

EFFECTIVENESS OF COMPUTER-BASED SIMULATED SMALL ARMS FIRING DEVICE FOR OFFICER CADET TRAINING IN THE SRI LANKA ARMY

Major Haritha Pagodaarachchi

ABSTRACT

Sri Lanka Military Academy (SLMA) is the main military institution that facilitates Officer Cadets to improve their firing skills. Yet, the use of live-firing has been restricted due to an array of reasons. Against this backdrop, it is essential to identify the existing limitations of live-firing in induction training and to identify the viability of new technological advancements to overcome those limitations. As there is growing tendency towards the increased use of virtual technologies such as simulator firing, this research explores the feasibility of introducing a computer-based small arms firing simulator device to identify and improve the effectiveness of Officer Cadets training in the Sri Lankan Army. As a data collection method, views were collected from a sample of Officer Cadets, recently passed out Young Officers and weapon training instructors through two questionnaires. The study revealed that weather and environmental problems, logistic requirements, availability of firing ranges, safety issues, availability of limited amount of ammunition, and limited time availability due to compact training schedules have negatively affected on firing skills in induction training conducted by the Sri Lanka Army. Furthermore, the researcher found that cost effectiveness, user friendly environment, correct feedback, safety and limited space for training are advantages of small arms firing simulator. While it is identified that simulator firing is no substitute for live-firing, it is identified that exposure to simulator firing can greatly improve basic marksmanship skills of Officer Cadets. Therefore, the researcher concludes that combined practice of live-firing with simulator firing can be utilised to enhance the basic marksmanship skills among the Officer Cadets at SLMA and KDU.

Keywords: Firing, Marksmanship, Simulator

INTRODUCTION

Accurate firing is an essential competency in any military. Every Army officer or Officer Cadet should improve their accuracy in handling weapons. The proficiency of handling weapons always depends on proper training and the application of basic marksmanship fundamentals. Induction training is generally the opportunity where trainees learn basic marksmanship skills that carry a long way in their careers. In some instances, those who could not acquire the basic skills of accurate firing

during the induction training have never been able to develop this important skill even later on in their careers. Therefore, it is important to implement a proper system to deliver continuous training to the officers throughout their career. However, it should also be compatible with the available resources and time constraints.

Sri Lanka Army provides a number of opportunities for Officer Cadets at Sri Lanka Military Academy (SLMA) and General Sir John Kotelawala Defence University (KDU) to improve basic marksman skills. However, there are limitations in the weapon handling training in Officer Cadet Courses due to an array of reasons. In this study, the researcher focuses on understanding the prevailing limitations of manual firing for Officer Cadets in the present training context at SLMA and KDU, in order to explore the possibility of introducing a small arms firing simulator towards achieving better competency in this area.

According to Galanis et al. (2013), small arms induction training is a vital component in any military. Firing is a skill that requires constant practice to develop or maintain a certain competency level. While routine weapon training practices at SLMA help improve weapon handling skills, it does not provide them an opportunity to recognise their own mistakes. Therefore, the trainees need frequent opportunities to practice firing and check their performances. Existing limitations in manual firing are hard to overcome and is nearly impossible to increase firing opportunities. On the other hand, the training curricula are overloaded, therefore, it has become difficult to allot additional time slots to accommodate firing demands. During an interview conducted on April 22, 2019, the Commanding Officer of the Officer Cadet Wing at SLMA, Colonel AP Wickramasekara stated that the Sri Lanka Army encounters serious limitations on manual firing that negatively impact on the performance of trainees. Wu and Bill (2008) argue that there are many issues that need to be addressed when organising induction training outdoor by using manual platforms. Due to weather and environmental problems, logistic requirements, availability of firing ranges, safety issues, availability of limited ammunition, and limited time availability due to compact training schedule have negatively affected on firing skills in induction training conducted by the Sri Lanka Army.

Therefore, this research attempts to identify the prevailing limitations in the present manual firing platform that in turn would pave the way to explore probable remedial measures to overcome such issues. It also focuses on advantages of introducing computer-based small arms firing simulator devices for enhanced performance in small arms firing skills of Officer Cadets. The study aims at establishing a positive-ended bridge between current issues in the manual firing platform and introducing small arms firing simulators that the author perceives would produce a way towards enhanced firing performance by the target audience. The author is optimistic about the virtual technologies in weapon training due to its many factors such as low risk, low cost which requires no capital expenditure, more

firing opportunities, cost effectiveness, ability to identify weapon handling errors accurately, and environment friendliness.

SCOPE AND LIMITATIONS

The scope of this paper covers the potentialities of implementing a new system for small arms firing training and how it leads to the improvement of efficiency and effectiveness of Officer Cadets in Sri Lanka Army in their inductive military training. During this research the focus was made on the survey methods by involving Officer Cadets of SLMA who have undergone the marksmanship package using computer-based simulated small arm firing training at Marksmanship and Sniper Training School (MSTS) in 2019. As SLMA conducts different types of programmes for different types of entrants, identifying time-based limitations to each programme and their relationship to Officer Cadets' firing performance is assumed to be comparatively complex. At present, only MSTS holds small arms firing simulator devices in which a limited opportunity is given to Officer Cadets, therefore, identifying the effectiveness becomes unclear.

BASIC MARKSMANSHIP SKILLS

Precision firing is an important factor in any military training around the world. Anderson (2014) revealed that it is important to improve the weapon handling capabilities of Army Officer or Officer Cadet. Marksmanship can be defined as a fundamental skill necessary for military personnel that enables an accurate fire practice to reach the desired range of weapon. Nevertheless, marksmanship is a basic component of cadet training within the Army worldwide. Generally the marksmanship training is conducted on live-firing ranges and live-firing performances indicate the training competency (Chung et al., 2011). Aiming, breath control, movement control, trigger control, follow-through are five fundamental elements in marksmanship training. All of these elements work together as one process and should be practiced together in the following ways (Chung et al., 2011).

Table 1: Fundamentals of Basic Marksmanship Skills

SER	TOPIC	SUB TOPIC
1.	Breath control	Breathing control, natural respiratory pause, and natural aiming point.
2.	Trigger control	Bucking, finger placement, flinching, firm grip and grip of firing hand, trigger control and squeeze.
3.	Aiming	Accuracy, aiming process, follow-through, eye on front sight post, sight adjustment, sight alignment.
4.	Position	Body placement, bone support, eye relief, feet placement, finger placement, firm grip, forward elbow placement, forward hand placement, leg placement, muscular relaxation, muscular tension, rifle butt placement, stable firing position, stock weld placement.
5.	Other	Consistency, distance effects, weapons safety.

Source: Chung et al., 2011

Apart from these basic fundamentals, adapting to the different environmental conditions is also an important factor in making a competent shooter in the battle field. Weather is the most considering factor that can affect shooter target. According to Scribner et al., (2007) weather affects the round that leaves the barrel, especially when taking targets over 600 meters distant. Wind, light, humidity, and temperature are four types of weather conditions affecting the manual firing target. Wind can change the target drastically and the round is affected by wind from left and from right at right angles. Humidity is the amount of vapor in the air per square foot. High density resists the motion of the bullet and in the group, the mean point of intact is lower than the point of aim (Scribner et al., 2007). Light will affect the shooter's visibility and move the round away from the group target. In contrast, marksmanship fundamentals provide foundation to create a competent shooter. Live-firing is the commonly used method in the field for delivering marksmanship fundamentals. However, with the technological evolution, simulator based training is increasingly being used for sharpening the skills of shooters.

MARKSMANSHIP TRAINING FOR OFFICER CADETS

Sri Lanka Military Academy (SLMA) is the main institution of military training for Officer Cadets in the Sri Lanka Army. There are a number of Officer Cadet training programmes conducted by SLMA as directed by the Army Training Command and Directorate of Training (Directorate of Training, 2019). The basic summary of the programmes are as follows:

Table 2: Course Curriculum of SLMA

SER	COURSE	DURATION	NUMBER OF PERIODS
1.	Officer Cadets Degree Course	Two years and nine months	270 day periods and 25 night periods
2.	Volunteer Officer Cadets Course	One year and six months	188 day periods and 16 night periods
3.	Lady Officer Cadets Course	One year	104 day periods and 2 night periods
4.	Intensive Course for KDU Officer Cadets	Six months	116 day periods and 2 night periods
5.	KDU Officer Cadets Course	One year	178 day periods and 6 night periods
6.	Direct Enlist Officer Cadets Course	Four months	43 day periods and 8 night periods

Source: SLMA, 2019

A perusal of the SLMA course syllabus would reveal that sufficient time periods are not allocated for weapons training. Weapons training periods are also divided into practical, theory and site preparation. Therefore, very limited time period is allocated for small arms firing training.

Basic Marksmanship Course at MSTS is another opportunity for Officer Cadets to obtain mastery in small arms firing. This package enables Officer Cadets to go through a comprehensive firing practice to improve their firing skills, correct their firing positions and simulator training. The course which is conducted for a duration of 12 days consists of 111 periods dedicated to both theory and practical sessions. This is a good opportunity for Officer Cadets to improve their marksmanship skills and identify their mistakes due to the close supervision and feedback provided by weapon training instructors to ensure complete and thorough understanding of the training (MSTS, 2019). Moreover, Officer Cadets of KDU get the opportunity to practice live-firing during KDU degree programme period. They have two live firing sessions annually during their cadet period at KDU and they are allocated with weapon training session periods in their provisional programmes to improve their marksmanship skills.

Apart from that, Sri Lanka Army's young officers are given an opportunity to train in small arms firing and live-firing sessions at the Infantry Training Centre at Minneriya and Army Training School (ATS) at Maduruoya during their Young Officers Course. Marksmanship skills and knowledge gained by officers during their cadet period can be practically exercised during these live-firing sessions.

SIMULATOR AND SIMULATION

Simulator is a computer system, device and programmable machine to direct training and monitor human action in a systematic way. In addition, simulation is a systematic process to control in a physical, mathematical, or otherwise logical representation of a system. According to the US Department of Defence (2011), there are three types of simulation methods named as virtual simulation, live simulation and constructive simulation. Among those, virtual simulation is the well-known method practice in marksmanship training.

SIMULATION-BASED TRAINING

Simulation technology has a long history in the field of marksmanship training. It delivers a technological substitution that resolves the resource sharing problem by creating a virtual environment for satisfying the demand. Some well-known simulator types are Extended Reality (XR), Mixed Reality (MR), Augmented Reality (AR) and Virtual Reality (VR). The MSTS firing simulator can be categorised as Mixed Reality (MR). Simulation-based training uses computer-based virtual environments to expand or replace percentages of the real environment. This helps to reduce the risk and damage to the participants and environment while reducing the overall training cost (National Training and Simulation Association, 2011).

USE OF SIMULATORS IN MILITARY TRAINING

In a review research by Orlansky et al. (1994) on aircraft simulators, they conclude that a combination of real equipment and simulators for training are always effective than the use of actual equipment alone. For example, one hour of aircraft simulator training was equivalent to 48 hours of actual aircraft time. In addition to that, the simulator averaged about 10% of operating costs of the actual aircraft. A review by Hays et al. (1992) and Caretta and Dunlap (1998) stated that the use of both simulator and actual aircraft for jet aircraft training consistently results in better performance rather than the use of an aircraft alone. Using simulators for training does not have a long history in Sri Lanka and marksmanship training is traditionally conducted on live-fire ranges. However, the cost of live ammunition, the availability and accessibility of live-fire ranges, and administrative overheads associated with planning and conducting live-fire practices make the use of simulators an attractive alternative for marksmanship training. Sri Lanka Army has been using simulators since 2017 for marksmanship training. Similar systems are currently being employed by Sri Lanka Navy for their marksmanship training.

EFFICIENCY AND EFFECTIVENESS OF MARKSMANSHIP ON SIMULATORS

According to the Stephens and Temby (2014), marksmanship simulators are believed to be effective environments for trainees to become familiar with different weapon systems, as well as learning the principles of marksmanship and receiving instructions. This is because marksmanship simulators are generally more accessible than live-fire ranges, and also provides a gentle environment in which to learn, particularly for trainees with limited or no experience with live-fire weapons. However, Thomason (2013) expresses the importance of having battle conditions in the simulator. The latter aspect is believed to lead to faster skill acquisition and hence, more efficient training during the early stages of learning. Overall, marksmanship simulation appears to be viewed as an effective supplement (but not replacement) for live-fire, when used in conjunction with marksmanship coaching.

There are few studies that provide empirical data regarding the effectiveness of marksmanship training conducted through the simulators. Several studies have shown that firing performance is generally poor in the simulator compared to live firing (Keefe and Tikuisis, 2003). In addition, there is considerable variation in the correlation between simulator and live-fire scores, with values of the correlation coefficient (r) ranging from 0.17 (low) to 0.68 (high) (Smith, and Hagman, 2003). For the majority of these studies, correlation coefficient value was found as low to moderate values. In these cases, simulator performance was not a useful predictor of live-firing performance and it was not possible to reliably predict live-fire qualifications.

Stephens and Temby (2014) concluded that the combination of simulator and live-fire training, achieved significantly higher scores in firing. It was concluded that the blended training method allowed cadet trainees (with minimal live-fire experience) to focus on learning the basic firing techniques and gaining familiarity with the weapon system on the simulator whilst conducting simple marksmanship practices.

COMPARISON OF MANUAL FIRING AND SIMULATOR FIRING

Table 3: Comparison of Live-Firing and Simulator Firing

SER	LIVE-FIRING	SIMULATOR FIRING
1.	Accommodate comparatively high training time and time for preparation.	Reduce live training time and ammunition usage (Indracompany.com, 2019).
2.	Safety issues arise when using for the first time.	Simulator can potentially be used to determine readiness for live-fire qualification (Stephen and Temby, 2014).
3.	Helps to improve army marksmanship training from different angles such as target type, shot distance, light and weather condition.	Only some parameters such as distance and light can be changed through the computational system (Indracompany.com, 2019).
4.	It is not easy to adjust for the desired training conditions.	Simulators can be adjusted as per the training conditions and the instructor's requirements (Stephen and Temby, 2014).
5.	Training conducted in the natural environment with natural disturbances. However, there is no proper mechanism to detect incorrect handling positions.	Aim point detection technology, realistic weapon handling technology, navigation and 3D geo-specific training environments can be seen in the simulator system (Esigma-systems.com, 2019).

Source: Ashley, 2014

According to Thomasson (2013), it is fairly well-established that varying levels of simulation can be effective tools in the practice and perfection of skills in the context of shooting as well as the improvement of other skills. In the firing, for instance, instructors rely on simulation as a useful training method for multiple reasons. Practice incorporating increasing levels of likeness to competitive situations has become common place at virtually all levels of shooters. Additionally, it must be noted that although it is difficult to perfectly simulate an actual scenario, training for the addition of various qualitative characteristics can still be useful during preparation.

An example of an increasingly prevalent method of simulation in practice for gunners of all levels, for instance, is the use of artificial noise during practice in order to prepare for battle field or arena. Most notably, the practice of trying to simulate external conditions, such as crowd noise, weapon noise can be found

with gunners due to the significant effect that artificial noise can have on a team's level of play. Although this method of simulation only provides one qualitative parallel to actual competitive situations, it has become popular in order to allow for preparation of a salient element of shooting performance. The example of using artificial noise to simulate battle conditions is a prime representation of a way in which simulation can be presented employing only one element to ten competitive situations in a more genuine fashion. However, more than just simulating sound, visual experiences will have added importance for training (John, 2013).

METHODOLOGY

Primary data for the study was collected from a sample size of 230 respondents that included 144 Officer Cadets, 56 recently commissioned young officers and 30 weapon training instructors of Sri Lanka Army using a structured questionnaire. These Officer Cadets, young officers and weapon training instructors were selected based on the criteria of convenience of the researcher in regard to the data collection. As participants of the research questionnaire are representative of all Officer Cadets and weapon training instructors of Sri Lanka Army, the collected data and its results can be generalised to the entire community. The close-ended positive questions were designed with five-point Likert scale in order to examine how strongly factors are agreed or disagreed.

FINDINGS AND DISCUSSION

Research data collected from sample population comprising 230 respondents reveal the possible correlations among the developed variable through the conceptual framework. Relation of mediating variable; introduction of small arms firing simulators on induction training, with independent variables; number of rounds per individuals, availability of firing ranges, cost, heavy logistic requirements, safety, environmental effects, level of acquisition of skills by the students are facts to consider. Majority have disagreed that they received adequate live and training ammunition under manual firing. The conclusion is that the respondents did not receive adequate training and live ammunition due to various constraints and training designs. Responding to the question on ease at which live-firing ranges for Officer Cadets at SLMA is reserved, majority disagreed with the statement and a few respondents provided neutral answers. Presently SLMA does not have a firing range on its own and all the firing ranges are under the control of the MSTs. SLMA training wing staff finds it extremely difficult to reserve firing ranges according to the SLMA training schedule as MSTs, too, conducts a number of marksmanship courses and competitions. The majority agreed that safety level in simulator firing is higher than live-firing. As safety is an essential factor at any training establishment; simulator firing can reduce risks to a greater extent. When Officer Cadets go through simulator firing sessions over a period of time they can

adopt best practices that can be applied to a live-firing environment to ensure better safety. The majority agree on bad weather and environmental factors negatively affecting their groupings in firing. Therefore, it is evident that evaluation and on-site correction of individual defects is difficult during induction training. The majority of respondents tend to favour simulator firing due to its maintainability with little repair and also due to the device's ability to detect the mistakes of the firer which helps them in making corrections in the simulator firing device. Officer Cadets are of the opinion that their individual skills can be sharpened by using simulation technology-based firing sessions. Although majority agreed with simulation-based training as more interesting than manual firing training, this result indicates the necessity of simulator training for Officer Cadets during their induction training that will greatly assist them in perfecting their firing skills.

Correlation between effectiveness of simulator training with live-firing accuracy, less time restrictions for training and user friendliness under small arms simulator shows that there was positive correlation between variables. There was negative correlation between effectiveness of simulator training with the environment and weather conditions. Therefore, the researcher has identified that environmental and weather conditions do not affect simulator training sessions as per the survey results. On the other hand, correlation output shows that there was negative correlation between simulator training and risk factor which indicates that simulator firing systems that are safer than manual firing ranges. There was a positive correlation when it comes to the deployment of small firing simulators enhanced combat efficiency and effectiveness of the Officer Cadets with achieved good marksmanship skills during induction training. It also proved that simulator firing sessions are more supportive than manual firing in achieving marksmanship skills and positively affected weather constraints, reduced ammunition costs and other operational expenses.

CONCEPTUAL FRAMEWORK

Based on the results of the survey, a conceptual framework for this study was devised as follows:

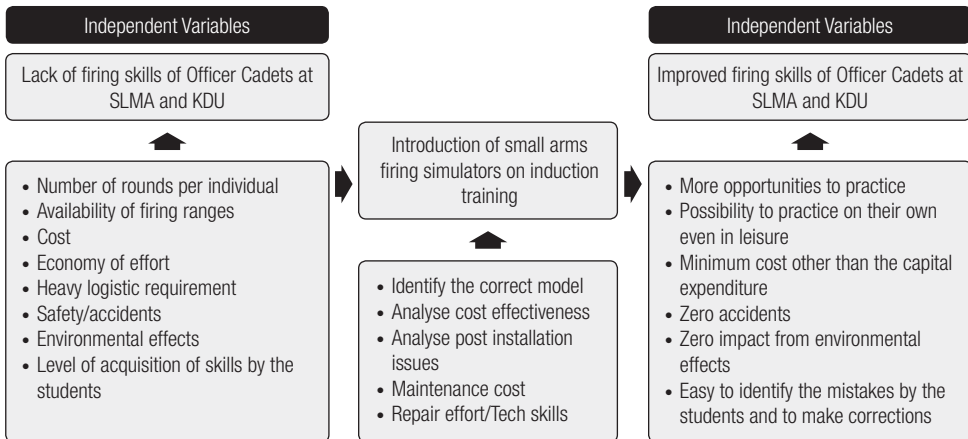


Figure 1: Conceptual Framework

Source: Developed by Author, 2019

EXISTING MANUAL FIRING COURSE CURRICULUM

In this study, the researcher found the effectiveness of simulator firing to improve basic marksmanship skills among Officer Cadets at SLMA and KDU. Therefore, the researcher arrived at the following conclusions through the data analysis and the data presentation. The majority responded that the Officer Cadets do not receive sufficient live and training ammunition for firing due to various constraints. Furthermore, Officer Cadets expect more weapon handling and live firing sessions to develop their basic marksmanship skills as most of the participants in the survey expressed their discontent on the unavailability of such training. On the other hand, this result suggests that the present course curriculum needs to be upgraded to allocate adequate live firing sessions. In addition, wasting of time on different non-training purposes is inevitable during manual firing sessions at firing ranges; thus, it is worthwhile to explore remedial measures to curtail the waste and utilise that time purposefully.

WEAPON HANDLING AND FIRING

The majority of the survey participants were of the opinion that accuracy in live firing depends on individual skill level and external factors. Accuracy in live firing depends on individual's aiming, trigger squeeze quality, steadiness, control of breathing, body relaxation, confidence, quality of the weapon, wind direction and speed, temperature and humidity whereas accuracy is least dependent on the condition of ammunition. Therefore, it is essential to identify individual weaknesses and improve individual firing skills. However, in manual firing it is difficult to identify individual weaknesses due to the impact of external factors. Therefore, to

improve individual errors an environment free of external impacts should be made available during induction training.

SIMULATOR FIRING

In this study, the researcher identified that deployment of firing simulators at SLMA and KDU has the potential of rectifying most of the limitations that the manual firing has. According to the National Training and Simulation Association (2011), firing simulators reduce the risk and damage to the participants and environment while reducing the overall training cost. Majority of the participants accepted that simulator firing can reduce risks to a greater extent. Furthermore, a majority of the participants agreed with cost effectiveness of simulator training considering less repairs and damages. According to Stephen and Temby (2014), marksmanship simulators are generally more accessible than live-fire ranges and also provides a gentle environment to learn. As per the view of the majority of participants, simulation-based training is more interesting than manual firing training and also user-friendly devices offer a unique feedback and are easily acclimatised. However, the majority is of the opinion that they achieved marksman skills during their exposure to simulator firing. Therefore, the researcher demonstrates that simulator firing training programmes are effective in firing practices. Orlansky et al., (1994), Hays et al., (1992), and Caretta and Dunlap (1998) reviewed that a combination of real equipment and simulators for training are always effective than the use of the actual equipment alone. Although simulator firing is not at all a total replacement for live-firing, it provides greater opportunities for trainees to identify their weaker areas and seek the professional assistance of instructors. Similarly, instructors can better facilitate the trainees in a simulated environment prior to exposing them in live-firing environments.

CONCLUSION

Simulator firing in present day context is not an alien experience for young school leavers joining the Army. Certainly they have been exposed to similar commercial apparatus as youngsters. This foundation is worthwhile developing to inculcate one of the most important skills for military personnel that will remain right throughout their career.

In this study, the researcher mainly focused on the effectiveness of introducing firing simulators to enhance basic marksmanship skills among Officer Cadets at SLMA and KDU during their induction training. The survey results have amply proved that simulator firing practices are more effective due to prevailing constraints in live firing. The researcher identified that simulator firing is not a total replacement for live-firing due to obvious reasons; however, Officer Cadets' exposure to simulator firing can greatly improve their basic marksmanship skills. Therefore, the researcher

concluded that combined practice of live-firing with simulator firing enhance the basic marksmanship skills among the Officer Cadets at SLMA and KDU.

The research outcomes suggest that the introduction of small arms firing simulators enhance basic marksmanship skills among Officer Cadets at SLMA and KDU. Furthermore, the use of firing simulators has the potential to overcome certain inherent limitations in live-firing, such as the scarcity of time, and the ability to reserve firing ranges. Accuracy, instant feedback to trainees and low maintenance cost provide potent justification for the need of computer-based small arms simulator for induction training.

It is recommended to introduce firing simulators during induction training at SLMA and KDU. Hence, Officer Cadets must be exposed to simulator environment prior to live-firing and provide them with the opportunity to rectify their shortcomings. Weapon training instructors should go through an orientation training capsule on simulator firing before employing them on instructor assignments. This instructor trainee relationship in a simulator firing environment can produce quality training for Officer Cadets. Officer Cadets receive better opportunities in simulator firing to correct their handling errors in the simulated environment as external factors cause minimum impacts. Once Officer Cadets are acclimatised with simulator firing to enhance weapon handling skills, they are better prepared to undertake live firing.

The small arms firing simulator reduces the live firing sessions. The live firing restricts to conduct individual assessment of trainees. Therefore, Small Arms Firing Simulator can be recommended for conducting orientation and marksmanship lessons during small arms training. Sequential progress of Officer Cadets can be better monitored in simulator firing. Therefore, Officer Cadets have the liberty to maintain their own records to have an idea on their progress.

REFERENCES

Anderson, M. (2014) 'Small arms training simulators in the New Zealand defence force', *4th International Defense and Homeland Security Simulation Workshop 2014: conference proceedings*. Defence Technology Agency, New Zealand Defence Force, pp. 7–12 [Online]. Available from: http://www.msc-les.org/proceedings/dhss/2014/DHSS2014_7.pdf [Accessed 6th February 2019].

Carretta, T.R. and Dunlap, R.D. (1998) Transfer of training effectiveness in flight simulation: 1986 to 1997. *United States Air Force Research Laboratory* [Online]. Available from: <https://apps.dtic.mil/dtic/tr/fulltext/u2/a362818.pdf> [Accessed 10th February 2019].

Chung, G.K.W.K., Nagashima, S.O., Delacruz, G.C., Lee, J.J., Wainess, R. and Baker, E.L. (2011) Review of rifle marksmanship training research (CRESST Report 773). *University of California* [Online]. Available from: <https://files.eric.ed.gov/fulltext/ED520427.pdf> [Accessed 10th February 2019].

Directorate of Training (2019) *Army training directive*. Colombo: Directorate of Training.

Esigma Systems GmbH (2019) Small arms shooting and mission training systems. *Munich: Esigma Systems GmbH*. [Online]. Available from: https://www.gladio-sim.com/Product_sheet_GLADIO.pdf [Accessed 10th February 2019].

Galantis, G., Sottolare, R., Best, C. (Ed). (2013) *Fundamental issues in defense training and simulation*. London: CRC Press.

Hays, R.T. Jacobs, J.W., Prince C. and Salas, E. (1992) 'Flight simulator training effectiveness: a meta-analysis', *Military Psychology*, 4(2), pp. 63–74 [Online]. Available from: <http://www.tandfonline.com/loi/hmlp20> [Accessed 16th April 2019].

Indracompany (2019) Small arms training simulator. *León: Indracompany*. [Online]. Available from: https://www.indracompany.com/sites/default/files/indra_sac.pdf [Accessed 10th February 2019].

Keefe, A.A. and Tikuisis, P. (2003) A comparison of target detection and rifle marksmanship during live and simulator firing with and without caffeine consumption: technical report (DRDC Toronto TR 2003-003). *Defence Research and Development Canada* [Online]. Available from: <https://apps.dtic.mil/dtic/tr/fulltext/u2/a414470.pdf> [Accessed 10th February 2019].

Marksmanship and Sniper Training School. (2019) Course syllabus of basic marksmanship course. [Unpublished document]. Marksmanship and Sniper Training School.

National Training and Simulation Association (2011) 'A Primer on Modeling and Simulation: The World of M&S'. *Arlington: National Training and Simulation Association* [Online]. Available from: <https://www.trainingsystems.org/-/media/sites/ntsa/homepage/miscellaneous/ms-primer.ashx?la=en> [Accessed 15th March 2019].

Orlansky, J., Dahlman, C.J., Hammon, C.P., Metzko, J., Taylor, H.L. and Youngblut, C. (1994) *The value of simulation for training*. *Institute for Defense Analyses*. [Online]. Available from: <https://apps.dtic.mil/sti/pdfs/ADA289174.pdf> [Accessed 10th February 2019].

Scribner, D.R., Wiley, Patrick, H. and Harper, W.H. (2007) A comparison of live and simulated fire soldier shooting performance (ARL-TR-4234). *Human Research and Engineering Directorate, U.S. Army Research Laboratory* [Online]. Available from: <https://apps.dtic.mil/sti/pdfs/ADA471786.pdf> [Accessed 10th February 2019].

Smith, M.D. and Hagman, J.D. (2003) Using the Laser Marksmanship Training System to predict rifle marksmanship qualification (Research Report 1804). *U.S. Army Research Institute for the Behavioral and Social Sciences*. [Online]. Available from: <https://apps.dtic.mil/dtic/tr/fulltext/u2/a415716.pdf> [Accessed 10th February 2019].

Sri Lanka Military Academy. (2019) Course curriculum. [Unpublished document]. Sri Lanka Military Academy.

Stephens, A. and Temby, P. (2014) Evaluation of the effectiveness of simulation for M4 marksmanship training (DSTO-TR-2950). *Defence Science and Technology Organisation, Australian Government Department of Defence* [Online]. Available from: <https://apps.dtic.mil/dtic/tr/fulltext/u2/a615318.pdf> [Accessed 10th February 2019].

Thomasson, J. (2013) An analysis of firearms training performance among active law enforcement officers in the USA. Doctor of Philosophy in Kinesiology. University of Arkansas, Fayetteville.

U.S. Department of Defense (2011) 'DoD Modeling and Simulation (M &S) Glossary'. *Alexandria: Modeling and Simulation Coordination Office* [Online]. Available from: <http://www.acqnotes.com/Attachments/DoD%20M&S%20Glossary%201%20Oct%2011.pdf> [Accessed 10th February 2019].

Wu, P.K. and Bill, R.G. (2008) 'Comparison of simulated wet bench fires with small and intermediate scale fire tests', *Fire and Materials: An International Journal*, 32(8), pp. 445–456 [Online]. Available from: <https://onlinelibrary.wiley.com/doi/pdf/10.1002/fam.975> [Accessed 10th February 2019].