differences in perceived training procedures between instructors who hold a Master Unlimited certificate of competency and those who hold other qualifications.

In order to address this hypothesis, four clusters of questions were developed and analyzed. The clusters dealt with simulator exercise development (cluster A), simulator exercise briefing (cluster B), simulator exercise running (cluster C) and simulator exercise de-briefing (cluster D). Each of the four groups was investigated separately.

Cluster A

Cluster A concerned simulator exercise development. Table 19 (page 114) contains a correlation matrix of the nine items in this cluster; and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.737 and considered acceptable for this exploratory research. All nine items were used to investigate exercise development.

An analysis of variance was completed for each item, the results of which are contained in Table 31. The means in columns 3 and 4 indicate that both groups of instructors reacted positively to all items. Instructors who held a Master Unlimited certificate of competency reacted more positively on three of the nine items, while those who held other qualifications reacted more positively on the remaining six items. However, columns 5 and 6 in Table 31 indicated that the groups did not have significantly different reactions to any of the nine items.

Instructors who held a Master Unlimited certificate of competency tended to agree more positively to the statement that evaluation is best achieved through a mixture of objective and subjective evaluation techniques; and instructors who held other qualifications agreed more positively to the statement that simulator exercises should be consistent with the objective.

An overall analysis of variance for Cluster A was completed. The results of this analysis are presented in Table 32. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who hold a Master Unlimited certificate of competency and those who hold other qualifications had similar attitudes and perceptions toward simulator exercise development.

Cluster B

Cluster B concerned simulator exercise briefing. Table 22 (page 119) contains a correlation matrix of the 11 items in this cluster; and as reported earlier the overall Chronbach's alpha reliability coefficient of these was 0.632 and considered acceptable for this exploratory research. All 11 items were used to investigate exercise briefing.

Table 31

Attitudes and Perceptions of Marine Simulator Instructors Who Hold a Master Unlimited Certificate of Competency and Those Who Hold Other Qualifications Toward Simulator Exercise Development

	Item	Means			
		Master	Other	F	Sig F
51.	It is easy to evaluate trainee performance during a simulator exercise.	2.22	2.28	0.18	.67
52.	Evaluation of simulator exercises is best achieved through a mixture of subjective and objective evaluation techniques.	1.88	2.00	1.78	.18
53.	Marine simulator instructors have a good understanding of evaluation techniques.	2.23	2.15	0.35	.55
54.	The first step in good exercise development is for the instructor to clearly define the objective of the exercise.	1.43	1.40	0.13	.72
55.	Good exercise development is the most important part of simulator training.	1.63	1.66	0.09	.76
60.	Marine simulator exercise development includes validation and testing of all aspects of the exercise.	1.68	1.66	0.05	.82
61.	Simulator exercises should be consistent with the exercise objective.	1.71	1.54	3.53	.06
63.	It is important that the instructor develop a list of essential tasks that the trainee must perform during a simulator exercise.	1.94	1.90	0.15	.70

Table 31 continued

	Item	Means			
		Master	Other	F	Sig F
65.	Success in simulator exercises, especially in the early stages of a course, is important to the self esteem and confidence of all trainees.	1.93	1.88	0.22	.64

Table 32

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Hold a Master Unlimited Certificate of Competency and Those Who Hold Other Qualifications Toward Simulator Exercise Development

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	0.0223	0.0223	0.0023	.9621
Within Groups	114	1120.5552	9.8294		
Total	115	1120.5776			

Means: Master Unlimited 16.45
Other 16.42

An analysis of variance was completed for each item, the results of which are contained in Table 33. The means in columns 3 and 4 indicate that both groups of instructors reacted negatively to three of the items and positively to seven of the items. The remaining item, about giving trainees as much time as they required to prepare for a simulator exercise, produced a slightly positive reaction from instructors who held a Master Unlimited certificate of competency while the other group had a negative reaction to this item.

Overall, there was agreement, to some extent, about many aspects of exercise briefing. Both groups were particularly supportive of the need for careful instructor preparation for briefing and that it was a necessary part of simulator training.

Both groups were supportive, but less certain (more neutral) toward conducting a briefing in a formal manner; that the most effective way is through written instructions; and that simulator instructors have a good understanding of effective briefing techniques.

Instructors who held other qualifications had a tendency to agree more strongly with the statement that simulator exercise briefing should provide additional instruction, as necessary, to strengthen any areas of weakness that the trainees may have.

Table 33

Attitudes and Perceptions of Marine Simulator Instructors Who Hold a Master Unlimited Certificate of Competency and Those Who Hold Other Qualifications Toward Simulator Exercise Briefing

	Item	Means			
		Master	Other	F	Sig F
69.	A trainee should be given only the minimum amount of information necessary to complete the simulator exercise.	2.82	2.90	0.47	.49
70.	A briefing process is not necessary for most marine simulator exercises.	3.31	3.38	0.45	.50
71.	The most effective way to brief a simulator exercise is with oral instruction.	2.43	2.16	5.26	.02
72.	Exercise briefing requires careful preparation by the instructor.	1.82	1.80	0.04	.84
73.	Exercise briefings usually include sufficient time for the trainees to prepare a passage plan for the simulator exercise.	2.00	2.04	0.13	.72
74.	During the briefing, the instructor should review all relevant information necessary for the successful completion of the simulator exercise.	2.06	1.90	2.21	.14
75.	Simulator exercise briefing should provide additional instruction, as necessary, to strengthen any areas of weakness that the trainees may have.	1.99	1.80	3.25	.07
76.	Simulator exercise briefings should be conducted in a formal manner.	2.42	2.41	0.02	.90

Table 33 continued

	Item	Means		F	Sig F
		Master	Other		
77.	Marine simulator instructors have a good understanding of effective briefing techniques.	2.18	2.15	0.08	.78
78.	The most effective way to brief a simulator exercise is with written instruction.	2.78	2.84	0.25	.62
80.	Trainees should be given as much time as they need to prepare for a simulator exercise.	2.49	2.63	1.60	.21

Table 34

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Hold a Master Unlimited Certificate of Competency and Those Who Hold Other Qualifications Toward Simulator Exercise Briefing

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	0.0297	.0297	0.0029	.9569
Within Groups	111	1121.7756	10.1061		
Total	112	1121.8053			

Means: Master Unlimited 24.18
Other 24.15

Columns 5 and 6 in Table 33 indicated that the groups had significantly different reactions to only one of the 11 items. Instructors who held a Master Unlimited certificate of competency agreed to a significantly lesser extent ($p=.02$) with the statement that the most effective way to brief a simulator exercise is with oral instruction.

An overall analysis of variance for Cluster B was completed. The results of this analysis are presented in Table 34. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was therefore accepted and it was concluded that instructors who hold a Master Unlimited certificate of competency and those who hold other qualifications had similar attitudes and perceptions toward simulator exercise briefing.

Cluster C

Cluster C concerned simulator exercise running. Table 25 (page 123) contains a correlation matrix of the 12 items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.614 and considered acceptable for this exploratory research. All 12 items were used to investigate exercise running.

An analysis of variance was completed for each item, the results of which are contained in Table 35. The means in columns 3 and 4 indicate that both groups reacted negatively to eight of 12 items and positively to four items.

Table 35

Attitudes and Perceptions of Marine Simulator Instructors Who Hold a Master Unlimited Certificate of Competency and Those Who Hold Other Qualifications Toward Simulator Exercise Running

	Item	Means			
		Master	Other	F	Sig F
26.	Simulators are most effectively used in teaching situations when large groups of trainees are involved.	3.30	3.31	0.00	.97
30.	The objective of a simulator exercise need not be identified for trainees.	3.09	3.29	2.14	.15
33.	Simulator training can be an effective learning experience for all trainees who take simulator courses.	1.57	1.53	0.11	.74
34.	Simulators are most effectively used in teaching situations when small groups of trainees are involved.	1.38	1.49	1.19	.28
41.	It is not necessary for a marine simulator instructor to be a mariner to effectively make use of a marine simulator for training.	3.65	3.34	6.59	.01
43.	It is important that there are enough learning materials available during the course for trainees to review basic knowledge required for marine simulator training courses.	1.78	1.78	0.00	.96
44.	Trainees often know more about new marine technology than marine simulator instructors.	3.04	2.92	0.99	.32
83.	The trainee should always have the freedom to determine the speed of Own Ship, even if it means that the planned scenario will be spoiled.	2.05	2.32	4.08	.05

Table 35 continued

	Item	Means		F	Sig F
		Master	Other		
84.	The instructor should stop the simulator as soon as the exercise objective has been met, even if further learning can take place.	2.96	2.96	0.00	.97
85.	The instructor should not manoeuvre target ships in order to prevent a collision with Own Ship.	2.78	2.72	0.20	.66
88.	The exercise should be allowed to continue even when the trainee has no chance of achieving the exercise objective.	2.73	2.82	0.69	.41
89a	Simulator instructors should force trainees into making mistakes during simulator exercises.	3.28	3.10	2.03	.16

Table 36

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Hold a Master Unlimited Certificate of Competency and Those Who Hold Other Qualifications Toward Simulator Exercise Running

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	14.9251	14.9251	1.2543	.2651
Within Groups	113	1344.6053	11.8992		
Total	114	1359.5304			

Means: Master Unlimited 22.01
Other 22.76

Both groups strongly indicated support for small groups of trainees on simulator courses and that simulator training can be an effective learning experience for all trainees. Instructors supported the notion of identifying the exercise objective for the trainees and also felt that sufficient learning materials for review of basic knowledge should be available during simulator courses. There was some evidence of uncertainty (more neutral) as to when a simulator exercise should be stopped and whether an instructor should manoeuvre target ships in order to prevent collisions with the trainee's ship.

Columns 5 and 6 in Table 35 indicate that the two groups had significantly different reactions to only two of the 12 items. Instructors who held a Master Unlimited certificate of competency disagreed to a greater extent ($p=.01$) with the statement that it is not necessary for a marine simulator instructor to be a mariner to effectively make use of a marine simulator for training. This group also agreed to a greater extent ($p=.05$) with the statement that the trainee should always have the freedom to determine the speed of Own Ship, even if it means that the planned scenario will be spoiled.

An overall analysis of variance for Cluster C was completed. The results of this analysis are presented in Table 36. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who hold a Master Unlimited certificate of competency and those who hold other qualifications had similar attitudes and perceptions toward simulator exercise running.

Cluster D

Cluster D concerned simulator exercise de-briefing. Table 28 (page 128) contains a correlation matrix of the 13 items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.650 and considered acceptable for this exploratory research. All 13 items were used to investigate exercise de-briefing.

An analysis of variance was completed for each item, the results of which are contained in Table 37. The means in columns 3 and 4 indicate that both groups of reacted negatively to four of the items while both groups reacted positively to the nine remaining items.

In general, both groups of instructors were in agreement that trainees who did well in simulator exercises also tended to do well in other classroom activities. However, both groups were somewhat neutral toward the notion of trainees learning almost as much from each other as from the instructor.

Both groups indicated a strong belief that the de-brief should start with a review of the positive aspects of trainee performance, not focus just on mistakes that were made during

Table 37

Attitudes and Perceptions of Marine Simulator Instructors Who Hold a Master Unlimited Certificate of Competency and Those who Hold Other Qualifications Toward Simulator Exercise De-briefing

	Item	Means			
		Master	Other	F	Sig F
28.	Trainees who benefit most from simulator exercises tend to also be those who are most active in other classroom activities.	2.15	2.16	0.01	.91
29.	During simulator exercises which involve a group of trainees, only the trainee in the lead role (Master or Watch Officer) will gain experience or knowledge.	2.95	3.16	2.17	.14
39.	Trainees in a given group can learn almost as much from each other as they can learn from the instructor.	2.30	2.40	0.59	.44
46.	A good marine simulator instructor will make use of trainees to help other trainees during a simulator course.	2.01	1.90	1.23	.27
50.	Simulation can be an effective teaching tool for all trainees, regardless of their learning style.	1.74	1.84	0.91	.34
91.	The focus of a simulator exercise debrief should be only on mistakes that were made during the run.	3.36	3.24	1.36	.25
92.	The debrief is a good time for the trainees to relax before the next simulator exercise.	2.99	2.80	2.06	.15
93.	The debrief should be done quickly so as not to waste valuable simulator time.	3.20	3.02	2.00	.16

Table 37 continued

	Item	Means		F	Sig F
		Master	Other		
95.	The debrief is the most important part of simulator training.	1.93	2.21	4.37	.04
96.	The instructor should take advantage of the debrief to provide additional instruction in areas where the trainees have demonstrated a weakness.	1.70	1.62	0.61	.44
99.	The debrief should start with a review of the positive aspects of the trainees performance during the simulator exercise.	1.82	1.78	0.20	.66
100	Trainees must be accountable for their actions during a simulator exercise.	1.77	1.90	2.01	.16
101	Playback of all or a part of a simulator exercise can be useful in exercise de-briefing.	1.69	1.71	0.08	.77

Table 38

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Hold a Master Unlimited Certificate of Competency and Those who Hold Other Qualifications Toward Simulator Exercise De-briefing

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	14.0624	14.0624	1.0544	.3068
Within Groups	108	1440.3376	13.3365		
Total	109	1454.4000			

Means: Master Unlimited 24.18
Other 24.15

the exercise and take as much time as required to complete.

Columns 5 and 6 in Table 37 indicate that the two groups had significantly different reactions to only one of the 13 items. Instructors who hold a Master Unlimited certificate of competency agreed to a greater extent (p=.04) with the statement that the de-brief is the most important part of simulator training.

An overall analysis of variance for Cluster D was completed. The results of this analysis are presented in Table 38. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was therefore accepted and it was concluded that instructors who hold a Master Unlimited certificate of competency and those who hold other qualifications had similar attitudes and perceptions toward simulator exercise de-briefing.

Test of Hypothesis 4

Hypothesis 4: There are no differences in perceived training procedures between instructors who have served as Master on a ship and those who have not served as Master on a ship.

In order to address this hypothesis, four clusters of questions were developed and analyzed. The clusters dealt with simulator exercise development (cluster A), simulator exercise briefing (cluster B), simulator exercise running (cluster C) and simulator exercise de-briefing (cluster D). Each of the four groups was investigated separately.

Cluster A

Cluster A concerned simulator exercise development. Table 19 (page 114) contains a correlation matrix of the nine items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.737 and considered acceptable for this exploratory research. All nine items were used to investigate exercise development.

An analysis of variance was completed for each item, the results of which are contained in Table 39. The means in columns 3 and 4 indicate that instructors who served as Master and those who did not serve as Master reacted positively to all items.

Both groups were somewhat unsure (more neutral) about whether it is easy to evaluate trainee performance during a simulator exercise and whether simulator instructors have a good understanding of evaluation techniques. They were, however, in close agreement that evaluation of simulator exercises is best achieved through a mixture of subjective and objective evaluation techniques.

Instructors in both groups also agreed that good exercise development is the most important part of simulator training, that simulator exercises should be consistent with the exercise objective and that marine simulator exercise

Table 39

Attitudes and Perceptions of Marine Simulator Instructors Who Have and Have Not Served as Master on a Ship Toward Simulator Exercise Development

	Item	Means			
		Yes	No	F	Sig F
51.	It is easy to evaluate trainee performance during a simulator exercise.	2.22	2.28	0.21	.65
52.	Evaluation of simulator exercises is best achieved through a mixture of subjective and objective evaluation techniques.	1.91	1.94	0.14	.71
53.	Marine simulator instructors have a good understanding of evaluation techniques.	2.23	2.13	0.61	.43
54.	The first step in good exercise development is for the instructor to clearly define the objective of the exercise.	1.37	1.51	2.39	.12
55.	Good exercise development is the most important part of simulator training.	1.62	1.67	0.23	.63
60.	Marine simulator exercise development includes validation and testing of all aspects of the exercise.	1.63	1.76	1.93	.17
61.	Simulator exercises should be consistent with the exercise objective.	1.64	1.67	0.15	.70
63.	It is important that the instructor develop a list of essential tasks that the trainee must perform during a simulator exercise.	1.98	1.87	1.11	.29
65.	Success in simulator exercises, especially in the early stages of a course, is important to the self esteem and confidence of all trainees.	1.87	1.95	0.53	.47

Table 40

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Have and Have Not Served as Master on a Ship Toward Simulator Exercise Development

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	4.8760	4.8760	0.5015	.4803
Within Groups	115	1118.1155	9.7227		
Total	116	1122.9915			

Means:	Served as Master	16.29
	Not Served as Master	16.70

development includes validation and testing of all aspects of the exercise.

Columns 5 and 6 in table 39 indicated that the two groups did not have significantly different reactions on any of the nine items.

An overall analysis of variance for Cluster A was completed. The results of this analysis are presented in Table 40. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who have served as Master on a ship and those who have not served as Master on a ship had similar attitudes and perceptions toward simulator exercise development.

Cluster B

Cluster B concerned simulator exercise briefing. Table 22 (page 119) contains a correlation matrix of the 11 items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.632 and considered acceptable for this exploratory research. All 11 items were used to investigate exercise briefing.

An analysis of variance was completed for each item, the results of which are contained in Table 41. The means in columns 3 and 4 indicate that instructors who had served as Master and those who had not served as Master reacted negatively to three items. While those who had been Master reacted neutrally to one item, those who had not been Master reacted negatively to this item. Both groups reacted positively to the seven remaining items .

Generally, instructors agreed that a briefing process was necessary for marine simulator exercises and that the briefing requires careful preparation by the instructor. Both groups were less strong in their agreement that trainees should be given more than the minimum of information during the debrief and the extent to which the instructor should review relevant information during the briefing. There was some evidence of uncertainty regarding the use of oral or written briefing and as to whether the briefing session should be conducted in a formal manner.

Columns 5 and 6 in Table 41 indicate that the two groups had significantly different reactions to only one of the 11 items. Instructors who had not served as Master significantly agreed ($p=.04$) more strongly that the briefing process should provide additional instruction, as necessary, to strengthen areas of weakness that trainees may have.

An overall analysis of variance for Cluster B was completed. The results of this analysis are presented in Table 42. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who have served as Master on a ship and those who have not

Table 41

Attitudes and Perceptions of Marine Simulator Instructors Who Have and Have Not Served as Master on a Ship Toward Simulator Exercise Briefing

	Item	Means			
		Yes	No	F	Sig F
69.	A trainee should be given only the minimum amount of information necessary to complete the simulator exercise.	2.82	2.91	0.64	.43
70.	A briefing process is not necessary for most marine simulator exercises.	3.35	3.31	0.16	.69
71.	The most effective way to brief a simulator exercise is with oral instruction.	2.35	2.27	0.43	.51
72.	Exercise briefing requires careful preparation by the instructor.	1.78	1.85	0.61	.44
73.	Exercise briefings usually include sufficient time for the trainees to prepare a passage plan for the simulator exercise.	2.00	2.04	0.11	.74
74.	During the briefing, the instructor should review all relevant information necessary for the successful completion of the simulator exercise.	1.94	2.09	2.15	.15
75.	Simulator exercise briefing should provide additional instruction, as necessary, to strengthen any areas of weakness that the trainees may have.	2.01	1.80	4.47	.04
76	Simulator exercise briefings should be conducted in a formal manner.	2.40	2.44	0.13	.72
77.	Marine simulator instructors have a good understanding of effective briefing techniques.	2.21	2.10	1.12	.29

Table 41 continued

	Item	Means		F	Sig F
		Yes	No		
78.	The most effective way to brief a simulator exercise is with written instruction.	2.80	2.80	0.00	.95
80.	Trainees should be given as much time as they need to prepare for a simulator exercise.	2.50	2.61	0.98	.32

Table 42

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Have and Have Not Served as Master on a Ship Toward Simulator Exercise Briefing

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	.5260	.5260	0.0523	.8194
Within Groups	112	1125.3074	10.0474		
Total	113	1125.8333			

Means:	Served as Master	24.11
	Not Served as Master	24.24

served as Master on a ship had similar attitudes and perceptions toward simulator exercise briefing.

Cluster C

Cluster C concerned simulator exercise running. Table 25 (page 123) contains a correlation matrix of the 12 items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.614 and considered acceptable for this exploratory research. All 12 items were used to investigate exercise running.

An analysis of variance was completed for each item, the results of which are contained in Table 43. The means in columns 3 and 4 indicate that instructors who had served as Master and those who had not served as Master reacted negatively to eight of the 12 items while both groups reacted positively to the four remaining items.

Both groups agreed that simulator training can be an effective learning experience for all trainees and that simulator training is best suited to small groups of trainees. Instructors all indicated that it was necessary to be a mariner to make effective use of a marine simulator. There was some uncertainty as to whether the exercise should be stopped once it became apparent that the exercise objective could not be met and as to whether the instructor should manoeuvre target ships to prevent collisions with the trainee's ship.

Columns 5 and 6 in Table 43 indicate that the two groups had significantly different reactions to only two of the 12 items. Instructors who had served as Master significantly disagreed (p=.01) more strongly with the statement that simulators are most effectively used in teaching situations when large groups of trainees are involved. This same group also significantly disagreed (p=.01) more strongly with the statement that the instructor should stop the simulator as soon as the exercise objective has been met, even if further learning can take place.

An overall analysis of variance for Cluster C was completed. The results of this analysis are presented in Table 44. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who have served as Master on a ship and those who have not served as Master on a ship had similar attitudes and perceptions toward simulator exercise running.

Cluster D

Cluster D concerned simulator exercise de-briefing. Table 28 (page 128) contains a correlation matrix of the 13 items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.650 and considered acceptable for this exploratory research. All 13 items were used to investigate exercise de-briefing.

Table 43

Attitudes and Perceptions of Marine Simulator Instructors Who Have and Have Not Served as Master on a Ship Toward Simulator Exercise Running

	Item	Means			
		Yes	No	F	Sig F
26.	Simulators are most effectively used in teaching situations when large groups of trainees are involved.	3.43	3.13	6.68	.01
30.	The objective of a simulator exercise need not be identified for trainees.	3.11	3.25	1.28	.26
33.	Simulator training can be an effective learning experience for all trainees who take simulator courses.	1.58	1.53	0.22	.64
34.	Simulators are most effectively used in teaching situations when small groups of trainees are involved.	1.36	1.50	1.99	.16
41.	It is not necessary for a marine simulator instructor to be a mariner to effectively make use of a marine simulator for training.	3.60	3.42	2.15	.14
43.	It is important that there are enough learning materials available during the course for trainees to review basic knowledge required for marine simulator training courses.	1.79	1.76	0.14	.71
44.	Trainees often know more about new marine technology than marine simulator instructors.	3.03	2.98	0.14	.71
83.	The trainee should always have the freedom to determine the speed of Own Ship, even if it means that the planned scenario will be spoiled.	2.13	2.15	0.03	.87

Table 43 continued

	Item	Means Yes	Means No	F	Sig F
84.	The instructor should stop the simulator as soon as the exercise objective has been met, even if further learning can take place.	3.03	2.87	2.67	.01
85.	The instructor should not manoeuvre target ships in order to prevent a collision with Own Ship.	2.71	2.79	0.34	.56
88.	The exercise should be allowed to continue even when the trainee has no chance of achieving the exercise objective.	2.74	2.78	0.13	.72
89a	Simulator instructors should force trainees into making mistakes during simulator exercises.	3.28	3.09	2.34	.13

Table 44

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Have and Have Not Served as Master on a Ship Toward Simulator Exercise Running

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	21.4484	21.4484	1.8321	.1786
Within Groups	114	1334.5860	11.7069		
Total	115	1356.0345			

Means: Served as Master 21.93
Not Served as Master 22.80

An analysis of variance was completed for each item, the results of which are contained in Table 45. The means in columns 3 and 4 indicate that instructors who had served as Master and those who had not served as Master reacted negatively to four of the items while both groups reacted positively to the nine remaining items.

There was general agreement that simulation can be an effective teaching tool for all trainees, regardless of their learning style and that a good marine simulator instructor will make use of trainees to help other trainees during a simulator course. However, both groups disagreed that the focus of a simulator exercise debrief should be only on mistakes that were made during the run, that the debrief is a good time to relax and that the debrief should be done quickly so as not to waste simulator time.

Both groups agreed that the debrief should start with a review of the positive aspects of the exercise and that playback of all or part of an exercise can be useful in debriefing.

Columns 5 and 6 in Table 45 indicate that the two groups had significantly different reactions to only one of the 13 items. Instructors who had served as Master agreed more strongly to a significant extent ($p=.00$) with the statement that trainees must be accountable for their actions during a simulator exercise.

An overall analysis of variance for Cluster D was completed. The results of this analysis are presented in Table 46. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who have served as Master on a ship and those who have not served as Master on a ship had similar attitudes and perceptions toward simulator exercise de-briefing.

Test of Hypothesis 5

Hypothesis 5: There are no differences in perceived training procedures between instructors who hold a teaching certificate and those who do not hold a teaching certificate.

In order to address this hypothesis, four clusters of questions were developed and analyzed. The clusters dealt with simulator exercise development (cluster A), simulator exercise briefing (cluster B), simulator exercise running (cluster C) and simulator exercise de-briefing (cluster D). Each of the four groups was investigated separately.

Cluster A

Cluster A concerned simulator exercise development. Table 19 (page 114) contains a correlation matrix of the nine items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.737 and considered acceptable for this exploratory research. All nine items were used to investigate exercise development.

Table 45

Attitudes and Perceptions of Marine Simulator Instructors Who Have and Have Not Served as Master on a Ship Toward Simulator Exercise De-briefing

	Item	Means			
		Yes	No	F	Sig F
28.	Trainees who benefit most from simulator exercises tend to also be those who are most active in other classroom activities.	2.16	2.13	0.06	.80
29.	During simulator exercises which involve a group of trainees, only the trainee in the lead role (Master or Watch Officer) will gain experience or knowledge.	3.10	2.93	1.61	.21
39.	Trainees in a given group can learn almost as much from each other as they can learn from the instructor.	2.37	2.33	0.08	.78
46.	A good marine simulator instructor will make use of trainees to help other trainees during a simulator course.	1.96	2.02	0.31	.58
50.	Simulation can be an effective teaching tool for all trainees, regardless of their learning style.	1.76	1.78	0.03	.85
91.	The focus of a simulator exercise debrief should be only on mistakes that were made during the run.	3.34	3.24	1.02	.31
92.	The debrief is a good time for the trainees to relax before the next simulator exercise.	2.94	2.87	0.24	.63
93.	The debrief should be done quickly so as not to waste valuable simulator time.	3.10	3.15	0.12	.73
95.	The debrief is the most important part of simulator training.	1.99	2.09	0.62	.43

Table 45 continued

	Item	Means		F	Sig F
		Yes	No		
96.	The instructor should take advantage of the debrief to provide additional instruction in areas where the trainees have demonstrated a weakness.	1.62	1.75	1.94	.17
99.	The debrief should start with a review of the positive aspects of the trainees performance during the simulator exercise.	1.77	1.86	0.91	.34
100	Trainees must be accountable for their actions during a simulator exercise.	1.72	1.98	9.36	.00
101	Playback of all or a part of a simulator exercise can be useful in exercise de-briefing.	1.72	1.69	0.09	.77

Table 46

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Have and Have Not Served as Master on a Ship Toward Simulator Exercise De-briefing

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	43.0949	43.0949	.0720	.1786
Within Groups	108	1409.4597	13.0506		
Total	109	1452.5545			

Means:		
	Served as Master	39.89
	Not Served as Master	38.63

An analysis of variance was completed for each item, the results of which are contained in Table 47. The means in columns 3 and 4 indicate that both groups reacted positively to all items.

There was some evidence of uncertainty in both groups as to whether it was easy to evaluate trainee performance during a simulator exercise however, both groups agreed that both objective and subjective evaluation techniques were necessary.

Both groups agreed that simulator exercise development is the most important part of simulator training, that exercise development should start with a clearly defined objective and that the exercise should be consistent with the objective. Both groups also agreed that marine simulator exercise development includes validation and testing of all aspects of the exercise.

Columns 5 and 6 in Table 47 indicated that the two groups did not have significantly different reactions to any of the nine items. Instructors who held a teaching certificate had a tendency to agree more strongly with the statement that marine simulator instructors had a good understanding of evaluation techniques.

An overall analysis of variance for Cluster A was completed. The results of this analysis are presented in Table 48. The analysis of variance indicated no significant differences between the two groups. This section of the null

Table 47

Attitudes and Perceptions of Marine Simulator Instructors Who Hold and Do Not Hold a Teaching Certificate Toward Simulator Exercise Development

	Item	Means			
		Yes	No	F	Sig F
51.	It is easy to evaluate trainee performance during a simulator exercise.	2.12	2.28	1.26	.26
52.	Evaluation of simulator exercises is best achieved through a mixture of subjective and objective evaluation techniques.	1.90	1.93	0.09	.77
53.	Marine simulator instructors have a good understanding of evaluation techniques.	2.03	2.27	3.07	.08
54.	The first step in good exercise development is for the instructor to clearly define the objective of the exercise.	1.46	1.40	0.36	.55
55.	Good exercise development is the most important part of simulator training.	1.73	1.60	1.38	.24
60.	Marine simulator exercise development includes validation and testing of all aspects of the exercise.	1.65	1.69	0.15	.69
61.	Simulator exercises should be consistent with the exercise objective.	1.76	1.61	2.61	.11
63.	It is important that the instructor develop a list of essential tasks that the trainee must perform during a simulator exercise.	1.86	1.96	0.89	.35
65.	Success in simulator exercises, especially in the early stages of a course, is important to the self esteem and confidence of all trainees.	1.80	1.96	2.09	.15

Table 48

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Hold and Do Not Hold a Teaching Certificate Toward Simulator Exercise Development

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	5.0320	5.0320	.5211	.4718
Within Groups	116	1120.0527	9.6556		
Total	117	1125.0847			

Means:		
	Served as Master	16.14
	Not Served as Master	16.58

hypothesis was accepted and it was concluded that instructors who have a teaching certificate and those who do not have a teaching certificate had similar attitudes and perceptions toward simulator exercise development.

Cluster B

Cluster B concerned simulator exercise briefing. Table 22 (page 119) contains a correlation matrix of the 11 items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.632 and considered acceptable for this exploratory research. All 11 items were used to investigate exercise briefing.

An analysis of variance was completed for each item, the results of which are contained in Table 49. The means in columns 3 and 4 indicate that both groups of instructors reacted negatively to three of the items and positively to seven of the items. The remaining item produced a slightly positive reaction from instructors who held a teaching certificate while the other group had a negative reaction to this item.

There was general agreement that a briefing process was necessary for simulator exercises and that briefing requires careful preparation by the instructor. There was, however, some evidence of uncertainty as to whether the briefing should be conducted in a formal manner and how much time should be given to trainees to prepare for a simulator exercise.

Columns 5 and 6 in Table 49 indicated that the groups had significantly different reactions to three of the 11 items. Instructors who had a teaching certificate did not agree ($p=.04$) as strongly with the statement that the most effective way to brief a simulator exercise is with oral instruction. This same group disagreed ($p=.03$) less strongly with the statement that the most effective way to brief a simulator exercise is with written instruction. While both of these statements produced significantly different responses, both groups were uncertain (more neutral) as to which method (oral or written) was most effective. Instructors who had a teaching certificate agreed significantly ($p=.01$) more strongly with the statement that exercise briefings usually include sufficient time for the trainees to prepare a passage plan for the simulator exercise.

An overall analysis of variance for Cluster B was completed. The results of this analysis are presented in Table 50. The analysis of variance indicated significant differences between the two groups. This section of the null hypothesis was rejected and it was concluded that instructors who have a teaching certificate and those who do not have a teaching certificate had different attitudes and perceptions toward simulator exercise briefing.

Cluster C

Cluster C concerned simulator exercise running. Table 25

Table 49

Attitudes and Perceptions of Marine Simulator Instructors Who Hold and Do Not Hold a Teaching Certificate Toward Simulator Exercise Briefing

	Item	Means			
		Yes	No	F	Sig F
69.	A trainee should be given only the minimum amount of information necessary to complete the simulator exercise.	2.88	2.84	0.11	.74
70.	A briefing process is not necessary for most marine simulator exercises.	3.33	3.33	0.00	.97
71.	The most effective way to brief a simulator exercise is with oral instruction.	2.49	2.24	4.23	.04
72.	Exercise briefing requires careful preparation by the instructor.	1.81	1.81	0.00	.99
73.	Exercise briefings usually include sufficient time for the trainees to prepare a passage plan for the simulator exercise.	1.80	2.10	6.84	.01
74.	During the briefing, the instructor should review all relevant information necessary for the successful completion of the simulator exercise.	1.88	2.05	2.49	.12
75.	Simulator exercise briefing should provide additional instruction, as necessary, to strengthen any areas of weakness that the trainees may have.	1.95	1.90	0.20	.66
76	Simulator exercise briefings should be conducted in a formal manner.	2.33	2.46	1.20	.28
77.	Marine simulator instructors have a good understanding of effective briefing techniques.	2.13	2.18	0.18	.67

Table 49 continued

	Item	Means			
		Yes	No	F	Sig F
78.	The most effective way to brief a simulator exercise is with written instruction.	2.63	2.88	4.92	.03
80.	Trainees should be given as much time as they need to prepare for a simulator exercise.	2.39	2.61	3.43	.07

Table 50

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Hold and Do Not Hold a Teaching Certificate Toward Simulator Exercise Briefing

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	69.5943	69.5943	7.4359	.0074
Within Groups	113	1057.5884	9.3592		
Total	114	1127.1826			

Means: Served as Master 16.14
Not Served as Master 16.58

(page 123) contains a correlation matrix of the 12 items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.614 and considered acceptable for this exploratory research. All 12 items were used to investigate exercise running.

An analysis of variance was completed for each item, the results of which are contained in Table 51. The means in columns 3 and 4 indicate that both groups reacted negatively to eight of the 12 items while both groups reacted positively to the four remaining items.

There was general agreement that simulators are most effectively used in teaching situations when small groups of trainees are involved and that simulator training can be an effective learning experience for all trainees who take simulator courses. There was some evidence of uncertainty (more neutral) as to when simulator exercises should be terminated however, both groups strongly disagreed with the statement that simulator instructors should force trainees into making mistakes during simulator exercises.

Columns 5 and 6 in Table 51 indicate that the two groups had significantly different reactions to only two of the 12 items. Instructors who had a teaching certificate disagreed ($p=.00$) less strongly with the statement that it is not necessary for a marine simulator instructor to be a mariner to effectively make use of a marine simulator for training. This

Table 51

Attitudes and Perceptions of Marine Simulator Instructors Who Hold and Do Not Hold a Teaching Certificate Toward Simulator Exercise Running

	Item	Means			
		Yes	No	F	Sig F
26.	Simulators are most effectively used in teaching situations when large groups of trainees are involved.	3.36	3.28	0.38	.54
30.	The objective of a simulator exercise need not be identified for trainees.	3.13	3.17	0.12	.73
33.	Simulator training can be an effective learning experience for all trainees who take simulator courses.	1.60	1.54	0.22	.64
34.	Simulators are most effectively used in teaching situations when small groups of trainees are involved.	1.41	1.41	0.00	.99
41.	It is not necessary for a marine simulator instructor to be a mariner to effectively make use of a marine simulator for training.	3.26	3.65	9.17	.00
43.	It is important that there are enough learning materials available during the course for trainees to review basic knowledge required for marine simulator training courses.	1.74	1.80	0.4	.53
44.	Trainees often know more about new marine technology than marine simulator instructors.	3.10	2.96	1.28	.26
83.	The trainee should always have the freedom to determine the speed of Own Ship, even if it means that the planned scenario will be spoiled.	2.10	2.16	0.17	.68

Table 51 continued

	Item	Means			
		Yes	No	F	Sig F
84.	The instructor should stop the simulator as soon as the exercise objective has been met, even if further learning can take place.	2.95	2.96	0.00	.95
85.	The instructor should not manoeuvre target ships in order to prevent a collision with Own Ship.	3.02	2.61	8.44	.00
88.	The exercise should be allowed to continue even when the trainee has no chance of achieving the exercise objective.	2.66	2.81	1.80	.18
89a	Simulator instructors should force trainees into making mistakes during simulator exercises.	3.20	3.20	0.00	.96

Table 52

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Hold and Do Not Hold a Teaching Certificate Toward Simulator Exercise Running

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	.7347	.7347	0.0617	.8042
Within Groups	115	1368.9234	11.9037		
Total	116	1369.6581			

Means: Served as Master 22.21
Not Served as Master 22.38

group also disagreed significantly (p=.00) more strongly with the statement that the instructor should not manoeuvre target ships in order to prevent a collision with Own Ship.

An overall analysis of variance for Cluster C was completed. The results of this analysis are presented in Table 52. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who have a teaching certificate and those who do not have a teaching certificate had similar attitudes and perceptions toward simulator exercise running.

Cluster D

Cluster D concerned simulator exercise de-briefing. Table 28 (page 128) contains a correlation matrix of the 13 items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.650 and considered acceptable for this exploratory research. All 13 items were used to investigate exercise de-briefing.

An analysis of variance was completed for each item, the results of which are contained in Table 53. The means in columns 3 and 4 indicate that both groups reacted negatively to four of the items while both groups reacted positively to the nine remaining items.

Instructors generally agreed that instructors should use trainees to help other trainees and that trainees can learn from each other. Both groups disagreed that the debrief should focus only on mistakes and that the debrief was a good time for trainees to relax. Both groups also disagreed that the debrief should be done quickly so as not to waste simulator time. Instructors generally agreed that the debrief should start with a review of the positive aspects of the exercise and that instructors should provide additional instruction during the debrief. Instructors were also in agreement on issues related to trainee accountability and usefulness of exercise playback during the de-briefing session.

Columns 5 and 6 in Table 53 indicate that the two groups had significantly different reactions to only two of the 13 items. Instructors who had a teaching certificate agreed ($p=.02$) more strongly with the statement that simulation can be an effective teaching tool for all trainees, regardless of their learning style. The same group agreed to a lesser extent ($p=.03$) that the debrief is the most important part of simulator training.

An overall analysis of variance for Cluster D was completed. The results of this analysis are presented in Table 54. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who have a teaching certificate and those who do not have a teaching certificate had similar attitudes and perceptions toward simulator exercise de-briefing.

Test of Hypothesis 6

Hypothesis 6: There are no differences in perceived training procedures between instructors who are certified as a marine simulator instructor by their country and those who are not certified by the government of their country.

In order to address this hypothesis, four clusters of questions were developed and analyzed. The clusters dealt with simulator exercise development (cluster A), simulator exercise briefing (cluster B), simulator exercise running (cluster C) and simulator exercise de-briefing (cluster D). Each of the four groups was investigated separately.

Cluster A

Cluster A concerned simulator exercise development. Table 19 (page 114) contains a correlation matrix of the nine items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.737 and considered acceptable for this exploratory research. All nine items were used to investigate exercise development.

An analysis of variance was completed for each item, the results of which are contained in Table 55. The means in columns 3 and 4 indicate that instructors who are certified by the government of their country and those who are not certified reacted positively to all items.

Table 53

Attitudes and Perceptions of Marine Simulator Instructors Who Hold and Do Not Hold a Teaching Certificate Toward Simulator Exercise De-briefing

	Item	Means			
		Yes	No	F	Sig F
28.	Trainees who benefit most from simulator exercises tend to also be those who are most active in other classroom activities.	2.25	2.11	1.16	.28
29.	During simulator exercises which involve a group of trainees, only the trainee in the lead role (Master or Watch Officer) will gain experience or knowledge.	3.20	2.96	2.64	.11
39.	Trainees in a given group can learn almost as much from each other as they can learn from the instructor.	2.28	2.38	0.70	.40
46.	A good marine simulator instructor will make use of trainees to help other trainees during a simulator course.	2.00	1.98	0.04	.84
50.	Simulation can be an effective teaching tool for all trainees, regardless of their learning style.	1.60	1.85	5.53	.02
91.	The focus of a simulator exercise debrief should be only on mistakes that were made during the run.	3.34	3.29	0.25	.62
92.	The debrief is a good time for the trainees to relax before the next simulator exercise.	2.93	2.90	0.03	.86
93.	The debrief should be done quickly so as not to waste valuable simulator time.	3.15	3.11	0.09	.77
95.	The debrief is the most important part of simulator training.	2.24	1.93	4.79	.03

Table 53 continued

	Item	Means		F	Sig F
		Yes	No		
96.	The instructor should take advantage of the debrief to provide additional instruction in areas where the trainees have demonstrated a weakness.	1.66	1.68	0.04	.85
99.	The debrief should start with a review of the positive aspects of the trainees performance during the simulator exercise.	1.77	1.82	0.24	.63
100	Trainees must be accountable for their actions during a simulator exercise.	1.79	1.84	0.27	.60
101	Playback of all or a part of a simulator exercise can be useful in exercise de-briefing.	1.64	1.73	0.77	.38

Table 54

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Hold and Do Not Hold a Teaching Certificate Toward Simulator Exercise De-briefing

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	19.3636	19.3636	1.4591	.2297
Within Groups	109	1446.4922	13.2706		
Total	110	1465.8559			

Means: Served as Master 39.97
Not Served as Master 39.08

Instructors who were not certified had a tendency to agree more strongly that evaluation of simulator exercises is best achieved through a mixture of subjective and objective evaluation techniques however, both groups were somewhat uncertain (more neutral) as to whether evaluation of simulator exercises was easy. Both groups were also somewhat uncertain (more neutral) as to whether instructors had a good understanding of evaluation techniques. Both groups of instructors agreed on the importance of exercise development and on the value of clearly defined objectives.

Columns 5 and 6 in table 55 indicated that the two groups did not have significantly different reactions to any of the nine items.

An overall analysis of variance for Cluster A was completed. The results of this analysis are presented in Table 56. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who are certified as a marine simulator instructor by their country and those who are not certified by the government of their country had similar attitudes and perceptions toward simulator exercise development.

Cluster B

Cluster B concerned simulator exercise briefing. Table 22 (page 119) contains a correlation matrix of the 11 items in

Table 55

Attitudes and Perceptions of Marine Simulator Instructors Who Are and Are Not Certified By the Government of Their Country Toward Simulator Exercise Development

	Item	Means			
		Yes	No	F	Sig F
51.	It is easy to evaluate trainee performance during a simulator exercise.	2.17	2.31	1.08	.30
52.	Evaluation of simulator exercises is best achieved through a mixture of subjective and objective evaluation techniques.	2.02	1.86	3.33	.07
53.	Marine simulator instructors have a good understanding of evaluation techniques.	2.11	2.29	1.87	.17
54.	The first step in good exercise development is for the instructor to clearly define the objective of the exercise.	1.45	1.42	0.13	.72
55.	Good exercise development is the most important part of simulator training.	1.65	1.63	0.05	.82
60.	Marine simulator exercise development includes validation and testing of all aspects of the exercise.	1.66	1.69	0.12	.73
61.	Simulator exercises should be consistent with the exercise objective.	1.62	1.70	0.82	.37
63.	It is important that the instructor develop a list of essential tasks that the trainee must perform during a simulator exercise.	1.85	1.99	1.85	.18
65.	Success in simulator exercises, especially in the early stages of a course, is important to the self esteem and confidence of all trainees.	1.95	1.89	0.35	.56

Table 56

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Are and Are Not Certified By the Government of Their Country Toward Simulator Exercise Development

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	.3217	.3217	0.0339	.8543
Within Groups	114	1082.6697	9.4971		
Total	115	1082.9914			

Means: Certified by Government 16.43
Not Certified by Government 16.54

this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.632 and considered acceptable for this exploratory research. All 11 items were used to investigate exercise briefing.

An analysis of variance was completed for each item, the results of which are contained in Table 57. The means in columns 3 and 4 indicate that instructors who were certified by the government of their country and those who were not certified reacted negatively to four of the 11 items while both groups reacted positively to the seven remaining items.

Both groups of instructors agreed that a briefing process was necessary however, they were uncertain (more neutral) about which method of briefing (oral or written) was most effective and if the briefing should be conducted in a formal manner. Both groups also agreed that briefing should include preparation time but, again, were somewhat uncertain as to how much time should be allocated to this process.

Columns 5 and 6 in Table 57 indicate that the two groups had significantly different reactions to only two of the 11 items. Instructors who were certified agreed ($p=.04$) more strongly that during the briefing, the instructor should review all relevant information necessary for the successful completion of the simulator exercise. This same group also agreed ($p=.05$) more strongly that simulator exercise briefing should provide additional instruction, as necessary, to strengthen any areas of weakness that the trainees may have.

An overall analysis of variance for Cluster B was completed. The results of this analysis are presented in Table 58. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who are certified as a marine simulator instructor by their country and those who are not certified by the government of their country had similar attitudes and perceptions toward simulator exercise briefing.

Cluster C

Cluster C concerned simulator exercise running. Table 25 (page 123) contains a correlation matrix of the 12 items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.614 and considered acceptable for this exploratory research. All 12 items were used to investigate exercise running.

An analysis of variance was completed for each item, the results of which are contained in Table 59. The means in columns 3 and 4 indicate that instructors who were certified by the government of their country and those who were not certified reacted negatively to eight of the 12 items while both groups reacted positively to the four remaining items.

There was general support for small groups of trainees on simulator courses and agreement that simulator training can be

Table 57

Attitudes and Perceptions of Marine Simulator Instructors Who Are and Are Not Certified By the Government of Their Country Toward Simulator Exercise Briefing

	Item	Means			
		Yes	No	F	Sig F
69.	A trainee should be given only the minimum amount of information necessary to complete the simulator exercise.	2.80	2.90	0.84	.36
70.	A briefing process is not necessary for most marine simulator exercises.	3.27	3.40	1.63	.20
71.	The most effective way to brief a simulator exercise is with oral instruction.	2.24	2.39	1.86	.18
72.	Exercise briefing requires careful preparation by the instructor.	1.87	1.78	0.73	.39
73.	Exercise briefings usually include sufficient time for the trainees to prepare a passage plan for the simulator exercise.	1.96	2.04	0.49	.49
74.	During the briefing, the instructor should review all relevant information necessary for the successful completion of the simulator exercise.	1.88	2.10	4.19	.04
75.	Simulator exercise briefing should provide additional instruction, as necessary, to strengthen any areas of weakness that the trainees may have.	1.82	2.01	3.81	.05
76	Simulator exercise briefings should be conducted in a formal manner.	2.33	2.48	1.89	.17
77.	Marine simulator instructors have a good understanding of effective briefing techniques.	2.13	2.21	0.57	.45

Table 57 continued

	Item	Means			
		Yes	No	F	Sig F
78.	The most effective way to brief a simulator exercise is with written instruction.	2.80	2.80	0.00	.99
80.	Trainees should be given as much time as they need to prepare for a simulator exercise.	2.55	2.53	0.04	.85

Table 58

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Are and Are Not Certified By the Government of Their Country Toward Simulator Exercise Briefing

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	6.1088	6.1088	0.6074	.4374
Within Groups	111	1116.3336	10.0571		
Total	112	1122.4425			

Means: Certified by Government 23.91
Not Certified by Government 24.37

an effective learning experience for all trainees. Instructors supported the notion of identifying the exercise objective for the trainees and also felt that sufficient learning materials for review of basic knowledge should be available during simulator courses. There was some evidence of uncertainty (more neutral) as to when a simulator exercise should be stopped and whether an instructor should manoeuvre target ships in order to prevent collisions with the trainee's ship. Both groups disagreed with the statement that simulator instructors should force trainees into making mistakes during simulator exercises.

Columns 5 and 6 in Table 59 indicate that the two groups did not have significantly different reactions to any of the 12 items.

An overall analysis of variance for Cluster C was completed. The results of this analysis are presented in Table 60. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who are certified as a marine simulator instructor by their country and those who are not certified by the government of their country had similar attitudes and perceptions toward simulator exercise running.

Cluster D

Cluster D concerned simulator exercise de-briefing.

Table 59

Attitudes and Perceptions of Marine Simulator Instructors Who Are and Are Not Certified By the Government of Their Country Toward Simulator Exercise Running

	Item	Means			
		Yes	No	F	Sig F
26.	Simulators are most effectively used in teaching situations when large groups of trainees are involved.	3.28	3.31	0.05	.82
30.	The objective of a simulator exercise need not be identified for trainees.	3.24	3.09	1.29	.26
33.	Simulator training can be an effective learning experience for all trainees who take simulator courses.	1.65	1.49	2.28	.13
34.	Simulators are most effectively used in teaching situations when small groups of trainees are involved.	1.45	1.38	0.54	.47
41.	It is not necessary for a marine simulator instructor to be a mariner to effectively make use of a marine simulator for training.	3.42	3.62	2.62	.11
43.	It is important that there are enough learning materials available during the course for trainees to review basic knowledge required for marine simulator training courses.	1.80	1.77	0.07	.79
44.	Trainees often know more about new marine technology than marine simulator instructors.	2.97	3.04	0.42	.52
83.	The trainee should always have the freedom to determine the speed of Own Ship, even if it means that the planned scenario will be spoiled.	2.10	2.19	0.39	.54

Table 59 continued

	Item	Means		F	Sig F
		Yes	No		
84.	The instructor should stop the simulator as soon as the exercise objective has been met, even if further learning can take place.	2.92	2.99	0.54	.46
85.	The instructor should not manoeuvre target ships in order to prevent a collision with Own Ship.	2.71	2.75	0.11	.74
88.	The exercise should be allowed to continue even when the trainee has no chance of achieving the exercise objective.	2.75	2.75	0.00	.97
89a	Simulator instructors should force trainees into making mistakes during simulator exercises.	3.10	3.26	1.80	.18

Table 60

Attitudes and Perceptions of Marine Simulator Instructors Who Are and Are Not Certified By the Government of Their Country Toward Simulator Exercise Running

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	0.5064	0.5064	0.0423	.8374
Within Groups	113	1352.4153	11.9683		
Total	114	1352.9217			

Means: Certified by Government 22.44
Not Certified by Government 22.31

Table 28 (page 128) contains a correlation matrix of the 13 items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.650 and considered acceptable for this exploratory research. All 13 items were used to investigate exercise de-briefing.

An analysis of variance was completed for each item, the results of which are contained in Table 61. The means in columns 3 and 4 indicate that instructors who were certified by the government of their country and those who were not certified reacted negatively to four of the items while both groups reacted positively to the nine remaining items.

Both groups agreed that use of trainees to help other trainees was acceptable however, there was some uncertainty as to whether trainees can learn from each other. Both groups agreed that trainees who were not in a lead role during an exercise would gain experience and knowledge and that simulation can be an effective training tool regardless of individual learning style.

Instructors who were certified tended to disagree less strongly than the other group about the focus of the debrief however, they tended to agree more strongly with the notion of using the debrief to provide additional instruction.

Columns 5 and 6 in Table 61 indicate that the two groups had significantly different reactions to only one of the 13 items. Instructors who were certified significantly agreed (p=.02) more strongly with the statement that trainees must be accountable for their actions during a simulator exercise.

An overall analysis of variance for Cluster D was completed. The results of this analysis are presented in Table 62. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who are certified as a marine simulator instructor by their country and those who are not certified by the government of their country had similar attitudes and perceptions toward simulator exercise de-briefing.

Test of Hypothesis 7

Hypothesis 7: There are no differences in perceived training procedures between instructors who use simulator equipment that has a visual system and those who work on simulator equipment that does not have a visual system.

In order to address this hypothesis, four clusters of questions were developed and analyzed. The clusters dealt with simulator exercise development (cluster A), simulator exercise briefing (cluster B), simulator exercise running (cluster C) and simulator exercise de-briefing (cluster D). Each of the four groups was investigated separately.

Cluster A

Cluster A concerned simulator exercise development. Table 19 (page 114) contains a correlation matrix of the nine

Table 61

Attitudes and Perceptions of Marine Simulator Instructors Who Are and Are Not Certified By the Government of Their Country Toward Simulator Exercise De-briefing

	Item	Means			
		Yes	No	F	Sig F
28.	Trainees who benefit most from simulator exercises tend to also be those who are most active in other classroom activities.	2.21	2.11	0.57	.45
29.	During simulator exercises which involve a group of trainees, only the trainee in the lead role (Master or Watch Officer) will gain experience or knowledge.	3.07	3.03	0.08	.78
39.	Trainees in a given group can learn almost as much from each other as they can learn from the instructor.	2.38	2.31	0.29	.59
46.	A good marine simulator instructor will make use of trainees to help other trainees during a simulator course.	1.95	2.04	0.86	.36
50.	Simulation can be an effective teaching tool for all trainees, regardless of their learning style.	1.75	1.79	0.18	.67
91.	The focus of a simulator exercise debrief should be only on mistakes that were made during the run.	3.21	3.39	3.35	.07
92.	The debrief is a good time for the trainees to relax before the next simulator exercise.	2.83	2.97	1.18	.28
93.	The debrief should be done quickly so as not to waste valuable simulator time.	3.12	3.14	0.03	.87
95.	The debrief is the most important part of simulator training.	2.08	1.97	0.71	.40

Table 61 continued

	Item	Means		F	Sig F
		Yes	No		
96.	The instructor should take advantage of the debrief to provide additional instruction in areas where the trainees have demonstrated a weakness.	1.59	1.75	2.88	.09
99.	The debrief should start with a review of the positive aspects of the trainees performance during the simulator exercise.	1.73	1.88	2.64	.11
100	Trainees must be accountable for their actions during a simulator exercise.	1.70	1.90	5.35	.02
101	Playback of all or a part of a simulator exercise can be useful in exercise de-briefing.	1.75	1.68	0.51	.48

Table 62

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Are and Are Not Certified By the Government of Their Country Toward Simulator Exercise De-briefing

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	4.1641	4.1641	0.3139	.5764
Within Groups	108	1432.5995	13.2648		
Total	109	1436.7636			

Means: Certified by Government 39.63
Not Certified by Government 39.24

items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.737 and considered acceptable for this exploratory research. All nine items were used to investigate exercise development.

An analysis of variance was completed for each item, the results of which are contained in Table 63. The means in columns 3 and 4 indicate that instructors who worked with a visual system and those who did not work with a visual system reacted positively to all items.

There was general agreement by both groups that exercise development is the most important part of simulator training and that validation and testing are part of exercise development. There was also agreement on the items related to evaluation and the success and self esteem of trainees.

Columns 5 and 6 in table 63 indicated that the two groups had significantly different reactions on three of the nine items. Instructors who did not work with a visual system agreed ($p=.05$) more strongly that trainee performance was easy to evaluate during a simulator exercise. This same group also agreed ($p=.01$) more strongly that marine simulator instructors had a good understanding of evaluation techniques. Instructors who worked with a visual system agreed ($p=.02$) that the first step in good exercise development is for the instructor to clearly define the objective of the exercise.

An overall analysis of variance for Cluster A was completed. The results of this analysis are presented in Table 64. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who work with a visual system and instructors who do not work with a visual system had similar attitudes and perceptions toward simulator exercise development.

Cluster B

Cluster B concerned simulator exercise briefing. Table 22 (page 119) contains a correlation matrix of the 11 items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.632 and considered acceptable for this exploratory research. All 11 items were used to investigate exercise briefing.

An analysis of variance was completed for each item, the results of which are contained in Table 65. The means in columns 3 and 4 indicate that instructors who worked with a visual system and those who did not work with a visual system reacted negatively to four items while both groups reacted positively to the seven remaining items.

In general, both groups agreed that briefing is necessary and that careful preparation by the instructor is required. There was some evidence (more neutral) that both groups were uncertain about whether the briefing should be formal and whether oral or written briefing was most effective. While

Table 63

Attitudes and Perceptions of Marine Simulator Instructors Who Work With a Visual System and Those Who Do Not Work With a Visual System Toward Exercise Development

	Item	Means			
		Yes	No	F	Sig F
51.	It is easy to evaluate trainee performance during a simulator exercise.	2.37	2.11	3.88	.05
52.	Evaluation of simulator exercises is best achieved through a mixture of subjective and objective evaluation techniques.	1.88	1.97	1.12	.29
53.	Marine simulator instructors have a good understanding of evaluation techniques.	2.37	2.03	6.71	.01
54.	The first step in good exercise development is for the instructor to clearly define the objective of the exercise.	1.32	1.53	5.62	.02
55.	Good exercise development is the most important part of simulator training.	1.57	1.72	2.06	.15
60.	Marine simulator exercise development includes validation and testing of all aspects of the exercise.	1.67	1.70	.11	.75
61.	Simulator exercises should be consistent with the exercise objective.	1.64	1.68	.19	.67
63.	It is important that the instructor develop a list of essential tasks that the trainee must perform during a simulator exercise.	1.97	1.89	.63	.43
65.	Success in simulator exercises, especially in the early stages of a course, is important to the self esteem and confidence of all trainees.	1.94	1.89	.27	.60

Table 64

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Work With a Visual System and Those Who Do Not Work With a Visual System Toward Exercise Development

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	1.7084	1.7084	0.1835	.6692
Within Groups	114	1061.2571	9.3093		
Total	115	1062.9655			

Means: Visual System 16.60
No Visual System 16.36

both groups agreed that the briefing session should include preparation time, they were uncertain as to whether trainees should be given all the time they needed to prepare.

Columns 5 and 6 in table 65 indicated that the two groups had significantly different reactions on only one of the 11 items. Instructors who did not work with a visual system disagreed ($p=.01$) less strongly with the statement that a briefing process is not necessary for most marine simulator exercises.

An overall analysis of variance for Cluster B was completed. The results of this analysis are presented in Table 66. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who work with a visual system and instructors who do not work with a visual system had similar attitudes and perceptions toward simulator exercise briefing.

Cluster C

Cluster C concerned simulator exercise running. Table 25 (page 123) contains a correlation matrix of the 12 items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.614 and considered acceptable for this exploratory research. All 12 items were used to investigate exercise running.

An analysis of variance was completed for each item, the results of which are contained in Table 67. The means in columns 3 and 4 indicate that instructors who worked with a visual system and those who did not work with a visual system reacted positively to four items while both groups reacted negatively to the eight remaining items.

There was general support for small groups of trainees on simulator courses and agreement that simulator training can be an effective learning experience for all trainees. Instructors supported the notion of identifying the exercise objective for the trainees and also felt that sufficient learning materials for review of basic knowledge should be available during simulator courses. There was some evidence of uncertainty (more neutral) as to when a simulator exercise should be stopped and whether an instructor should manoeuvre target ships in order to prevent collisions with the trainee's ship. Both groups disagreed with the statement that simulator instructors should force trainees into making mistakes during simulator exercises.

Columns 5 and 6 in table 67 indicated that the two groups did not have significantly different reactions on any of the 12 items.

An overall analysis of variance for Cluster C was completed. The results of this analysis are presented in Table 68. The analysis of variance indicated no significant differences between the two groups. This section of the null

Table 65

Attitudes and Perceptions of Marine Simulator Instructors Who Work With a Visual System and Those Who Do Not Work With a Visual System Toward Exercise Briefing

	Item	Means			
		Yes	No	F	Sig F
69.	A trainee should be given only the minimum amount of information necessary to complete the simulator exercise.	2.93	2.77	1.99	.16
70.	A briefing process is not necessary for most marine simulator exercises.	3.45	3.20	6.32	.01
71.	The most effective way to brief a simulator exercise is with oral instruction.	2.29	2.36	0.35	.55
72.	Exercise briefing requires careful preparation by the instructor.	1.80	1.83	0.11	.74
73.	Exercise briefings usually include sufficient time for the trainees to prepare a passage plan for the simulator exercise.	1.94	2.08	1.67	.20
74.	During the briefing, the instructor should review all relevant information necessary for the successful completion of the simulator exercise.	2.07	1.94	1.71	.19
75.	Simulator exercise briefing should provide additional instruction, as necessary, to strengthen any areas of weakness that the trainees may have.	1.99	1.86	1.52	.22
76	Simulator exercise briefings should be conducted in a formal manner.	2.49	2.35	1.73	.19
77.	Marine simulator instructors have a good understanding of effective briefing techniques.	2.20	2.15	0.24	.63

Table 65 continued

	Item	Means		F	Sig F
		Yes	No		
78.	The most effective way to brief a simulator exercise is with written instruction.	2.82	2.84	0.05	.82
80.	Trainees should be given as much time as they need to prepare for a simulator exercise.	2.54	2.56	0.05	.82

Table 66

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Work With a Visual System and Those Who Do Not Work With a Visual System Toward Exercise Briefing

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	.0884	0.0884	0.0091	.9242
Within Groups	111	1078.4603	9.7159		
Total	112	1078.5487			

Means: Visual System 24.21
No Visual System 24.27

hypothesis was accepted and it was concluded that instructors who work with a visual system and instructors who do not work with a visual system had similar attitudes and perceptions toward simulator exercise running.

Cluster D

Cluster D concerned simulator exercise de-briefing. Table 28 (page 128) contains a correlation matrix of the 13 items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.650 and considered acceptable for this exploratory research. All 13 items were used to investigate exercise de-briefing.

An analysis of variance was completed for each item, the results of which are contained in Table 69. The means in columns 3 and 4 indicate that instructors who worked with a visual system and those who did not work with a visual system reacted negatively to four items while both groups reacted positively to the nine remaining items.

Both groups agreed that it is good practice to use trainees to help other trainees however, there was some uncertainty (more neutral) as to whether trainees can learn from each other. Both groups agreed that simulation can be an effective training tool regardless of individual learning style. Both groups were in general agreement regarding the conduct and content of the debrief session.

Instructors who worked with a visual system tended to

Table 67

Attitudes and Perceptions of Marine Simulator Instructors Who Are and Are Not Certified By the Government of Their Country Toward Simulator Exercise Running

	Item	Means			
		Yes	No	F	Sig F
26.	Simulators are most effectively used in teaching situations when large groups of trainees are involved.	3.34	3.28	0.25	.62
30.	The objective of a simulator exercise need not be identified for trainees.	3.22	3.10	0.87	.35
33.	Simulator training can be an effective learning experience for all trainees who take simulator courses.	1.57	1.55	0.07	.80
34.	Simulators are most effectively used in teaching situations when small groups of trainees are involved.	1.36	1.47	1.13	.29
41.	It is not necessary for a marine simulator instructor to be a mariner to effectively make use of a marine simulator for training.	3.55	3.51	0.12	.73
43.	It is important that there are enough learning materials available during the course for trainees to review basic knowledge required for marine simulator training courses.	1.79	1.78	0.03	.86
44.	Trainees often know more about new marine technology than marine simulator instructors.	2.99	3.03	0.16	.69
83.	The trainee should always have the freedom to determine the speed of Own Ship, even if it means that the planned scenario will be spoiled.	2.12	2.16	0.06	.80

Table 67 continued

	Item	Means			
		Yes	No	F	Sig F
84.	The instructor should stop the simulator as soon as the exercise objective has been met, even if further learning can take place.	3.02	2.88	2.60	.11
85.	The instructor should not manoeuvre target ships in order to prevent a collision with Own Ship.	2.83	2.67	1.31	.25
88.	The exercise should be allowed to continue even when the trainee has no chance of achieving the exercise objective.	2.72	2.80	0.54	.46
89a	Simulator instructors should force trainees into making mistakes during simulator exercises.	3.23	3.17	0.24	.63

Table 68

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Work With a Visual System and Those Who Do Not Work With a Visual System Toward Exercise Running

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	.1332	0.1332	0.0110	.9166
Within Groups	113	1366.2146	12.0904		
Total	114	1366.3478			

Means: Visual System 22.27
No Visual System 22.34

agree more strongly than the other group with the statement that the de-brief is the most important part of simulator training.

Columns 5 and 6 in table 69 indicated that the two groups had significantly different reactions on four of the 13 items. Instructors who did not work with a visual system disagreed (p=.00) to a lesser extent with the statement that during simulator exercises which involve a group of trainees, only the trainee in the lead role (Master or Watch Officer) will gain experience or knowledge. This group also disagreed (p=.00) that the focus of the debrief should only be on mistakes however they disagreed (p=.01) less strongly that the debrief was a good time for trainees to relax. Instructors who worked with a visual system agreed (p=.01) that a good instructor will use trainees to help other trainees during a simulator course.

An overall analysis of variance for Cluster D was completed. The results of this analysis are presented in Table 70. The analysis of variance indicated significant differences between the two groups. This section of the null hypothesis was rejected and it was concluded that instructors who work with a visual system and instructors who do not work with a visual system had different attitudes and perceptions toward simulator exercise de-briefing.

Test of Hypothesis 8

Hypothesis 8: There are no differences in perceived training procedures between instructors who work at privately funded facilities and those who work at publicly funded facilities.

In order to address this hypothesis, four clusters of questions were developed and analyzed. The clusters dealt with simulator exercise development (cluster A), simulator exercise briefing (cluster B), simulator exercise running (cluster C) and simulator exercise de-briefing (cluster D). Each of the four groups was investigated separately.

Cluster A

Cluster A concerned simulator exercise development. Table 19 (page 114) contains a correlation matrix of the nine items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.737 and considered acceptable for this exploratory research. All nine items were used to investigate exercise development.

An analysis of variance was completed for each item, the results of which are contained in Table 71. Means in columns 3 and 4 indicate the groups reacted positively to all items.

There was some uncertainty (more neutral) as to whether trainee performance was easy to evaluate however, both groups agreed that both subjective and objective evaluation techniques are required to evaluate trainee performance.

Table 69

Attitudes and Perceptions of Marine Simulator Instructors Who Work With a Visual System and Those Who Do Not Work With a Visual System Toward Exercise De-briefing

	Item	Means		F	Sig F
		Yes	No		
28.	Trainees who benefit most from simulator exercises tend to also be those who are most active in other classroom activities.	2.15	2.18	0.06	.80
29.	During simulator exercises which involve a group of trainees, only the trainee in the lead role (Master or Watch Officer) will gain experience or knowledge.	3.32	2.75	21.1	.00
39.	Trainees in a given group can learn almost as much from each other as they can learn from the instructor.	2.28	2.41	1.19	.28
46.	A good marine simulator instructor will make use of trainees to help other trainees during a simulator course.	1.86	2.13	7.62	.01
50.	Simulation can be an effective teaching tool for all trainees, regardless of their learning style.	1.83	1.71	1.31	.25
91.	The focus of a simulator exercise debrief should be only on mistakes that were made during the run.	3.46	3.13	10.9	.00
92.	The debrief is a good time for the trainees to relax before the next simulator exercise.	3.06	2.75	6.15	.01
93.	The debrief should be done quickly so as not to waste valuable simulator time.	3.19	3.06	1.07	.30
95.	The debrief is the most important part of simulator training.	1.91	2.15	3.18	.08

Table 69 continued

	Item	Means Yes	Means No	F	Sig F
96.	The instructor should take advantage of the debrief to provide additional instruction in areas where the trainees have demonstrated a weakness.	1.65	1.70	0.25	.62
99.	The debrief should start with a review of the positive aspects of the trainees performance during the simulator exercise.	1.78	1.84	0.35	.56
100	Trainees must be accountable for their actions during a simulator exercise.	1.82	1.80	0.08	.78
101	Playback of all or a part of a simulator exercise can be useful in exercise de-briefing.	1.74	1.67	0.64	.43

Table 70

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Work With a Visual System and Those Who Do Not Work With a Visual System Toward Exercise De-briefing

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	91.1291	91.1291	7.2565	.0082
Within Groups	107	1343.7333	12.5583		
Total	108	1434.8624			

Means: Visual System 40.27
No Visual System 38.43

There was general agreement on the use of exercise objectives and the need for consistency.

Columns 5 and 6 in table 71 indicated that the two groups did not have significantly different reactions to any of the 9 items. However, there was a tendency for instructors who worked at public facilities to agree more strongly with the statement that marine simulator instructors have a good understanding of evaluation techniques. This group also had a tendency to agree more strongly that good exercise development is the most important part of simulator training. Instructors who worked at public facilities to agree more strongly with the statement that success in simulator exercises, especially in the early stages of a course, is important to the self esteem and confidence of all trainees.

An overall analysis of variance for Cluster A was completed. The results of this analysis are presented in Table 72. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who work at private simulator facilities and instructors who work at private simulator facilities had similar attitudes and perceptions toward simulator exercise development.

Cluster B

Cluster B concerned simulator exercise briefing. Table 22 (page 119) contains a correlation matrix of the 11 items in

Table 71

Attitudes and Perceptions of Marine Simulator Instructors Who Are Employed at Private and Public Simulator Facilities Toward Simulator Exercise Development

	Item	Means			
		Priv.	Public	F	Sig F
51.	It is easy to evaluate trainee performance during a simulator exercise.	2.38	2.21	0.75	.39
52.	Evaluation of simulator exercises is best achieved through a mixture of subjective and objective evaluation techniques.	1.95	1.93	0.05	.83
53.	Marine simulator instructors have a good understanding of evaluation techniques.	2.43	2.13	2.75	.10
54.	The first step in good exercise development is for the instructor to clearly define the objective of the exercise.	1.55	1.39	1.72	.19
55.	Good exercise development is the most important part of simulator training.	1.86	1.61	3.06	.08
60.	Marine simulator exercise development includes validation and testing of all aspects of the exercise.	1.68	1.67	0.01	.93
61.	Simulator exercises should be consistent with the exercise objective.	1.64	1.68	0.11	.74
63.	It is important that the instructor develop a list of essential tasks that the trainee must perform during a simulator exercise.	2.05	1.89	1.36	.25

Table 71 continued

	Item	Means		F	Sig F
		Priv.	Public		
65.	Success in simulator exercises, especially in the early stages of a course, is important to the self esteem and confidence of all trainees.	2.09	1.87	2.71	.10

Table 72

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Are Employed at Private and Public Simulator Facilities Toward Simulator Exercise Development

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	34.0548	34.0548	3.4230	.0671
Within Groups	105	1044.6368	9.9489		
Total	106	1078.6916			

Means: Private Institution 17.70
Public Institution 16.25

this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.632 and considered acceptable for this exploratory research. All 11 items were used to investigate exercise briefing.

An analysis of variance was completed for each item, the results of which are contained in Table 73. The means in columns 3 and 4 indicate that both groups of instructors reacted negatively to three of the items and positively to seven of the items. The remaining item produced a slightly positive reaction from instructors who were employed at private facilities while the other group had a negative reaction to this item.

In general, both groups agreed that briefing is necessary and that careful preparation by the instructor is required. There was some evidence (more neutral) that both groups were uncertain about whether the briefing should be formal and whether oral or written briefing was most effective. While both groups agreed that the briefing session should include preparation time, they were uncertain as to whether trainees should be given all the time they need to prepare.

Columns 5 and 6 in Table 73 indicated that the groups did not have significantly different reactions to any of the 11 items.

An overall analysis of variance for Cluster B was completed. The results of this analysis are presented in

Table 74. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who work at private simulator facilities and instructors who work at private simulator facilities had similar attitudes and perceptions toward simulator exercise briefing.

Cluster C

Cluster C concerned simulator exercise running. Table 25 (page 123) contains a correlation matrix of the 12 items in this cluster and as reported earlier, the overall Chronbach's alpha reliability coefficient of these was 0.614 and considered acceptable for this exploratory research. All 12 items were used to investigate exercise running.

An analysis of variance was completed for each item, the results of which are contained in Table 75. The means in columns 3 and 4 indicate that both groups reacted negatively to eight of the 12 items while both groups reacted positively to the four remaining items.

There was general agreement that small groups of trainees on simulator courses were preferred and agreement that simulator training can be an effective learning experience for all trainees. Instructors supported the notion that sufficient learning materials for review of basic knowledge should be available during simulator courses. There was slight disagreement with statements related to when a simulator

Table 73

Attitudes and Perceptions of Marine Simulator Instructors Who Are Employed at Private and Public Simulator Facilities Toward Simulator Exercise Briefing

	Item	Means		F	Sig F
		Priv.	Public		
69.	A trainee should be given only the minimum amount of information necessary to complete the simulator exercise.	2.95	2.84	0.60	.44
70.	A briefing process is not necessary for most marine simulator exercises.	3.36	3.30	0.20	.66
71.	The most effective way to brief a simulator exercise is with oral instruction.	2.40	2.31	0.32	.57
72.	Exercise briefing requires careful preparation by the instructor.	1.77	1.82	0.11	.74
73.	Exercise briefings usually include sufficient time for the trainees to prepare a passage plan for the simulator exercise.	2.09	2.01	0.28	.60
74.	During the briefing, the instructor should review all relevant information necessary for the successful completion of the simulator exercise.	2.14	1.99	1.13	.29
75.	Simulator exercise briefing should provide additional instruction, as necessary, to strengthen any areas of weakness that the trainees may have.	1.95	1.90	0.16	.69
76	Simulator exercise briefings should be conducted in a formal manner.	2.29	2.41	0.80	.37

Table 73 continued

	Item	Means		F	Sig F
		Priv.	Public		
77.	Marine simulator instructors have a good understanding of effective briefing techniques.	2.27	2.13	1.06	.31
78.	The most effective way to brief a simulator exercise is with written instruction.	2.90	2.81	0.42	.52
80.	Trainees should be given as much time as they need to prepare for a simulator exercise.	2.41	2.57	1.13	.29

Table 74

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Are Employed at Private and Public Simulator Facilities Toward Simulator Exercise Briefing

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	.1525	.1525	0.0148	.9034
Within Groups	103	1060.3618	10.2948		
Total	104	1060.5143			

Means: Private Institution 24.15
Public Institution 24.25

exercise should be stopped and whether an instructor should manoeuvre target ships in order to prevent collisions with the trainee's ship. Both groups disagreed with the statement that simulator instructors should force trainees into making mistakes during simulator exercises. There was a tendency for instructors who worked at private facilities to disagree less strongly that a marine simulator instructor did not have to be a mariner.

Columns 5 and 6 in Table 75 indicate that the two groups had significantly different reactions to only one of the 12 items. Instructors who worked at public facilities disagreed (p=.05) less strongly with the statement that the objective of a simulator exercise need not be identified for trainees.

An overall analysis of variance for Cluster C was completed. The results of this analysis are presented in Table 76. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who work at private simulator facilities and instructors who work at private simulator facilities had similar attitudes and perceptions toward simulator exercise running.

Cluster D

Cluster D concerned simulator exercise de-briefing. Table 28 (page 128) contains a correlation matrix of the 13 items in this cluster and as reported earlier, the overall

Chronbach's alpha reliability coefficient of these was 0.650 and considered acceptable for this exploratory research. All 13 items were used to investigate exercise de-briefing.

An analysis of variance was completed for each item, the results of which are contained in Table 77. The means in columns 3 and 4 indicate that both groups reacted negatively to four of the items while both groups reacted positively to the nine remaining items.

Both groups agreed that it is good practice to use trainees to help other trainees however, there was some uncertainty (more neutral) as to whether trainees can learn from each other. Both groups agreed that simulation can be an effective training tool regardless of individual learning style. Both groups were in general agreement regarding the conduct and content of the debrief session.

Columns 5 and 6 in Table 77 indicate that the two groups had significantly different reactions to only two of the 13 items. Instructors who worked at public simulator facilities disagreed ($p=.02$) to a lesser extent that during simulator exercises which involve a group of trainees, only the trainee in the lead role (Master or Watch Officer) will gain experience or knowledge. This same group agreed ($p=.05$) to a lesser extent with the statement that a good marine simulator instructor will make use of trainees to help other trainees during a simulator course.

Table 75

Attitudes and Perceptions of Marine Simulator Instructors Who Are Employed at Private and Public Simulator Facilities Toward Simulator Exercise Running

	Item	Means			
		Priv.	Public	F	Sig F
26.	Simulators are most effectively used in teaching situations when large groups of trainees are involved.	3.27	3.33	0.14	.71
30.	The objective of a simulator exercise need not be identified for trainees.	3.41	3.06	3.91	.05
33.	Simulator training can be an effective learning experience for all trainees who take simulator courses.	1.68	1.54	0.98	.32
34.	Simulators are most effectively used in teaching situations when small groups of trainees are involved.	1.55	1.35	2.27	.13
41.	It is not necessary for a marine simulator instructor to be a mariner to effectively make use of a marine simulator for training.	3.32	3.62	3.27	.07
43.	It is important that there are enough learning materials available during the course for trainees to review basic knowledge required for marine simulator training courses.	1.82	1.77	0.14	.70
44.	Trainees often know more about new marine technology than marine simulator instructors.	2.95	3.02	0.18	.67
83.	The trainee should always have the freedom to determine the speed of Own Ship, even if it means that the planned scenario will be spoiled.	2.18	2.16	0.01	.92

Table 75 continued

	Item	Means		F	Sig F
		Priv.	Public		
84.	The instructor should stop the simulator as soon as the exercise objective has been met, even if further learning can take place.	3.09	2.94	1.38	.24
85.	The instructor should not manoeuvre target ships in order to prevent a collision with Own Ship.	2.82	2.71	0.32	.57
88.	The exercise should be allowed to continue even when the trainee has no chance of achieving the exercise objective.	2.91	2.70	2.26	.14
89a	Simulator instructors should force trainees into making mistakes during simulator exercises.	3.32	3.19	0.61	.44

Table 76

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Are Employed at Private and Public Simulator Facilities Toward Simulator Exercise Running

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	.1332	.1332	0.0110	.9166
Within Groups	113	1366.2146	12.0904		
Total	114	1366.3478			

Means: Private Institution 22.24
Public Institution 22.27

Table 77

Attitudes and Perceptions of Marine Simulator Instructors Who Are Employed at Private and Public Simulator Facilities Toward Simulator Exercise De-briefing

	Item	Means			
		Priv.	Public	F	Sig F
28.	Trainees who benefit most from simulator exercises tend to also be those who are most active in other classroom activities.	2.14	2.17	0.02	.89
29.	During simulator exercises which involve a group of trainees, only the trainee in the lead role (Master or Watch Officer) will gain experience or knowledge.	3.32	2.90	5.16	.02
39.	Trainees in a given group can learn almost as much from each other as they can learn from the instructor.	2.41	2.36	0.09	.77
46.	A good marine simulator instructor will make use of trainees to help other trainees during a simulator course.	1.77	2.04	3.81	.05
50.	Simulation can be an effective teaching tool for all trainees, regardless of their learning style.	1.91	1.72	1.40	.24
91.	The focus of a simulator exercise debrief should be only on mistakes that were made during the run.	3.41	3.25	1.27	.26
92.	The debrief is a good time for the trainees to relax before the next simulator exercise.	2.91	2.91	0.00	.99
93.	The debrief should be done quickly so as not to waste valuable simulator time.	3.18	3.11	0.18	.67
95.	The debrief is the most important part of simulator training.	2.29	2.03	2.00	.16

Table 77 continued

	Item	Means		F	Sig F
		Priv.	Public		
96.	The instructor should take advantage of the debrief to provide additional instruction in areas where the trainees have demonstrated a weakness.	1.59	1.71	0.92	.34
99.	The debrief should start with a review of the positive aspects of the trainees performance during the simulator exercise.	1.91	1.76	1.43	.23
100	Trainees must be accountable for their actions during a simulator exercise.	1.95	1.79	2.05	.15
101	Playback of all or a part of a simulator exercise can be useful in exercise de-briefing.	1.82	1.71	0.77	.38

Table 78

Analysis of Variance for the Attitudes and Perceptions of Marine Simulator Instructors Who Are Employed at Private and Public Simulator Facilities Toward Simulator Exercise De-briefing

Source	D.F.	Sum of Squares	Mean Squares	F	Sig F
Between Groups	1	3.9597	3.9597	0.2980	.5864
Within Groups	97	1288.7272	13.2858		
Total	98	1292.6869			

Means:

Private Institution	39.65
Public Institution	39.15

An overall analysis of variance for Cluster D was completed. The results of this analysis are presented in Table 78. The analysis of variance indicated no significant differences between the two groups. This section of the null hypothesis was accepted and it was concluded that instructors who work at private simulator facilities and instructors who work at private simulator facilities had similar attitudes and perceptions toward simulator exercise de-briefing.

Test of Hypothesis 9

Hypothesis 9: There is no relationship between the number of years served at sea before becoming a marine simulator instructor and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

As can be seen in Table 79, the correlation coefficients are very small with no significant relationships at the .05 level between years of service at sea and any of the four training procedure constructs of exercise development, exercise briefing, exercise running and exercise de-briefing. Based on this analysis, the null hypothesis was therefore accepted and it was concluded that there was no relationship between the number of years served at sea before becoming a marine simulator instructor and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

Table 79

Relationship Between the Number of Years an Instructor Spent at Sea and the Attitudes and Perceptions Toward Training Procedures.

	Correlation Coefficient				
	Years at Sea	Exercise Development	Exercise Briefing	Exercise Running	Exercise De-briefing
Years at sea	1.0000	-.0947 p=.310	-.0895 p=.344	+.0668 p=.476	+.0350 p=.717

Test of Hypothesis 10

Hypothesis 10: There is no relationship between the number of years served as a marine simulator instructor and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

As can be seen in Table 80, the correlation coefficients are very small with no significant relationships at the .05 level between years of service as a marine simulator instructor and any of the four training procedure constructs of exercise development, exercise briefing, exercise running and exercise de-briefing. Based on this analysis, the null hypothesis was therefore accepted and it was concluded that there was no relationship between the number of years served as a marine simulator instructor and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

Table 80

Relationship Between the Number of Years served as an Instructor and the Attitudes and Perceptions Toward Training Procedures.

	Correlation Coefficient				
	Years as Instruct	Exercise Development	Exercise Briefing	Exercise Running	Exercise De-briefing
Years as Instructor	1.0000	+.0982 p=.290	+.0309 p=.743	+.1041 p=.264	-.0245 p=.798

Test of Hypothesis 11

Hypothesis 11: There is no relationship between the age of the simulator equipment used by marine simulator instructors and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

As can be seen in Table 81, the correlation coefficients are very small with no significant relationships at the .05 level between the age of the simulator equipment and any of the four training procedure constructs of exercise development, exercise briefing, exercise running and exercise de-briefing. Based on this analysis, the null hypothesis was therefore accepted and it was concluded that there was no relationship between the age of the simulator equipment used by marine simulator instructors and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

Table 81

Relationship Between the Age of the Simulator Equipment that the Instructor Uses and the Attitudes and Perceptions Toward Training Procedures.

	Correlation Coefficient				
	Age of Equipment	Exercise Development	Exercise Briefing	Exercise Running	Exercise De-briefing
Age of Equipment	1.0000	+.0453 p=.626	+.0750 p=.426	+.0638 p=.494	+.0285 p=.767

Test of Hypothesis 12

Hypothesis 12: There is no relationship between optimum simulator exercise length and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

As can be seen in Table 82, the correlation coefficients are very small with no significant relationships at the .05 level between the optimum simulator exercise length and any of the four training procedure constructs of exercise development, exercise briefing, exercise running and exercise de-briefing. Based on this analysis, the null hypothesis was therefore accepted and it was concluded that there was no relationship between optimum simulator exercise length and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

Table 82

Relationship Between Optimum Simulator Exercise Running Time and the Attitudes and Perceptions Toward Training Procedures.

	Correlation Coefficient				
	Exercise Length	Exercise Development	Exercise Briefing	Exercise Running	Exercise De-briefing
Exercise Length	1.0000	-.0133 p=.886	+.0382 p=.685	-.1088 p=.243	+.0860 p=.370

Test of Hypothesis 13

Hypothesis 13: There is no relationship between time spent briefing trainees and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

The relationships between briefing time and exercise running or exercise de-briefing were not significant although there was a tendancy for increased time spent briefing to reflect more negative attitudes toward items related to de-briefing.

As can be seen in Table 83, there is a significant relationship between time spent in exercise briefing and the attitudes toward exercise development and exercise briefing at the .05 level. That is, as briefing time increases, attitudes and perceptions about the various elements of exercise development and exercise briefing become more positive. Based on these results, the null hypothesis was therefore partially rejected and it was concluded that there is a relationship between the attitudes and perceptions of instructors toward related simulator exercise constructs and time spent on briefing.

Table 83

Relationship Between Exercise Briefing Time and the Attitudes and Perceptions Toward Training Procedures.

	Correlation Coefficient				
	Briefing Time	Exercise Development	Exercise Briefing	Exercise Running	Exercise De-briefing
Briefing Time	1.0000	-.1810 p=.050	-.2134 p=.022	-.0313 p=.738	+.1594 p=.095

Test of Hypothesis 14

Hypothesis 14: There is no relationship between time spent de-briefing trainees and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

As can be seen in Table 84, there is a significant relationship between exercise de-briefing time and the attitudes toward exercise development, exercise briefing and exercise de-briefing at the .05 level. That is, as de-briefing time increases, attitudes and perceptions about the various elements of exercise development and exercise briefing become more positive. However, it is also evident that as de-briefing time increases, attitudes and perceptions about the various elements of exercise de-briefing become more negative. Based on this analysis, the null hypothesis was therefore rejected and it was concluded that there is a relationship between the attitudes and perceptions of instructors toward related simulator exercise constructs and time spent on de-briefing.

Table 84

Relationship Between Exercise De-briefing Time and the Attitudes and Perceptions Toward Training Procedures.

	Correlation Coefficient				
	Debrief Time	Exercise Development	Exercise Briefing	Exercise Running	Exercise De-briefing
Debrief Time	1.0000	-.2017 p=.028	-.1950 p=.037	-.1234 p=.185	+.4204 p=.000

Test of Hypothesis 15

Hypothesis 15: There is no relationship between time spent on exercise development and the attitudes and perceptions of marine simulator instructors toward perceived training procedures.

As can be seen in Table 85, there is a significant relationship between time spent in exercise development and the attitudes toward exercise de-briefing at the .05 level. That is, as development time increases, attitudes and perceptions about the various elements of exercise de-briefing become more negative. However, relationships between development time and the other three constructs of exercise development, exercise briefing and exercise running were not significant. Based on this analysis, the null hypothesis was therefore accepted and it was concluded that there is little relationship between the attitudes and perceptions of instructors toward related simulator exercise constructs and time spent on exercise development.

Table 85

Relationship Between Exercise Development Time and the Attitudes and Perceptions Toward Training Procedures.

	Correlation Coefficient				
	Develop Time	Exercise Development	Exercise Briefing	Exercise Running	Exercise De-briefing
Development Time	1.0000	-.0079 p=.932	-.0284 p=.763	-.0212 p=.820	+.2080 p=.028

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Introduction

The purpose for undertaking this study was to investigate the attitudes and perceptions of instructors who operated courses using marine simulators. Instructors who used two types of marine simulator, radar navigation simulators and ship manoeuvring simulators, were studied. This chapter presents a summary of the findings of the study and the conclusions drawn from the data. Recommendations to improve simulator training at the Marine Institute and other simulator facilities and for additional studies are also presented in this chapter.

Data Collection

Data was collected through the administration of a single questionnaire. Two questionnaires were mailed to each of 259 radar navigation and ship manoeuvring simulator facilities with instructions for their completion and return. The questionnaires were sent and returned between September and December, 1995 and were analyzed between January and June, 1996. A total of 136 responses were received representing 35 countries.

The Respondents

The respondents were marine simulator instructors who operated either a radar navigation simulator, a ship manoeuvring simulator or both types of simulator. These instructors were employed at either a privately owned simulator facility or a publicly funded facility. Almost all of the respondents had mariner qualifications and had served at sea for some time before becoming a simulator instructor.

Simulator Equipment

The simulator equipment represented in this study ranged from one year old to ten years of age and over. Simulators that were one to three years old represented 38% of the total while simulators that were ten years old and over represented 33% of the total. The simulators were fitted with similar equipment and many of them also had visual systems. Many of the organizations represented in the study have plans to either upgrade existing simulator equipment or purchase new simulator equipment within the next two years.

Summary of the Findings

A total of 15 hypotheses were used to study the attitudes and perceptions of marine simulator instructors. Hypothesis 1 investigated attitudes and perceptions of marine simulator instructors toward marine simulator training in general. Hypothesis 2 to 8 investigated perceived differences in training procedures among a number of sub-groups within the sample. Hypotheses 9 to 15 looked at possible relationships between selected variables and the attitudes and perceptions of marine simulator instructors.

General Perceptions of Simulator Use

Hypothesis 1 compared the general perceptions held by simulator instructors toward the use of simulators for training. The 14 items that were used to investigate this hypothesis were analyzed individually however, they were not grouped into a cluster. Responses were compared by type of simulator used, professional certification held, service as Master of a ship, teacher certification, certification as simulator instructor, use of visual systems and employment situation. While some of the items produced statistically significant differences among the various sub-groups at or below the .05 level, they were not sufficient to indicate differences among the sub-groups as a whole. Therefore, the null hypothesis was accepted.

Perceived Differences in Training Procedures

Hypotheses 2 to 8 investigated perceived differences in training procedures. Four clusters of questions were used to investigate each hypothesis. The four clusters were: Cluster A, which dealt with exercise development; Cluster B, which dealt with exercise briefing; Cluster C, which dealt with exercise running; and Cluster D, which dealt with exercise de-briefing.

Hypothesis 2 compared the perceptions of instructors who used radar navigation simulators, ship manoeuvring simulators and both radar navigation and ship manoeuvring simulators.

The analyses of variance carried out on each of the four clusters indicated that differences were statistically significant in only one of the clusters, cluster D. Therefore the null hypothesis was accepted for each cluster, except Cluster D for which it was rejected.

Hypothesis 3 compared the perceptions of instructors who held a Master Unlimited certificate of competency and those who held other marine qualifications. The analyses of variance carried out on each of the four clusters indicated that there were no statistically significant differences in any of the clusters. Therefore the null hypothesis was accepted.

Hypothesis 4 compared the perceptions of instructors who had served as Master on a ship and those who had not served as Master. The analyses of variance carried out on each of the four clusters indicated that there were no statistically significant differences in any of the clusters. Therefore the null hypothesis was accepted.

Hypothesis 5 compared the perceptions of instructors who held a teaching certificate and those who did not hold a teaching certificate. The analyses of variance carried out on each of the four clusters indicated that differences were statistically significant in only one of the clusters, cluster B. Therefore the null hypothesis was accepted for each cluster, except cluster B for which it was rejected.

Hypothesis 6 compared the perceptions of instructors who were certified as simulator instructors by the government of their country and those who were not certified. The analyses of variance carried out on each of the four clusters indicated that there were no statistically significant differences in any of the clusters. Therefore the null hypothesis was accepted.

Hypothesis 7 compared the perceptions of instructors who use simulator equipment that had a visual system and those who use equipment that did not have a visual system. The analyses of variance carried out on each of the four clusters indicated that differences were statistically significant in only one of the clusters, cluster D. Therefore the null hypothesis was accepted for each cluster, except Cluster D for which it was rejected.

Hypothesis 8 compared the perceptions of instructors who work at privately funded facilities and those who work at publicly funded facilities. The analyses of variance carried out on each of the four clusters indicated that there were no statistically significant differences in any of the clusters. Therefore the null hypothesis was accepted.

Relationships Between Selected Variables

Hypotheses 9 to 15 investigated relationships between selected variables and the attitude scale constructs for exercise development, exercise briefing, exercise running and exercise de-briefing.

Hypothesis 9 investigated the relationship between the number of years served at sea before becoming a marine simulator instructor and the attitude scale constructs. A correlation analysis indicated that there were no significant relationships between years spent at sea and the attitudes and perceptions of marine simulator instructors. Therefore, the null hypothesis was accepted.

Hypothesis 10 investigated the relationship between the number of years served as a marine simulator instructor and the attitude scale constructs. A correlation analysis indicated that there were no significant relationships between years served as a marine simulator instructor and the attitudes and perceptions of marine simulator instructors. Therefore, the null hypothesis was accepted.

Hypothesis 11 investigated the relationship between the age of the simulator equipment used and the attitude scale constructs. A correlation analysis indicated that there were no significant relationships between the age of the simulator equipment used and the attitudes and perceptions of marine simulator instructors. Therefore, the null hypothesis was accepted.

Hypothesis 12 investigated the relationship between optimum simulator exercise length and the attitude scale constructs. A correlation analysis indicated that there were no significant relationships between the instructor's optimum simulator exercise length and the attitudes and perceptions of marine simulator instructors. Therefore, the null hypothesis was accepted.

Hypothesis 13 investigated the relationship between time spent briefing trainees and the attitude scale constructs. A correlation analysis indicated that there was a significant relationship between the instructors average briefing time and the attitudes and perceptions of marine simulator instructors toward exercise development and exercise briefing. Therefore, the null hypothesis was partially rejected.

Hypothesis 14 investigated the relationship between time spent de-briefing trainees and the attitude scale constructs. A correlation analysis indicated that there was a significant relationship between the instructors average de-briefing time and the attitudes and perceptions of marine simulator instructors toward exercise development, exercise briefing and exercise de-briefing. Therefore, the null hypothesis was rejected.

Hypothesis 15 investigated the relationship between time spent on exercise development and the attitude scale constructs. A correlation analysis indicated that there was only a significant relationship between the instructors average development time and the attitudes and perceptions of marine simulator instructors toward exercise de-briefing. The other three constructs revealed no significant relationships. Therefore, the null hypothesis was accepted.

Conclusions and Implications

Introduction

This study addressed attitudes and perceptions of marine simulator instructors toward simulator training in general and specifically in the areas of exercise development, exercise briefing, exercise running and exercise de-briefing. The study also attempted to determine whether relationships existed between selected variables and instructors attitudes and perceptions toward exercise development, exercise briefing, exercise running and exercise de-briefing. Each of these areas will be discussed separately.

General Perceptions of Simulator Use

On the basis of the study, it was concluded that instructor perceptions of selected general aspects of simulator training in general were not statistically significant at the .05 level. In all but a few cases, the different groups either unanimously agreed with the statements or unanimously disagreed. There were, however, some individual statements which produced significantly different responses. Overall, the data indicates that the type of simulator used, professional certification held, service as Master of a ship, teacher training, certification as simulator instructor, use of visual systems and employment situation had little or no effect on the attitudes and perceptions of instructors toward simulator training in general. Since the statements in this section were analyzed for each of the above categories, they will be dealt with separately.

Simulator Type

In general, it appears that the type of simulator used has very little effect on the attitudes and perceptions of the instructors who operate them. The responses to the individual items, with the exceptions noted below, are similar for all three groups however, it should be noted that instructors who operated only ship manoeuvring simulators produced more positive responses to most items than did the other groups. None of the items produced a strong response from any of the groups and, in fact, the means for almost all of the items are grouped around the neutral value of 2.5 indicating that instructors were somewhat uncertain in their responses.

Instructors who operated only radar navigation simulators disagreed that trainees must make mistakes in order to learn from a simulator exercise while instructors who operated only ship manoeuvring simulators agreed with the same statement. Neither group produced strong feelings toward this statement however, the difference was statistically significant at the .02 level. The somewhat neutral response to this statement indicates that instructors are somewhat unsure of the learning process as it relates to simulator use.

Instructors who operated both types of simulator agreed more strongly that instructors who understood the technical aspects of the simulator were more effective than those who did not understand the technical aspects. The responses to this statement were statistically different at the .03 level. This difference has implications for training requirements of instructors. Clearly there is a belief among some instructors that an understanding of the technology which drives simulators has an impact on the effectiveness of the training in which simulators are employed.

A statement to the effect that radar navigation simulators were really ship manoeuvring simulators without the visual system was included in this section. Not surprisingly, instructors who operated only radar navigation simulators agreed with the statement while instructors who operated only ship manoeuvring simulators disagreed. This difference, which was significant at the .01 level, indicates that the differences between these two types of simulator may not be clearly understood.

Overall, instructors from all three groups appear to share similar perceptions of the general usage of simulators in marine training. Although there is no data to support the notion, it is likely that the majority of instructors who indicated that they currently operate only ship manoeuvring simulators have, at some time, also operated radar navigation simulators. This may account for the marked similarity in the responses of all groups since they share a common training background. Future training programmes for marine simulator instructors should attempt to clarify issues related to general simulator use. The differences noted above in the areas of learning processes and technological differences are important issues which could be a source of future study.

Professional Certification

The various marine qualifications held by instructors do not appear to have an effect on their attitudes and perceptions toward the general issues of simulator training. The responses to the individual items, with the exceptions noted below, are similar for both groups with instructors who hold other qualifications showing a slightly more positive response to most items. None of the items produced a strong response from either group with the means for many of the items close to the neutral value of 2.5 indicating that instructors were somewhat uncertain in their responses.

Instructors who held a Master Unlimited certificate of competency agreed more strongly than instructors who held other marine qualifications that instructors who had been in command of a ship would make more effective use of simulators. The responses produced a statistically significant difference at the .04 level. Since both groups agreed with the statement and since persons who have been Master on a ship generally have more experience that those who have not been Master, this seems to be a clear endorsement of the importance of professional experience to the simulator instructor.

The issue of whether radar navigation simulators were really ship manoeuvring simulators without the visual system produced a statistically significant difference at the .04 level. While both groups agreed with the statement, those who held a Master Unlimited certificate agreed less strongly. This difference may be due to the greater level of experience possessed by this group, giving them more time to have formed opinions regarding the differences in these two simulator types.

While there appears to be sufficient evidence to support the notion that a marine simulator instructor should hold some level of marine qualification, there does not appear to be any justification for further investigation into the suitability of one level of certification over another. There does, however, appear to be a need to investigate the issues of general simulator use in order to provide instructors with a more clearly defined role for simulator training.

Service as Master

In general, the responses from both groups were similar for the majority of items. While instructors reacted positively to all but one item, the responses to many items tended to be neutral as evidenced by means around the value of

2.5. Instructors tended to be somewhat uncertain (more neutral) about the primary purpose of simulator training and the relationship to on-the-job training and sea service requirements. Instructors also tended to be uncertain regarding trainee perceptions of simulator realism and whether they must make mistakes in order to learn. There was also some evidence of uncertainty related to the instructors' ability to troubleshoot and correct simulator problems and to the level of instructor confidence when operating the equipment. The only item which produced clear agreement from both groups was related to the need to understand how humans learn.

Instructors who had served as Master agreed that instructors who had been in command of a ship would make more effective use of simulators in marine education. Those who had not been in command of a ship disagreed with this statement, but only marginally so. It was not surprising that the difference was statistically significant at the .00 level given the nature of the statement for these groups. The fact that the response from instructors who had not been in command of a ship was neutral supports the notion that professional mariner experience is an important quality for simulator instructors. However, there is no indication of any differences in the perceptions of the groups toward simulator training in general.

Teacher Training

In general, the responses from both groups were similar for the majority of items. While instructors reacted positively to most items, the responses often tended to be neutral as evidenced by means around the value of 2.5. Instructors tended to be somewhat uncertain (more neutral) about the primary purpose of simulator training and the relationship to on-the-job training and sea service requirements. Instructors also tended to be uncertain regarding trainee perceptions of simulator realism and whether they must make mistakes in order to learn. Although instructors who had a teaching certificate tended to agree more strongly regarding the need to be able to trouble shoot and correct simulator problems there was some evidence of uncertainty as to the level of instructor confidence when operating the equipment. Instructors clearly agreed on the need to understand how humans learn in order to be an effective teacher.

Instructors who did not hold a teaching certificate agreed more strongly that trainees generally accepted simulator training as being representative of the real world. The difference in responses to this statement were statistically significant at the .00 level. This is consistent with Giles and Salmon (1978) who stated that simulators reproduce life-like experiences requiring trainees to make decisions.

Instructors who held a teaching certificate agreed more strongly that simulator instructors who understood technical aspects of the simulator were more effective. The difference in responses to this statement were statistically significant at the .04 level. The same group also agreed more strongly that simulation requires that instructors use specialized teaching techniques not used in other areas of education. The difference in responses to this statement were statistically significant at the .05 level.

While the different responses to most of the statements were not statistically significant, those differences identified above indicate that instructors who held a teaching certificate placed a greater value on issues related to student acceptance of simulation and understanding of the technical aspects of simulation. They also indicated a greater awareness of specialized teaching techniques required for simulation usage.

The fact that the responses to so many items indicated a general uncertainty among the respondents leads to the conclusion that marine simulator instructors need to be better informed on issues related to simulator training. While it is clear that teacher training does have an effect in some areas, it is also clear that teacher training needs to be improved in order to address more of these issues. Marine simulator instructors can certainly benefit from a programme of teacher training however, the focus of the training should be specifically related to the use of simulation.

Certification as Simulator Instructor

The responses from both groups were similar for the majority of items. Instructors reacted positively to most items, however, the responses often tended to be neutral as evidenced by means around the value of 2.5. Instructors tended to be somewhat uncertain (more neutral) about the relationship between simulator training and on-the-job training and sea service requirements. Instructors also tended to be somewhat uncertain about whether trainees must make mistakes in order to learn. Although both groups tended to agree that instructors need to understand the technical aspects of the simulator, they tended to be more neutral in their response regarding the need to be able to trouble shoot and correct simulator problems. There was also some evidence of uncertainty as to the level of instructor confidence when operating the equipment. As in previous comparisons, instructors clearly agreed on the need to understand how humans learn in order to be an effective teacher.

Certified instructors agreed that a marine simulator is primarily used to practice skills acquired elsewhere while uncertified instructors slightly disagreed with the statement. The differences in the responses of the two groups was statistically significant at the .01 level and may be due in part to the use of part task simulators for skill development prior to taking mandatory courses on radar navigation simulators as part of the certification process. This may also be due to the fact that mariner training requirements are closely related to on-the-job training as evidenced by the sea service requirements for obtaining certification. This result also supports statements made by Muirhead and Tasker (1991) relating to use of ship manoeuvring simulators for basic skill training who suggested that this was not cost effective.

Both groups disagreed that trainees do not expect simulator training to be realistic as compared to the real world, however the responses differed significantly at the .00 level. Certified instructors disagreed less strongly than did uncertified instructors. This may be explained in part by the focus of the trainee on the broader issue of obtaining certification rather than a focus on learning skills through the use of simulation. Trainees who take non-mandatory simulator courses are more likely to have a stronger focus on the acquisition of skills through simulation. Trainees who are exposed to simulation for the first time are also likely to be somewhat uncertain of what to expect in terms of simulator realism.

Certified instructors marginally disagreed with the statement that simulator training could replace much of the on-the-job training a mariner is required to do. Uncertified instructors marginally agreed with this statement. While the means indicated that both groups were uncertain about this item, the difference was statistically significant at the .01 level. It is possible that the issue of mandatory versus non-mandatory simulator courses had an effect on this difference. Whereas mandatory simulator courses are an integral part of an overall training regime, non-mandatory simulator courses are almost always in the area of specific skill development not normally included in the mandatory training requirements. Kunz (1993) has stated that on-the-job training is often considered the best method of training however, it would be useful to investigate the comparative benefits and practicalities of on-the-job training versus simulator training in the marine industry.

Instructor certification is not required by all maritime nations however certain marine simulation training courses are mandatory. As indicated by the data, many instructors are certified for delivery of simulation courses in their respective countries. It is very likely that this certification applies to mandatory simulation courses required for mariner certification and not to non-mandatory simulator training however, it is also likely that both groups contain individuals who deliver both mandatory and non-mandatory simulator training. This may explain why the responses of both groups are similar for most of the items.

Use of Visual Systems

In general, the responses from both groups were similar for the majority of items. Instructors reacted positively to most items, however, the responses to a number of the items tended to be neutral as evidenced by means near the neutral value of 2.5. Instructors tended to be somewhat uncertain (more neutral) about the relationship between simulator training and on-the-job training and sea service requirements. Instructors also tended to be somewhat uncertain about the primary application of simulator training and whether trainees must make mistakes in order to learn. Both groups tended to agree that instructors need to understand the technical aspects of the simulator however, they tended to be more neutral in their response regarding the need to be able to trouble shoot and correct simulator problems. There was also some evidence of uncertainty as to the level of instructor confidence when operating the equipment. As in previous comparisons, instructors clearly agreed on the need to understand how humans learn in order to be an effective teacher.

Instructors who did not work with a visual system agreed more strongly with the statement that radar navigation simulators are really ship simulators without the visual scene however, instructors who worked with a visual system produced a neutral response. The difference in the responses of the two groups to this statement was statistically significant at the .00 level. The response to this statement may have been influenced by the fact that all ship manoeuvring simulators have visual systems while radar navigation simulators can be equipped with visual systems. It is possible that the type of courses which are delivered on radar navigation simulators may be enhanced significantly with the addition of a visual system. The author was unable to identify any marine simulator research in this area however, the literature on learning styles and learning preferences clearly indicates that adding a visual system would potentially enhance learning for many individuals. The enhancement of training provided by radar navigation simulators through the addition of a visual system could be the subject of further study.

Employment Situation

In general, the responses from both groups were similar for the majority of items. As in previous comparisons, instructors reacted positively to most items, however, the responses to many of the items tended to be more neutral. Instructors tended to be somewhat uncertain (more neutral) about the relationship between simulator training and on-the-job training and sea service requirements. Instructors also tended to be somewhat uncertain about the primary application of simulator training and whether trainees must make mistakes in order to learn. Both groups tended to agree that instructors need to understand the technical aspects of the simulator, however, there was also some evidence of uncertainty as to the level of instructor confidence when operating the equipment. Instructors who worked at public facilities tended to be more neutral in their response regarding the need to be able to trouble shoot and correct simulator problems than were instructors who worked at private facilities. While the difference was not significant, there may be some connection to the level of technical support available at the different facility types. As in previous comparisons, instructors clearly agreed on the need to understand how people learn in order to be an effective teacher.

The only significant difference among instructors employed at public or private institutions was related to a comparison of the use of simulation for training in the marine industry and other industries. Differences in the responses to this statement were statistically significant at the .03 level. While both groups agreed that the use of simulation in the marine industry was far behind the use of simulation in other industries, instructors who worked at public institutions agreed more strongly. Although there is nothing in the data to support the notion, it is possible that, with cuts in public funding for education, the private sector institutions have a slight advantage in technology and therefore enjoy a higher level of usage than the public sector institutions.

Perceived Differences in Training Procedures

Overall, on the basis of the study, it was concluded that instructors perceived differences in training procedures were not statistically significant at the .05 level. A number of individual statements produced statistically significant differences at or below the .05 level, however, there was insufficient evidence to reject the null hypothesis for any of the comparisons in this section. The study looked at four distinct elements of simulator training in which the instructor is directly involved. These elements were exercise development, exercise briefing, exercise running and exercise de-briefing. Responses were compared by type of simulator used, professional certification held, service as Master of a ship, teacher certification, certification as simulator instructor, use of visual systems and employment situation.

Type of Simulator

Hypothesis 2 compared the perceptions of instructors who used radar navigation simulators, ship manoeuvring simulators and both radar navigation and ship manoeuvring simulators. The analyses of variance carried out on each of the four clusters indicated that differences were statistically significant in cluster D which dealt with exercise de-briefing. While the null hypothesis was rejected for Cluster D, it was accepted for the remaining three clusters. However, a number of individual statements in the remaining three clusters did produce significant differences at or below the .05 level.

On the basis of the responses to items in Cluster A, it was concluded that instructor perceptions toward exercise development were similar for all three groups. They agreed on the best way to evaluate simulator exercises but were somewhat neutral regarding the ease of evaluating simulator exercises and instructor understanding of evaluation techniques. Instructors agreed on the use of objectives in exercise development and that good exercise development is the most important part of simulator training.

On the basis of the responses to items in Cluster B, it was concluded that instructor perceptions toward exercise briefing were similar for all three groups. All groups strongly agreed that a briefing process was necessary, however there was evidence of uncertainty as to whether it should be a formal process and whether oral or written briefing was the preferred method. Oral briefing appears to be more commonly used, however Bole (1986) has identified some advantages of written briefing. It would be useful to conduct a study into the relative effectiveness of oral versus written forms of briefing.

There was general agreement that the instructor should review all relevant information during the briefing, however, there was some indication of uncertainty as to how much information should be given. While all groups agreed that preparation time should be allowed, there was uncertainty as to whether trainees should be given all the time they need to prepare.

The only statement in Cluster B that produced a significantly different response was related to the provision of additional instruction during the briefing process to strengthen areas of trainee weakness. While all three groups agreed with this statement, instructors who operated only ship manoeuvring simulators agreed less strongly than the other two groups.

On the basis of the responses to items in Cluster C, it was concluded that instructor perceptions toward exercise running were similar for all three groups. There was general agreement that simulators were most effective with small groups of trainees and that the learning experience was effective for all trainees. Instructors agreed that the exercise could run beyond the attainment of the objective if further learning could take place, however they appeared to be somewhat uncertain whether the exercise should be allowed to continue if attainment of the objective became impossible.

The statement concerning the freedom of the trainee to determine the speed of the Own Ship during the exercise produced a significant difference at the .04 level. While all groups agreed with the statement, instructors who operated only ship manoeuvring simulators and both types of simulator agreed more strongly than instructors who operated only radar navigation simulators. This difference may be due to the differences in the focus of training offered on radar navigation simulators and ship manoeuvring simulators. The former tends to focus more on situations involving other ships within the gaming area whereas the latter tends to focus more on situations which involve only the Own Ship. Changes in the speed of Own Ship in a radar navigation simulator exercise will have an effect on the planned interactions with other ships, which in turn, may affect the planned learning outcomes.

Cluster D concerned exercise de-briefing. While nine of the statements did not produce significant differences, four statements produced significant differences at or below the .05 level. Based on the responses to items in Cluster D, it was concluded that there are differences in the perceptions of instructors toward exercise de-briefing. Instructors who operated only radar navigation simulators disagreed less strongly that only the trainee in the lead role during a simulator exercise will gain experience. This may be due to the number of trainees which are present in each Own Ship cubicle during the training. In radar navigation simulators the number of trainees is often limited to two while four is most common with ship manoeuvring simulators. The reduced numbers may provide less opportunity for trainees to observe others during the exercise.

It is interesting to note that instructors who operated only radar navigation simulators agreed less strongly with the concept of peer tutoring. Although all groups agreed that a good instructor would make use of trainees to help each other during a simulator course, there was a significant difference between instructors who operated only radar navigation simulators and those who operated only ship manoeuvring simulators. The data indicates some differences related to trainee interaction during simulator courses. This could be a subject for further investigation.

All groups disagreed that the de-brief was a good time for trainees to relax before the next exercise. Instructors who operated only radar navigation simulators agreed less strongly than the other two groups. Although the prime purpose of de-briefing is clearly to reflect on the past exercise, it may also be an appropriate time to relieve tensions prior to starting a new exercise. While the literature does not address this issue, it may be appropriate to investigate the effects of stress build up from previous exercises on trainee performance in subsequent exercises.

The final statement which produced a significant difference was related to trainees own accountability for actions taken during an exercise. While all groups agreed that the trainee should be accountable, instructors who operated ship manoeuvring simulators agreed less strongly. This difference may be due to the differences in the content of mandatory and non-mandatory courses where, in the former, trainees are learning basic skills required for certification, and in the latter, are learning skills to achieve proficiency.

Professional Certification

Hypothesis 3 compared the perceptions of instructors who held a Master Unlimited certificate of competency and those who held other marine qualifications. The analyses of variance carried out on each of the four clusters indicated that there were no statistically significant differences in any of the clusters. While the null hypothesis was accepted, a number of individual statements in three of the four clusters produced significant differences at or below the .05 level.

On the basis of the responses to items in Cluster A, it was concluded that instructor perceptions toward exercise development were similar for both groups. Each were in agreement regarding the best way to evaluate simulator exercises but were somewhat neutral regarding the ease of evaluating simulator exercises and instructors understanding of evaluation techniques. Instructors agreed on the use of objectives in exercise development and that good exercise development is the most important part of simulator training.

On the basis of the responses to items in Cluster B, it was concluded that instructor perceptions toward exercise briefing were similar for both groups. Both strongly agreed that a briefing process was necessary however, there was evidence of uncertainty as to whether it should be a formal process and whether oral or written briefing was the preferred method. There was general agreement that the instructor should review all relevant information during the briefing, however, there was some indication of uncertainty as to how much information should be given. While both groups agreed that preparation time should be allowed, there was uncertainty as to whether trainees should be given all the time they need to prepare.

While both groups agreed with the statement that oral briefing was the most effective way to brief a simulator exercise, instructors who held a Master unlimited certificate agreed marginally with the statement. Both groups disagreed that written briefings were more effective. The lack of strong agreement or disagreement indicates that instructors may not prefer either of the methods and that a combination of written and oral briefing may be preferred by most instructors. Instructors need to be informed about effective briefing methods in order to improve simulator training.

On the basis of the responses to items in Cluster C, it was concluded that instructor perceptions toward exercise running were similar for both groups. There was general agreement that simulators were most effective with small groups of trainees and that the learning experience is effective for all trainees. Instructors agreed that the exercise could run beyond the attainment of the objective if further learning could take place however, they appeared to be somewhat uncertain whether the exercise should be allowed to continue if attainment of the objective became impossible. There was also some uncertainty as to whether the instructor should manoeuvre target ships during the exercise.

Instructors who held a Master unlimited certificate disagreed more strongly that it was not necessary for a marine simulator instructor to be a mariner. This supports the positions of Carpenter (1991) and Rosengren (1992) who were both adamant that marine simulator instructors should also be mariners. While the strong negative response is undoubtedly due to the fact that the respondents were mariners, the difference, which was significant at the .01 level, may also be due to differences in experience between the two groups.

The statement concerning the freedom of the trainee to determine the speed of the Own Ship during the exercise produced agreement from both groups however, instructors who held a Master unlimited certificate agreed more strongly. At sea, ship's officers must always ensure that the speed of the ship is safe for the prevailing circumstances. Ship Masters would value officers who took the initiative to change the ship's speed for safety reasons. The differences in the responses to this statement may be due to possible differences in the sea experience levels of the two groups.

On the basis of the responses to items in Cluster D, it was concluded that instructor perceptions toward exercise de-briefing were similar for both groups. In general, both groups were in agreement with the concept of peer tutoring however, they were somewhat unsure of how much trainees could learn from each other. Instructors were in general agreement with the manner in which the de-brief should be conducted and with the content of the de-brief.

Both groups agreed that the debrief was the most important part of simulator training, however instructors who held Master unlimited certificates significantly agreed more strongly at the .04 level. The difference may be due to differences in the experience levels of the two groups, both at sea, and as simulator instructors.

Experience as Master

Hypothesis 4 compared the perceptions of instructors who had served as Master on a ship and those who had not served as

Master. The analyses of variance carried out on each of the four clusters indicated that there were no statistically significant differences for any of the clusters. While the null hypothesis was accepted, a number of individual statements in three of the four clusters produced significant differences at or below the .05 level.

On the basis of the responses to items in Cluster A, it was concluded that instructor perceptions toward exercise development were similar for both groups. Both groups were in agreement regarding the best way to evaluate simulator exercises but were somewhat neutral regarding the ease of evaluating simulator exercises and instructor understanding of evaluation techniques. Instructors agreed on the use of objectives in exercise development and that good exercise development is the most important part of simulator training.

On the basis of the responses to items in Cluster B, it was concluded that instructor perceptions toward exercise briefing were similar for both groups. Both groups strongly agreed that a briefing process was necessary however, there was evidence of uncertainty as to whether it should be a formal process and whether oral or written briefing was the preferred method. There was general agreement that the instructor should review all relevant information during the briefing, however, there was some indication of uncertainty as to how much information should be given. While both groups agreed that preparation time should be allowed, there was uncertainty as to whether trainees should be given all the time they need to prepare.

Both groups agreed that exercise briefing should include additional instruction if necessary, instructors who had not served as Master significantly agreed more strongly, at the .04 level, about this.

On the basis of the responses to items in Cluster C, it was concluded that instructor perceptions toward exercise running were similar for both groups. There was general agreement that simulators were most effective with small groups of trainees and that the learning experience is effective for all trainees. Instructors appeared to be somewhat uncertain whether the exercise should be allowed to continue if attainment of the objective became impossible. There was also some uncertainty as to whether the instructor should manoeuvre target ships during the exercise.

Both groups disagreed that simulators are more effectively used with large groups of trainees, however, instructors who had served as Master significantly disagreed more strongly at the .01 level. Instructors who had served as Master also significantly disagreed more strongly at the .01 level with the statement that simulator exercises should be stopped as soon as the exercise objective had been met, even if further learning can take place. The Marine Board (1996) has indicated that the decision as to when to stop a simulator exercise rests with the instructor.

On the basis of the responses to items in Cluster D, it was concluded that instructor perceptions toward exercise de-briefing were similar for both groups. In general, both groups were in agreement with the concept of peer tutoring however, they were somewhat unsure of how much trainees could learn from each other. Instructors were in general agreement with the manner in which the de-brief should be conducted and with the content of the de-brief.

Instructors who had served as Master significantly agreed more strongly at the .00 level with the statement that trainees must be accountable for their actions during a simulator exercise.

Teacher Training

Hypothesis 5 compared the perceptions of instructors who held a teaching certificate and those who did not hold a teaching certificate. The analyses of variance carried out on each of the four clusters indicated that differences were statistically significant in only one of the clusters, cluster B. While the null hypothesis was accepted, a number of individual statements in two of the remaining three clusters produced significant differences at or below the .05 level.

On the basis of the responses to items in Cluster A, it was concluded that instructor perceptions toward exercise development were similar for both groups. Both groups were in agreement regarding the best way to evaluate simulator exercises but were somewhat neutral regarding the ease of evaluating simulator exercises and instructors understanding of evaluation techniques. Instructors agreed on the use of objectives in exercise development and that good exercise development is the most important part of simulator training.

The analysis of variance carried out on cluster B indicated that there was a significant difference in the attitudes and perceptions toward simulator exercise briefing. It is unlikely that a programme of teacher training would be directly related to simulation which may account for the lack of significant differences in the areas of exercise development, running and de-briefing. It is likely, however, that teacher training would contain elements about learner preparation and learning styles which might be expected to influence the instructors attitudes and perceptions toward exercise briefing.

On the basis of the responses to items in Cluster C, it was concluded that instructor perceptions toward exercise running were similar for both groups. There was general agreement that simulators were most effective with small groups of trainees and that the learning experience is effective for all trainees. Instructors appeared to be somewhat uncertain whether the exercise should be allowed to continue if attainment of the objective became impossible. There was also some uncertainty as to whether the instructor should stop the exercise after the objective had been attained if further learning could take place.

Both groups disagreed with the statement that is was not necessary for a simulator instructor to be a mariner to effectively use a marine simulator for training however, instructors who had a teaching certificate significantly disagreed less strongly at the .00 level. The exact influence of teacher training on this difference is unclear however, it is possible that teacher training had the effect of enhancing the importance of good teaching thereby lessening the emphasis on mariner qualifications.

Although both groups disagreed, instructors who held a teaching certificate disagreed more strongly with the statement that instructors should not manoeuvre target ships to prevent a collision with Own Ship. The question of whether to manoeuvre a target ship is essentially one of preserving the realism of the exercise. In real life most ships will conform to the established rules governing collision avoidance while the remainder will either manoeuvre inappropriately or not at all. There is support in the literature for instructor intervention in simulator exercises, however authors such as Caillou et. al. (1992), Beadon (1992), Jones (1995) and Kerr

(1977) indicate varying degrees of support. While the influence of teacher training is again unclear, it is possible that the need to represent facts and situations accurately has been stressed within teacher training programmes.

On the basis of the responses to items in Cluster D, it was concluded that instructor perceptions toward exercise de-briefing were similar for both groups. In general, both groups were in agreement with the concept of peer tutoring however, they were somewhat unsure about how much trainees could learn from each other. Instructors were in general agreement with the manner in which the de-brief should be conducted and with the content of the de-brief. Instructors generally agreed with the concept of social learning which supports Bandura's (1969) work regarding the capacity of individuals to learn by observation. Instructors were somewhat uncertain however, as to whether trainees who are active in the classroom also benefit most from simulator exercises.

Instructors who held a teaching certificate significantly agreed more strongly at the .02 level that simulation can be an effective teaching tool for all trainees regardless of their learning style. While both groups agreed with the statement, it is possible that instructors who had completed teacher training possessed a better understanding of individual learning styles and that this enhanced knowledge had an influence on their response to this statement.

Both groups also agreed that the debrief is the most important part of simulator training. Instructors who held a teaching certificate significantly agreed less strongly at the .03 level, indicating that they place more value on the other elements of simulator training. It is possible that elements of their teacher training programme may have provided an enhanced awareness of the importance of all elements of simulator training.

Certification as Simulator Instructor

Hypothesis 6 compared the perceptions of instructors who were certified as simulator instructors by the government of their country and those who were not certified. The analyses of variance carried out on each of the four clusters indicated that there were no statistically significant differences in any of the clusters. While the null hypothesis was accepted, a number of individual statements in two of the four clusters produced significant differences at or below the .05 level.

On the basis of the responses to items in Cluster A, it was concluded that instructor perceptions toward exercise development were similar for both groups. Both groups agreed on evaluation methodologies to be used with simulator exercises, but were somewhat neutral regarding the ease of evaluating simulator exercises and instructors understanding of evaluation techniques. Instructors agreed on the role of objectives in exercise development. Instructors also exhibited support for Smith (1990) in agreeing that good exercise development is the most important part of simulator training. They also agreed on the role of validation and testing in exercise development.

On the basis of the responses to items in Cluster B, it was concluded that instructor perceptions toward exercise briefing were similar for both groups. Both groups strongly agreed that a briefing process was necessary however, there was evidence of uncertainty as to whether it should be a formal process and whether oral or written briefing was the preferred method. There was general agreement that the instructor should review all relevant information during the briefing, however, there was some indication of uncertainty as to how much information should be given. While both groups agreed that preparation time should be allowed, there was uncertainty as to whether trainees should be given all the time they need to prepare.

Instructors who were certified by their respective governments significantly agreed more strongly that the instructor should review all relevant information necessary for the successful completion of the exercise. This same group also agreed more strongly that the briefing should provide additional instruction to strengthen areas of weakness. Instructors who teach mandatory courses are more likely to be certified than those who teach non-mandatory courses. It is also likely that trainees who take mandatory courses will be engaging in basic training which will require that the instructor pay more attention to the readiness of the trainee to do the simulator exercise.

On the basis of the responses to items in Cluster C, it was concluded that instructor perceptions toward exercise running were similar for both groups. There was general agreement that simulators were most effective with small groups of trainees and that the learning experience is effective for all trainees. Instructors appeared to be somewhat uncertain whether the exercise should be allowed to continue if attainment of the objective became impossible. There was also some uncertainty as to whether the instructor should stop the exercise after the objective had been attained if further learning could take place. Instructors also appeared to be uncertain as to the manoeuvring of target ships during the exercise.

On the basis of the responses to items in Cluster D, it was concluded that instructor perceptions toward exercise de-briefing were similar for both groups. In general, both groups agreed with the concept of peer tutoring however, they were somewhat unsure of how much trainees could learn from each other. Instructors were in general agreement with the manner in which the de-brief should be conducted and with the content of the de-brief. Instructors generally supported social learning however, they were somewhat uncertain as to whether trainees who are active in the classroom also benefit most from simulator exercises.

While both groups agreed that trainees must be accountable for their actions during a simulator exercise, instructors who were certified significantly agreed more strongly. Since it is likely that trainees who take mandatory courses will be engaging in basic training, it is also more likely that instructors for these courses would have a greater expectation that the trainee would provide an explanation and justification for actions taken during the simulator exercise.

Use of Visual Systems

Hypothesis 7 compared the perceptions of instructors who use simulator equipment that had a visual system and those who use equipment that did not have a visual system. The analyses of variance carried out on each of the four clusters indicated that differences were statistically significant in only one of the clusters, cluster D. While the null hypothesis was accepted, a number of individual statements in two of the remaining three clusters produced significant differences at or below the .05 level.

On the basis of the responses to items in Cluster A, it was concluded that instructor perceptions toward exercise development were similar for both groups. Both groups agreed on evaluation methodologies to be used with simulator exercises but were somewhat neutral regarding the ease of evaluating simulator exercises. Instructors agreed on the use of objectives in exercise development and that good exercise development is the most important part of simulator training. They also agreed on the role of validation and testing in exercise development.

Although both groups agreed that it is easy to evaluate trainee performance during a simulator exercise, instructors who did not work with a visual system significantly agreed more strongly. The difference in responses may be due to the fact that a visual system adds to the overall capability of the simulator thereby adding more possibilities for trainees to learn. This, in turn, makes it necessary for instructors to be more stringent in applying evaluation techniques.

Both groups agreed that marine simulator instructors have a good understanding of evaluation techniques, however, instructors who did not work with a visual system significantly agreed more strongly. It may be possible that this difference in responses is also related to the enhanced capability that a visual system brings to the simulator. The evaluation techniques used when a visual system is present may be more difficult to apply. The effectiveness and application of evaluation techniques used with simulation could be the subject of further study into the use of simulation in marine education.

Although both groups agreed that the first step in good exercise development is to clearly define the objective of the exercise, instructors who worked with a visual system significantly agreed more strongly. It is likely that this difference is also due to the enhanced capability of the simulator fitted with a visual system. Since the exercises created for a simulator with a visual system are often more complex, the need for a clearly defined objective becomes more apparent to the instructor.

On the basis of the responses to items in Cluster B, it was concluded that instructor perceptions toward exercise briefing were similar for both groups. Both groups strongly agreed that a briefing process was necessary however, there was evidence of uncertainty as to whether it should be a formal process and whether oral or written briefing was the preferred method. There was general agreement that the instructor should review all relevant information during the briefing, however, there was some indication of uncertainty as to how much information should be given. While both groups agreed that preparation time should be allowed, there was uncertainty as to whether trainees should be given all the time they need to prepare.

While both groups strongly disagreed with the statement that a briefing process is not necessary for most marine simulator exercises, instructors who worked with a visual system significantly disagreed more strongly. It is likely that this difference can be attributed to the fact that most exercises designed for visual systems are more complex than exercises designed for simulators without visual systems. This would require instructors who work with visual systems to ensure that the briefing was as effective as possible thereby reinforcing the need for a briefing before each exercise.

On the basis of the responses to items in Cluster C, it was concluded that instructor perceptions toward exercise running were similar for both groups. There was general agreement that simulators were most effective with small groups of trainees and that the learning experience is effective for all trainees. Instructors appeared to be somewhat uncertain whether the exercise should be allowed to continue if attainment of the objective became impossible. There was marginal agreement that the instructor should not stop the exercise after the objective had been attained if further learning could take place. Instructors also appeared to be uncertain as to the manoeuvring of target ships during the exercise and whether the trainee should have control of the speed during an exercise.

The analysis of variance carried out on cluster D indicated that there was a significant difference in the attitudes and perceptions toward simulator exercise de-briefing. It is also likely that this difference can be attributed to the fact that most exercises designed for visual systems are more complex than exercises designed for simulators without visual systems. The de-brief for such exercises, while not substantially different in structure, would, out of necessity, be more complex than the de-brief for exercises without a visual system.

Employment Situation

Hypothesis 8 compared the perceptions of instructors who work at privately funded facilities and those who work at publicly funded facilities. The analyses of variance carried out on each of the four clusters indicated that there were no statistically significant differences in any of the clusters. While the null hypothesis was accepted, a number of individual statements in two of the four clusters produced significant differences at or below the .05 level.

On the basis of the responses to items in Cluster A, it was concluded that instructor perceptions toward exercise development were similar for both groups. Both groups agreed on evaluation methodologies to be used with simulator exercises but were somewhat neutral regarding instructors understanding of evaluation techniques and the ease of evaluating simulator exercises. Instructors agreed on the use of objectives in exercise development and that good exercise development is the most important part of simulator training. They also agreed on the role of validation and testing in exercise development.

On the basis of the responses to items in Cluster B, it was concluded that instructor perceptions toward exercise briefing were similar for both groups. Both groups strongly agreed that a briefing process was necessary however, there was evidence of uncertainty as to whether it should be a formal process and whether oral or written briefing was the preferred method. There was marginal agreement that the instructor should review all relevant information during the briefing, however, there was some indication of uncertainty as to how much information should be given. While both groups agreed that preparation time should be allowed, there was uncertainty as to whether trainees should be given all the time they need to prepare.

On the basis of the responses to items in Cluster C, it was concluded that instructor perceptions toward exercise running were similar for both groups. There was general agreement that simulators were most effective with small groups of trainees and that the learning experience is effective for all trainees. Instructors appeared to be somewhat uncertain whether the exercise should be allowed to continue if attainment of the objective became impossible. There was marginal agreement that the instructor should not stop the exercise after the objective had been attained if further learning could take place. Instructors also appeared to be uncertain as to the manoeuvring of target ships during the exercise and whether the trainee should have control of the speed during an exercise.

While both groups disagreed with the statement that the objective of a simulator exercise need not be identified for trainees. This is supportive of the position taken by Muirhead and Tasker (1991) regarding the presentation of objectives to trainees during the briefing session. Instructors who worked at private facilities significantly disagreed more strongly. There is nothing in the data to indicate the reasons for this difference. It is possible that disclosure of objectives in some simulator exercises may have an effect on the planned learning experience, particularly for evaluation of trainee response to emergencies.

On the basis of the responses to items in Cluster D, it was concluded that instructor perceptions toward exercise de-briefing were similar for both groups. In general, both groups agreed with the concept of peer tutoring however, they were somewhat unsure of how much trainees could learn from each other. Instructors were in general agreement with the manner in which the de-brief should be conducted and with the content of the de-brief. Instructors generally supported social learning however, they were somewhat uncertain as to whether trainees who are active in the classroom also benefit most from simulator exercises.

Both groups disagreed with the statement that during exercises which involve a group of trainees, only the trainee in the lead role will gain experience or knowledge. Instructors who worked at private schools significantly disagreed more strongly. It is possible that this difference is due to the fact that the majority of training done at public institutions tends to focus on individual skills while at private institutions the focus is more often on teamwork skills. In this context, social learning would be emphasized to a greater extent at private institutions.

Both groups agreed that a good marine simulator instructor will make use of trainees to help other trainees during a simulator course. Instructors who worked at private institutions significantly agreed more strongly than did the instructors who worked at public schools. It is also likely that the difference in responses is due to the focus on teamwork rather than individual skills.

Relationships Between Selected Variables

Overall, on the basis of the study, it was concluded that there were no relationships between a) the number of years an instructor has spent at sea; b) the number of years spent as a simulator instructor; c) the age of the simulator equipment; d) the optimum exercise run time; and e) time spent on exercise development when compared to the attitude scale constructs toward exercise preparation, exercise briefing, exercise running and exercise de-briefing. Indications of significant relationships were identified between the attitude scale constructs and both time spent briefing trainees and time spent de-briefing trainees. There was also a significant relationship between time spent on exercise development and attitudes toward exercise de-briefing. Each of the hypotheses in this section will be addressed separately.

Years at Sea

Hypothesis 9 investigated the relationship between the number of years spent at sea before becoming a marine simulator instructor and the attitude scale constructs. A correlation analysis indicated that there were no significant relationships between years spent at sea and the attitudes and perceptions of marine simulator instructors.

As previously stated, experience at sea is often used as a measure of suitability for initial hiring of simulator instructors. The minimum amount of time at sea will be that required to obtain the level of professional qualification held and will be served prior to becoming a simulator instructor. The experience gained at sea will prepare instructors for the delivery of simulator course content. Since simulator operation and usage is learned after becoming an instructor, it is unlikely that the number of years spent at sea will have an influence on attitudes and perceptions related to simulator use.

Years as Instructor

Hypothesis 10 investigated the relationship between the number of years served as a marine simulator instructor and the attitude scale constructs. A correlation analysis indicated that there were no significant relationships between years served as a marine simulator instructor and the attitudes and perceptions of marine simulator instructors.

Time spent as a simulator instructor does not appear to influence attitudes and perceptions about training. This suggests that instructors are satisfied with the status quo. Given that most instructors appear to be trained within a loosely structured mentoring system, it may be possible that attitudes and perceptions have been passed to new instructors and that teaching methodologies related to simulator use among marine simulator instructors have also been influenced in a like manner.

Age of Simulator Equipment

Hypothesis 11 investigated the relationship between the age of the simulator equipment used and the attitude scale constructs. A correlation analysis indicated that there were no significant relationships between the age of the simulator equipment used and the attitudes and perceptions of marine simulator instructors.

The age of the simulator equipment can be used to determine the relative capability of simulator equipment in use. The absence of a significant relationship between simulator age and the attitude scale constructs may indicate that attitudes toward training are independent of simulator capability. However, while more modern simulators have increased capabilities as compared to older equipment, it is possible that instructors using new equipment may only use the features with which they are already familiar. A future study could investigate the extent to which the full capabilities of simulator equipment, especially new simulator equipment, are being used. Such a study would also contribute to the development of a programme of training for marine simulator instructors.

Optimum Exercise Running Time

Hypothesis 12 investigated the relationship between the optimum simulator exercise length and the attitude scale constructs. A correlation analysis indicated that there were no significant relationships between the instructor's optimum simulator exercise length and the attitudes and perceptions of marine simulator instructors.

The fact that no relationships exist is not surprising since the length of an exercise should not have any impact on any of the distinct elements of the exercise. Attitudes and perceptions of instructors toward simulator training should not be affected by the length of the exercises used in the training. In reality, a simulator training course will be comprised of a number of exercises, each with it's own optimum running time. It is likely that the optimum running time for a given exercise may change depending on the actions of the trainee during the exercise.

Time Spent Briefing

Hypothesis 13 investigated the relationship between time spent briefing trainees and the attitude scale constructs. A correlation analysis indicated that there was a significant relationship between the time spent briefing trainees and the attitudes and perceptions of marine simulator instructors toward exercise development and exercise briefing.

The correlation between time spent briefing trainees and the attitude scale construct toward exercise development was negative, indicating that as briefing time increased, attitudes toward exercise development became more positive. That is, an instructor who exhibited a negative reaction to statements about exercise development would spend less time briefing than an instructor who had reacted positively to the statements.

Results of this study indicate that instructors place considerable importance on exercise development. It has also shown that instructors agree that exercise briefing requires careful preparation. Developing a simulator exercise takes time; and developing, validating and evaluating a quality simulator exercise takes even more time. Instructors who exhibit a positive attitude toward exercise development will spend considerable time perfecting exercises which they develop. It follows that these same instructors will also endeavour to maximize the interaction between the exercise and the trainees for which it was developed. Instructors, while they have little control over trainee decisions and actions during exercise running, have an opportunity to influence trainees during the briefing. This relationship represents the logical progression from one element of simulator training to another.

The correlation between average briefing time and the attitude scale construct toward exercise briefing was also negative indicating that as development time increases, attitudes toward exercise briefing become more positive. That is, instructors who exhibited a negative reaction to statements about exercise briefing would spend less time briefing than an instructor who had reacted positively to the statements.

This relationship is not surprising since it is unlikely that an instructor who had a negative attitude toward exercise briefing would spend time engaged in that activity. Conversely, it is likely that an instructor who had a positive attitude toward exercise briefing would be willing to invest the time required to ensure that the briefing was successful.

Time Spent De-briefing

Hypothesis 14 investigated the relationship between time spent de-briefing trainees and the attitude scale constructs. A correlation analysis indicated that there was a significant relationship between the time spent de-briefing trainees and the attitudes and perceptions of marine simulator instructors toward exercise development, exercise briefing and exercise de-briefing.

The correlation between time spent de-briefing trainees and the attitude scale construct toward exercise development was negative indicating that as de-briefing time increases, attitudes toward exercise development become more positive. That is, instructors who exhibited a negative reaction to statements about exercise development would spend less time de-briefing than an instructor who had reacted positively to the statements.

As discussed earlier, quality exercise development takes considerable time and would require a positive attitude on the part of the instructor. The process of de-briefing ensures that the learning experience of the trainee is optimized by reinforcing the positive aspects of trainee actions while attempting to alter the negative aspects. It is likely, therefore, that instructors who have a positive attitude toward exercise development would spend more time de-briefing in order to ensure that the learning process was complete.

The correlation between time spent de-briefing trainees and the attitude scale construct toward exercise briefing was also negative indicating that as de-briefing time increases, attitudes toward exercise briefing become more positive. That is, instructors who exhibited a negative reaction to statements about exercise briefing would spend less time de-briefing than an instructor who had reacted positively to the statements.

It is likely that an instructor who has a positive attitude toward exercise briefing will ensure that the briefing process covers all aspects of the simulator exercise. It is also likely that the same instructor would ensure that the de-briefing process was equally comprehensive, covering all aspects of the exercise discussed during the briefing as well as the trainee performance during the exercise. Clearly, this would require that the instructor spend considerable time engaged in the process of de-briefing.

The correlation between average de-briefing time and the attitude scale construct toward exercise de-briefing was positive indicating that as de-briefing time increased, attitudes toward exercise de-briefing became more negative. That is, instructors who exhibited a positive reaction to statements about exercise de-briefing would spend less time de-briefing than an instructor who had reacted negatively to the statements.

While the reasons for this relationship are unclear, it is possible that negative reactions to statements about de-briefing may be indicative of a poor understanding of the purposes and techniques of de-briefing. If this is indeed the case, it would be logical to expect that an instructor with a poor understanding of de-briefing to spend more time engaged in that activity. Instructors who had a good understanding of de-briefing would conduct a more efficient de-briefing and therefore spend less time in doing so.

Time Spent Developing Exercises

Hypothesis 15 investigated the relationship between time spent on exercise development and the attitude scale constructs. A correlation analysis indicated that there was a significant relationship between the time spent on exercise development and the attitudes and perceptions of marine simulator instructors toward exercise de-briefing.

The correlation between time spent on exercise development and the attitude scale construct toward exercise de-briefing was positive indicating that as exercise development time increases, attitudes toward exercise de-briefing become more negative. That is, instructors who exhibited a positive reaction to statements about exercise de-briefing would spend more time developing an exercise than an instructor who had reacted negatively to the statements.

At first glance, there appears to be some confusion in the relationship between development time and exercise de-briefing, given the findings in hypothesis 14. It has been established that, as de-briefing time increases, the attitudes toward exercise development become more positive. This indicates that further study of the relationship between exercise development time and attitudes toward de-briefing is necessary.

Summary

The attitudes and perceptions of marine simulator instructors were remarkably similar based on most of the different variables investigated. This does not mean that all marine simulator instructors are the same or that they all approach simulator training in the same way. In general however, instructors were positive toward elements of simulator training.

Instructors all agreed, some marginally so, that the use of simulation in the marine industry is far behind that of other industries. However, all instructors believed that simulation can be an effective teaching tool for all trainees, regardless of learning style. A belief in the overall value and effectiveness of simulator training is evident throughout the study.

In a number of cases, instructors seemed to be unsure of their attitudes toward some of the statements. This is evidenced by the means whose values were near 2.5, and as such, represented more neutral responses. Such responses were particularly evident with respect to statements related to the learning process as applied to simulation and to statements related to issues such as on-the-job training.

There appears to be some relationships between the attitude scale constructs and the instructor activities related to simulator training that were investigated. Relationships between time spent briefing and attitudes toward exercise development and exercise briefing were indicated in the study. There were also relationships between time spent de-briefing and attitudes toward exercise development, exercise briefing and exercise de-briefing. The final relationship indicated was between time spent developing exercises and attitudes toward exercise de-briefing.

Many of the statements used in this research were deliberately general in nature. Since the objective of the study was to identify areas of agreement and disagreement in the attitudes and perceptions of marine simulator instructors, more specific statements may have been counter-productive. The findings of this study could be used as the basis for more specific studies related to marine simulator training. These studies may be related to a number of concerns including effective teaching using marine simulators and transfer of learning from the simulator to the real world operation of ships. From the study, a number of recommendations are directed at current simulator instructors programmes as well as for future research.

Potential Instructors

It is apparent that some variables such as the time served at sea, length of service as a simulator instructor, type of simulator used and certification as a simulator instructor do not have significant effect on the attitudes and perceptions of simulator instructors. On the basis of the study, it is apparent that the potential simulator instructor would be a mariner that would most likely have professional qualification at the command level and command experience. This person should also possess a keen desire to use technology for the purpose of training mariners and a desire to become an effective teacher. Potential simulator instructors would exhibit an aptitude in the areas of computer applications and a willingness to learn about the technology involved in modern simulator equipment. Good communication and interpersonal skills as well as an understanding of group dynamics would also be an asset given the nature and constructs of effectively delivering training through exercise development, exercise briefing, exercise running and exercise de-briefing.

Recommendations

Recommendations for Instructor Training

Although further study is needed into specific aspects of marine simulator training (as outlined in this report), there are a number of factors that should be taken into account by persons and agencies involved in instructor preparation and development, regardless of the type of marine simulator. These include the following:

(a) The unanimous agreement among instructors that an understanding of how humans learn is essential to effective use of simulation for training. An instructor training programme should therefore include a module containing elements of educational psychology specifically related to learning theories and the psychology of human (adult) learning as they apply to simulation. This will help to clarify the learning process and allow instructors to approach simulation from an educational and pedagogical perspective.

(b) The tendency to agree that simulator instructors are more effective if they have an understanding of the technical aspects of simulator equipment suggests the need for the inclusion of a module on the technical aspects of simulator equipment. This could be comprised of an introduction to simulator elements including, but not limited to, databases of simulator exercise areas, ship mathematical models, radar coastline generation, visual systems, sound systems, computer systems and operator control stations. This module should be generic in that it should not be related to any particular simulator hardware, but include examples related to a range of equipment.

(c) The uncertainty exhibited by some of the instructors relating to general simulator use suggests the need for a module dealing with issues related to the general use of simulation in the marine industry. This module should contain, among other things, elements relating simulation to on-the-job training, use of simulation for skill acquisition and skill enhancement, trainee acceptance of simulation and comparisons with other industries that use simulation in training.

(d) The general agreement regarding the importance of exercise development indicates the need for the inclusion of a module which addresses issues related to simulator exercise development as an essential part of an instructor training programme. This module should include sections on the use of educational objectives, evaluation techniques, creation and documentation of exercises as well as validation and testing of exercises.

(e) The general evidence of uncertainty relating to some elements of exercise briefing indicates the need for a module which addresses issues related to simulator exercise briefing as part of an instructor training programme. This module should serve to clarify issues related to conducting effective briefing sessions, content of briefing sessions, provision of remedial learning and allocation of preparation time.

(f) The evidence of uncertainty among some instructors relating to their role in exercise running indicates the need for a module which addresses issues related to simulator exercise running as important to the overall training of marine simulator instructors. This module should contain elements related to effective exercise monitoring and data collection, instructor intervention, trainee interaction with simulator exercises and evaluation of exercise outcomes as compared with exercise objectives.

(g) The evidence of uncertainty among many of the groups related to elements of de-briefing indicates the need for a module to deal with issues related to effective de-briefing methodologies and content of de-briefing sessions as well as issues related to trainee accountability and the use of peer tutoring as a teaching technique.

Recommendations for Further Research

Based on the results of this research, a number of recommendations concerning further marine simulation training research are suggested:

1. A study to determine which training approaches are particularly suited for use with simulation training within marine education.

2. A study to determine how learning theories, including theories on how adults learn, can be applied to increase the effectiveness of simulator training within marine

education.

3. A study to identify trainee attitudes and perceptions of simulator training the results of which could be used to further improve the effectiveness of simulator training in the marine industry.

4. A study to identify ship owner / operator attitudes and perceptions of simulator training, the results of which could be used to further improve the effectiveness of simulator training in the marine industry.

5. A longitudinal study of the effectiveness of simulator training versus on-the-job training.

6. A study to determine appropriate methodologies to be used when developing exercises for use with marine simulators.

7. A study to determine briefing methods which are effective when used in conjunction with marine simulator training.

8. A study to determine the extent to which instructors should intervene when running simulator exercises.

9. A study to determine de-briefing methods which are effective when used in conjunction with marine simulator training.

10. Based on the results of this and other studies, a training plan, which will meet the requirements of both the Standards of Training Certification and Watchkeeping (STCW) code and marine simulator instructors, should be developed.

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APPENDIX A

QUESTIONNAIRE

Please answer the following questions in the spaces provided or circle the appropriate response.

1. Please indicate the approximate percentage of time you use each of the following.

   a) radar and navigation simulator .... ____ %

   b) ship manoeuvring simulator .... ____ %

   c) other simulator (identify) .... ____ %

2. How many hours per week do you, as an instructor, use a simulator for each of the following?

   a) teaching .... ____ hr

   b) preparation .... ____ hr

PART I: PERSONAL INFORMATION

3. Please indicate **the highest** professional marine qualification which you hold.

   a) Master Unlimited .... YES NO

   b) Master Limited .... YES NO

   c) Commander (Navy) .... YES NO

   d) Chief Officer .... YES NO

   e) Other (identify) ______________ .... YES NO

4. How many years did you serve at sea before becoming a marine simulator instructor? ___ years

5. How many years have you been a marine simulator instructor? ___ years

6. Have you been Master on any vessel? YES NO

7. Please indicate which of the following academic qualifications you hold.

a) PhD .... YES NO

b) Masters Degree .... YES NO

c) Bachelors Degree .... YES NO

d) Diploma .... YES NO

e) Teaching Certificate .... YES NO

f) Other (identify) ____________ .... YES NO

8. Are you presently enrolled in a program of study for any of the following?.

a) PhD .... YES NO

b) Masters Degree .... YES NO

c) Bachelors Degree .... YES NO

d) Diploma .... YES NO

e) Teaching Certificate .... YES NO

f) Other (identify) ____________ .... YES NO

9. Which of the following is <u>most</u> descriptive of your employment situation?

a) Private Institution .... YES

b) Public Institution (Government Funded) YES

c) Other (identify) .... YES

10a. Are you certified by the government of your country as a marine simulator instructor? YES NO

10b. If YES, please describe the sequence of requirements necessary for you to become certified.

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PART II: SIMULATOR EQUIPMENT/OPERATION

In responses where times are requested, please express the times in minutes. (eg. 95 minutes)

11. Ignoring the time for preparation, briefing and de-briefing, what is, in your opinion, the optimum length of a typical simulator exercise? ____ min.

12. Indicate the average time that you spend **briefing** before a typical simulator exercise. ____ min.

13. Indicate the average time that you spend **De-briefing** after a typical simulator exercise. ____ min.

14. Indicate the average time that it takes you to develop a typical simulator exercise. ____ min.

15. How many Own Ship Cubicles does your simulator have? ____

16. Which of the following choices indicates the age of your simulator?

a) 1 - 3 years .... YES

b) 4 - 6 years .... YES

c) 7 - 9 years .... YES

d) 10 years or more .... YES

17. Which of the following functions does your simulator serve?

- a) a radar and navigation simulator .... YES NO
- b) a ship manoeuvring simulator .... YES NO
- c) other (identify) ______________ .... YES NO

18a. Does your simulator have a visual system? ...... YES NO

18b. If YES, how many Own Ship Cubicles have visuals? ____

19. Please indicate which of the following systems are included in your simulator.

- a) motion system .... YES NO
- b) sound system .... YES NO
- c) ARPA system .... YES NO
- d) ECDIS system .... YES NO
- e) Exercise recording/playback .... YES NO

20. Given the existing simulator that you use, which of the following would you like to add or upgrade?

- a) Visual system .... ADD UPGR
- b) motion system .... ADD UPGR
- c) sound system .... ADD UPGR
- d) ARPA system .... ADD UPGR
- e) ECDIS system .... ADD UPGR
- f) navigation systems .... ADD UPGR
- g) ship mathematical models .... ADD UPGR
- i) exercise recording/playback .... ADD UPGR
- h) other (identify) .... ADD UPGR

21. Does your organization have plans to upgrade your simulator within the next two years? YES NO

22. Does your organization have plans to purchase a new simulator within the next two years? YES NO

23. Does your organization have a full-time technician to maintain and trouble shoot the simulator equipment. YES NO

PART III: GENERAL

Please circle the response which most closely reflects your opinion for each question. Circle 1 response only. Other answers should be placed in the space provided.

KEY: SA = Strongly Agree
A = Agree
D = Disagree
SD = Strongly Disagree

24. A marine simulator should be used primarily to practice skills which have been acquired elsewhere. SA A D SD

25. Instructors will make more effective use of simulators in marine education if they have been in command of a ship. SA A D SD

26. Simulators are most effectively used in teaching situations when large groups of trainees are involved. SA A D SD

27. Trainees generally accept simulator training as being representative of the real world. SA A D SD

28. Trainees who benefit most from simulator exercises tend to also be those who are most active in other classroom activities. SA A D SD

29. During simulator exercises which involve a group of trainees, only the trainee in the lead role (Master or Watch Officer) will gain experience or knowledge. SA A D SD

30. The objective of a simulator exercise need not be identified for trainees. SA A D SD

31. Trainees do not expect simulator training to be realistic as compared to the real world. SA A D SD

32. In order to learn from a simulator exercise, trainees must make mistakes. SA A D SD

33. Simulator training can be an effective learning experience for all trainees who take simulator courses. SA A D SD

34. Simulators are most effectively used in teaching situations when small groups of trainees are involved. SA A D SD

35. Simulator instructors who understand the technical aspects of the simulator are more effective than instructors who do not understand the technical aspects. SA A D SD

36. Radar and navigation simulators are really ship simulators without a visual scene. SA A D SD

37. The use of simulation for training in the marine industry is far behind the use of simulation for training in other industries. SA A D SD

38. Simulator training can replace much of the "on-the-job" training which a mariner is currently required to do. SA A D SD

39. Trainees in a given group can learn almost as much from each other as they can learn from the instructor. SA A D SD

40. Simulation requires that instructors use specialized teaching techniques that are not used in other areas of education. SA A D SD

41. It is not necessary for a marine simulator instructor to be a mariner to effectively make use of a marine simulator for training. SA A D SD

42. Simulator training is most effective if it comes before required periods of onboard training. SA A D SD

43. It is important that there are enough learning materials available during the course for trainees to review basic knowledge required for marine simulator training courses. SA A D SD

44. Trainees often know more about new marine technology than marine simulator instructors. SA A D SD

45. Some marine simulator instructors are unsure of themselves when operating marine simulators. SA A D SD

46. A good marine simulator instructor will make use of trainees to help other trainees during a simulator course. SA A D SD

47. Simulator training is best done after required periods of onboard training have been completed. SA A D SD

48. Marine simulator instructors must be able to trouble shoot and correct simulator problems in order to minimize course disruptions. SA A D SD

49. A marine simulator instructor needs to understand how humans learn in order to be an effective teacher. SA A D SD

50. Simulation can be an effective teaching tool for all trainees, regardless of their learning style. SA A D SD

51. It is easy to evaluate trainee performance during a simulator exercise. SA A D SD

52. Evaluation of simulator exercises is best achieved through a mixture of subjective and objective evaluation techniques. SA A D SD

53. Marine simulator instructors have a good understanding of evaluation techniques. SA A D SD

PART IV: SIMULATOR EXERCISE DEVELOPMENT

54. The first step in good exercise development is for the instructor to clearly define the objective of the exercise. SA A D SD

55. Good exercise development is the most important part of simulator training. SA A D SD

56. It takes years of experience using marine simulators for an instructor to acquire good exercise development skills. SA A D SD

57. Marine simulator exercises do not need to be tested on trainees before being used in a simulator course. SA A D SD

58. The criteria for successful completion of a marine simulator exercise should be decided <u>before</u> the exercise is developed. SA A D SD

59. Marine simulator exercises are easy to develop. SA A D SD

60. Marine simulator exercise development includes validation and testing of all aspects of the exercise. SA A D SD

61. Simulator exercises should be consistent with the exercise objective. SA A D SD

62. Marine simulator exercises do not always need to be realistic. SA A D SD

63. It is important that the instructor develop a list of essential tasks that the trainee must perform during a simulator exercise. SA A D SD

64. In a given group of trainees, exercise difficulty levels can be matched to individual trainees. SA A D SD

65. Success in simulator exercises, especially in the early stages of a course, is important to the self esteem and confidence of all trainees. SA A D SD

66. It is too difficult to match exercise difficulty with each individual trainee during a simulator course. SA A D SD

67. During a simulator course, exercises for all trainees should be more and more difficult as the course progresses. SA A D SD

68. Do you have any other comments regarding marine simulator exercise preparation?

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PART V: SIMULATOR EXERCISE BRIEFING

69. A trainee should be given only the minimum amount of information necessary to complete the simulator exercise. SA A D SD

70. A briefing process is not necessary for most marine simulator exercises. SA A D SD

71. The most effective way to brief a simulator exercise is with oral instruction. SA A D SD

72. Exercise briefing requires careful preparation by the instructor. SA A D SD

73. Exercise briefings usually include sufficient time for the trainees to prepare a passage plan for the simulator exercise. SA A D SD

74. During the briefing, the instructor should review all relevant information necessary for the successful completion of the simulator exercise. SA A D SD

75. Simulator exercise briefing should provide additional instruction, as necessary, to strengthen any areas of weakness that the trainees may have. SA A D SD

76. Simulator exercise briefings should be conducted in a formal manner. SA A D SD

77. Marine simulator instructors have a good understanding of effective briefing techniques. SA A D SD

78. The most effective way to brief a simulator exercise is with written instruction. SA A D SD

79. Trainees should prepare all simulator exercises in advance and carry out their own briefing under the supervision of the instructor. SA A D SD

80. Trainees should be given as much time as they need to prepare for a simulator exercise. SA A D SD

81. Do you have any more comments regarding marine simulator exercise briefing?

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PART VI: SIMULATOR EXERCISE RUNNING

82. Once the simulator exercise is started, the instructor should not make changes which will affect the exercise outcome. SA A D SD

83. The trainee should always have the freedom to determine the speed of Own Ship, even if it means that the planned scenario will be spoiled. SA A D SD

84. The instructor should stop the simulator as soon as the exercise objective has been met, even if further learning can take place. SA A D SD

85. The instructor should not manoeuvre target ships in order to prevent a collision with Own Ship. SA A D SD

86. Full data print-outs and plots should be collected for all simulator exercises. SA A D SD

87. Once the simulator exercise has started, the instructor should make changes as necessary in order to ensure that the exercise objective is met. SA A D SD

88. The exercise should be allowed to continue even when the trainee has no chance of achieving the exercise objective. SA A D SD

89a. Simulator instructors should force trainees into making mistakes during simulator exercises. SA A D SD

89b. Please identify reasons for the response you provided in question 89a.

90. Do you have any other comments regarding simulator exercise running?

PART VII: SIMULATOR EXERCISE DEBRIEF

91.	The focus of a simulator exercise de-brief should be only on mistakes that were made during the run.	SA A D SD
92.	The de-brief is a good time for the trainees to relax before the next simulator exercise.	SA A D SD
93.	The de-brief should be done quickly so as not to waste valuable simulator time.	SA A D SD
94.	The de-brief should be carried out by the trainees under the supervision of the instructor.	SA A D SD
95.	The de-brief is the most important part of simulator training.	SA A D SD

96. The instructor should take advantage of the de-brief to provide additional instruction in areas where the trainees have demonstrated a weakness. SA A D SD

97. Marine simulator instructors have a good understanding of effective de-briefing techniques. SA A D SD

98. Trainees who make mistakes will usually try to find some excuse rather than accept responsibility for the mistake. SA A D SD

99. The de-brief should start with a review of the positive aspects of the trainees performance during the simulator exercise. SA A D SD

100. Trainees must be accountable for their actions during a simulator exercise. SA A D SD

101. Playback of all or part of a simulator exercise can be useful in exercise de-briefing. SA A D SD

102. Do you have any other comments regarding simulator exercise de-briefing?

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Thank you for taking the time to answer this questionnaire.

Please remember to place the completed questionnaire in the self addressed return envelope provided and return it as soon as possible.

APPENDIX B

CORRESPONDENCE

1. Instructions to Content Experts
2. Request to Simulator Manufacturers
3. Instructions to Director of Simulator Facility
4. Instructions to Study Participant

Dear Sir

Thank you for agreeing to review the data collection instrument that I am proposing to use for my thesis. The title of my thesis is "Attitudes and perceptions of instructors operating marine simulator courses." Given your expertise in the area of marine simulation, I am certain that your input will strengthen the instrument considerably.

The purpose of my study is to gather data from marine simulator instructors at various facilities around the world in order to identify similarities and differences in the approaches to marine simulator training. To my knowledge, there have been no previous studies done in this area and I am hoping that the data collected will yield some interesting results.

I have enclosed a copy of the instrument and a comment form which you may use for your evaluation. I have also enclosed a self-addressed envelope which you may use to return your comments to me. In order to facilitate this process, I would ask that you review the instrument according to the following guidelines.

1. Review the instrument for content relevance.

2. Identify items which you feel should be excluded from the instrument.

3. Add items which you feel would strengthen the instrument.

4. Make any suggestions with regard to content and wording which you feel would strengthen the instrument.

I am looking forward to receiving your comments. Thank you again for agreeing to assist me in this process.

Yours sincerely

Robert Mercer

Dear Sir

I had the pleasure of meeting you during Marsim 93 in St. John's. I am employed as a Simulator Instructor at the Centre for Marine Simulation (formerly MOSSTRC). I am writing you to ask your assistance with my thesis research for a Master's Degree in Education. My research deals with attitudes and perceptions of marine simulator instructors. My research does not identify the manufacturers of marine simulation equipment, nor does it identify specific functionalities of simulator equipment.

I am in the process of compiling a mailing list in preparation for mailing out my questionnaire. I would like to include as many simulation facilities as possible in my study. Could you please send me the names and addresses of locations where your company has installed Ship Manoeuvring Simulators and Radar Navigation Simulators? Please be assured that I will keep this information in the strictest of confidence and will only use the addresses for the purpose of my research.

Thank you in advance for your consideration of my request. I am looking forward to your reply.

Yours Sincerely

Robert M. Mercer

The Director of Simulation

My name is Robert Mercer. I am a candidate for a Master's Degree in Education at the Memorial University of Newfoundland. My thesis supervisor is Dr. Denis Sharpe of the Faculty of Education. I am, at present, engaged in gathering data for my thesis which is titled: "Attitudes and perceptions of instructors operating marine simulator courses."

The puropse of this study is to gather information from practicing marine simulator instructors in order to determine differences and similarities in training methodologies and attitudes. There has been little research done in this area and I am hoping that my research will provide some useful data.

As your organization is a provider of marine simulation courses, I am turning to you for assistance. I have enclosed two copies of a questionnaire which I would like to administer to two of your instructors for your **Radar and Navigation / Ship Manoeuvring Simulator**. Instructions for completion are included with the questionnaire. Participation in this study will be limited to the completion of the questionnaire.

I have also enclosed a self-addressed return envelope for each questionnaire and a covering letter for each Instructor. The return envelopes have been coded in order to identify your organization for follow-up purposes. The results of this study will be made available, upon request, to all organizations which participate.

I have designed the study in such a way as to ensure that the identity of the instructors will be unknown, even to me. The identity of your organization will only be known to me and will be kept in the strictest of confidence. No individual or organization will be identified in the thesis.

Participation in this study is voluntary and participants may withdraw at any time without prejudice or may refrain from answering any questions which they choose to omit. This study meets the ethical guidelines of the Faculty of Education and Memorial University. Questions concerning this research may be directed to me, Dr. Sharpe or to Dr. Steve Norris, Associate Dean of Research.

I thank you in advance for your cooperation. I am looking forward to receiving the completed questionnaires from your instructors.

Yours sincerely
Captain Robert Mercer, Marine Institute

Dear Study Participant

My name is Robert Mercer. I am employed by the Marine Institute as a simulator instructor. I am also a candidate for a Master's Degree in Education at the Memorial University of Newfoundland. My thesis supervisor is Dr. Denis Sharpe of the Faculty of Education. I am, at present, engaged in gathering data for my thesis which is titled: "Attitudes and perceptions of instructors operating marine simulator courses."

The purpose of this study is to gather information from practising marine simulator instructors in order to determine differences and similarities in training methodologies and attitudes. There has been little research done in this area and I am hoping that my research will provide some useful data.

As you are an instructor providing training on a marine simulator, I am turning to you for assistance. Please read the instructions and answer the questions on the enclosed questionnaire. The questionnaire can be completed in approximately 30 minutes. Please take the time to complete the questionnaire now and return it to me as soon as possible. Participation in this study will be limited to the completion of the questionnaire.

I have also enclosed a self-addressed return envelope for each questionnaire. The return envelopes have been coded in order to identify your organization for follow-up purposes, however you will not be identified in any way. The identity of your organization will only be known to me and will be kept in the strictest of confidence. No individual or organization will be identified in the thesis. The results of this study will be made available to you and/or your organization upon request.

Participation in this study is voluntary and you may withdraw at any time without prejudice or may refrain from answering any questions which you choose to omit. This study meets the ethical guidelines of the Faculty of Education and Memorial University. Questions concerning this research may be directed to me, Dr. Sharpe or to Dr. Steve Norris, Associate Dean of Research.

In closing I would like to stress that your responses will be held in the strictest of confidence. I thank you in advance for your cooperation. I am looking forward to receiving your completed questionnaire.

Yours sincerely

Captain Robert Mercer
Marine Institute