Application of Artificial Intelligence (AI) in Air operations – A special Focus of the Air Power Application in Sri Lanka Air Force

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Abstract*: From the Stone Age humans have immensely worked to convert the physical environment to a more conducive environment. On the contemporary scenario the machine utilization for physical, analytical and logical process have immensely increased to an extent where the application of AI (Artificial Intelligence) or mechanical promptive thinking is essential to replace or substitute human intervention. The writer attempts to emphasize the world trends in artificial intelligence (AI) in military and the possible AI applications in air power for Sri Lanka*.

Keywords – Artificial Intelligence, Air Operations, Simulation, Intelligent agents

I. INTRODUCTION

Humans probably the most amazing creatures in the entire planet have endeavored to be in control of their environment. He did many discoveries from the wheel to the computers and rocket sciences. The invention of the computer has taken this advanced species to a much superior position where he made these machines to compute, think, and act mostly to control the environment on behalf on a far better speed and accuracy. Basically humans made artifacts to be intelligent. This can be called as artificial intelligence.

A. Problem Statement

Sri Lankan military has a lacuna in integrating AI to the military operations while other developed countries do extensive research and development in this discipline

B. Objectives

1. To establish a dedicated AI coordination facility for defence services in Sri Lanka
2. To establish a research and development facility in AI for the defence services in Sri Lanka

C. Methodology

The secondary data was gathered through the government publications, books, proceedings of conferences, journals, online publications, military publications and the data from the previous research work carried out. The writer gathered primary data from the direct participation in military effort during the military operations in Sri Lanka from 2006-2009. Unpublished and published data gathered from secondary sources have been utilized in identifying variables and parsimony. Also the literature survey was taken in to account in testing the findings. The researcher intends to highlight certain concepts in AI and the importance of application in Sri Lankan theatre. Further the researcher intends to emphasize certain AI utilities of developed countries while emphasizing the importance and limited utilization of Sri Lanka. The writer also emphasizes the significance of real time battle management.

Hypothesis: The application of AI will increase the operational potential of Sri Lanka Air Force.

The writer also identifies AI as the independent variable and the operational potential as the dependent variable and the same has been quantified and measured.

H1: μ AI = μ OP (Hypothesis to be tested)
Ho: μ AI $\neq$ μ OP (Hypothesis to be rejected)
μ AI – Application of AI, μ OP – Operational potential

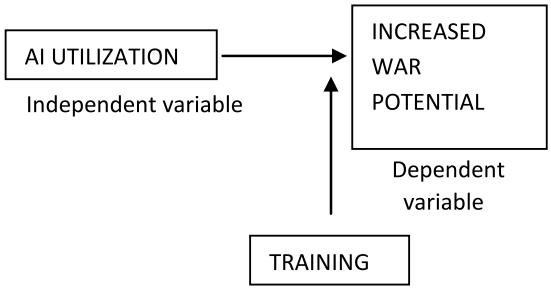
During the process the independent variable has been manipulated to quantify the mission success of the SLAF Operations.

The AI application in Sri Lankan context had been on the lag when compared with the international forum. However consciously or not several limited applications were considered in experimental level. After observing the promising results the tactical level of operation commanders have extensively

used such available applications. The researcher states that a methodical and systematic AI application with multi agent distributed systems in certain automations and various military operations will give Sri Lanka a greater prospect and provincial supremacy, especially in South Asian context.

II. THE SRI LANKAN CONTEXT

The writer attempts to identify the significance of AI (Artificial Intelligence) in air operations. However the theatre that has been studied only stacked to the Sri Lankan context as to reduce the complexity of the applied AI nature in various aspects. This will minimize the number of variables of the study area and only one moderating variable has been considered even though many others are present. In today's context, the warfare has been transformed into more technical and complex form. In this context the humans will not be able to monitor, control or direct these complex environments. Complex Information-based systems at times may lead to a data overload. This was a greater challenge for the humans to intervene into the decision make process. To minimize the risk in error and to ease out the human life the humans accepted AI in his day today life. In this research the writer formulated a theoretical framework as follows



The design of this research was compiled focusing attention to the objectives of the study. Mainly a qualitative analysis was conducted to minimize the ambiguities in mission success. The main purpose of the study was to explore and describe the utilization of AI in Air Operations). The hypothesis has been tested to increase the rigor of the research work. In developed countries such as United States, EMBM (Electromagnetic Battle Management) and JESM (Joint Electromagnetic Spectrum Management) are being considered when planning certain military operations. A similar approach was taken by the GOSL in eliminating the LTTE (Liberation Tigers of Tamil Elam) from Sri Lanka. The early stages of the Elam war were not a success and the war effort was in vain. GOSL (Government of Sri Lanka) failed to eliminate the terrorism from the country by a military perspective. However there had been many inventions and technologies towards the IV stage of Elam war, which enhanced the effectiveness and the efficiency of the armed forces. Especially the air warfare was much different than in the previous war efforts. According to the Command Air Intelligence Officer Sri Lanka Air Force (SLAF), it was a difficult task to pass down the targets to the attack squadrons' securely. So the targets were hand carried to the fighters and attack helicopters by a special representative from the Air Force Head Quarters Colombo. Those targets were neither properly analysed nor descriptive in a pilot perspective. However with the induction of Directorate of Military Intelligence (DMI), these targets were thoroughly analysed and directly transferred to the squadrons via a data link. This system was also linked with the Unmanned Aerial Vehicle (UAV) Squadrons and the Light Transport Squadron (Beach Craft). At the initial phases, the utilization of aerial imagery or reconnaissance carried out by the SLAF was stacked only to the nonmilitary application. With the induction of UAVs and new weapon systems to the SLAF, the application of partial AI distributed systems started to play a vital role even though the AI was not fully integrated. Previously the Sri Lankan military conventionally gathered information and intelligence by various means such Army, Navy or by Air Force intelligence (Mendis,N, 2014). The intelligence gathered will be analysed and interpreted in the Directorate of Military Intelligence (DMI). The main source of gathering this information was through the human agents. However with the extensive utilization in UAVs and Satellite imagery, the target processing and analyzing process was very convincing and methodical. However it was not fully automated though the extensive human resource utilization was handed over to the machines such as UAVs to gather raw data. Especially the Sri Lanka Air Force has focused its attention towards AI. Officers were sent to the Universities to study AI, especially to the University of Moratuwa (UoM). The experts were recruited for new appointments and they were

tasked for research and development in this discipline. So far the application in AI at SLAF is not in the direct AI form, but only in a lament Information technological approach. The basic concept of automating principle has been neglected in many areas and most of the decision makers have been fascinated only by the applied lament technology. Creating intelligence over artifacts or allowing the machines to think and behave themselves rationally has not been given adequate prominence. However, the systems such as AERMS (Aeronautical Engineering Resource Management System), EPAS (Equipment Provisioning and Accounting System), GERMS (General Engineering Resource Management System) reduced the extensive utilization of human intervention in data base management and coordinating and forecasting especially the issues related to the air assets and vehicles. The SLAF has integrated distributed systems with limited AI capability to its system.

III. FUTURE POSSIBILITIES

AI and intelligent agents are the main dimensions of synergy for computer simulation and computer games. They fabricate realism of the physical environment and provide unique opportunities for learning in complex and synthetic operations. Development of agents with advanced cognitive abilities which can handle perception, anticipation or understanding is much difficult. To develop agents who can handle or represent personality, emotion or cultural aspects of individuals and societies will be utmost difficult. In the recent past the transformation of the Society for Modeling and Simulation and varieties such as Agent-Directed Simulation (ADS) has introduced these kinds of innovations. These innovations gave promising synergy of artificial intelligence, simulation, and gaming. This includes simulation of agents, agent-supported simulation, and agent-based simulation.

At present the Sri Lankan military conducting advanced and higher studies for their senior officers, especially in Senior Staff Colleges. These trainings can be incorporated with the war game simulation with liaise relevant technical expertise such as UoM and other software development agencies. This process can simulate the exact battle grounds where the Officers can be tested for their rationale judgment. Here the observers can correct, replay or advice the battle commanders and more importantly supervisors can change the battle field environment at any moment in order to give the trainees a dynamic and challenging situation (Timothy, 2003). The war game simulation is extensively being utilized by many developed countries; Defence Advanced Research Project Agency (DARPA) is the biggest contributor at United States in this sense. The DARPA has come up with many developments in automation. The United States is applying AI in many senses apart from the counter insurgency operations (McAlinden et al., 2009). The Effect Based Operations is a new concept by the United States Air Force (USAF) utilizes and the researchers are promising machine-to-machine intelligence communications and cooperation in this project, which will rely on technologies like artificial intelligence, ontological reasoning, and knowledge-based processing.

IV. RESEARCH AND DEVELOPMENT FACILITY FOR ARTIFICIAL INTELLIGENCE AND THE AI COORDINATION FACILITY FOR NATIONAL CALAMITIES

The AI application in Sri Lankan context had been always lacking. However consciously or not certain limited applications were considered in experimental level. After seeing the promising results the tactical level of operation commanders have extensively used such available applications. The war effort by the Sri Lanka Air Force is one of the classic examples for this. As a result the researcher emphasizes the importance of methodical and systematic AI application in certain automations and various military operations. Also the researcher emphasizes that a research facility to be established to utilize the AI applications in military as in developed countries such as United States of America, Turkey, Netherlands, Germany, Israel etc. In furtherance the researcher highlights the importance of such facility in automating applications in military operations (DARPA facility Arlington). The Sri Lanka has many potential private firms who undertake the similar tasks in simulation such as Virtusa, BPO Connect and SimCentric Technologies. According to Mr Susantha Andradi the Chief Technical Officer from SImCentric Technologies, they are developing soft wares and simulation platforms for US military. Yet the Sri Lankan military could not use these expertises to develop an indigenous AI coordination facility even though all these engineers and designers are Sri Lankans. These companies uses the synthetic environments such as VBS2^{TM,} it's a photo realistic

3D training environment for land, sea and air. It is being utilized by many defence forces for synthetic environments (SEs). VBS2^{TM} itself does not focus on the realism of their virtual actors or AI units in other terms. To cover this gap in realism in Contemporary Operating Environment (COE) certain plugins like CoJACK (Interfacing a cognitive architecture)

As the German Research Center for Artificial Intelligence (Deutsches Forschungszentrum für Künstliche Intelligenz, DFKI) which was founded in 1988, the proposed Sri Lankan research facility should be obviously supported with appropriate budgetary allocation and with adequate infrastructure facility. The computers are the main objects. The Facility to be given a top priority in research and development, and the scholars and academics should be given a chance to work together with the Military. As organizations are inherently distributed the difficulties in integrating and coordinating such facility with limited resources and funds in Sri Lankan context to be mitigated. Distributed AI interacts with the different components of Organisational Intelligence and the following questions to be answered

a). The methods to determine the contributions of Organisational Intelligence to Distributed AI.
b). To ascertain the ways and means of distributed AI benefit the Organisational Intelligence.
c). To determine whether the organisational intelligence as an important distributed AI application.

While all these it is also imperative to consider the following facts in developing such facility,

i). Data Base Management system and knowledgebase management
ii). Modelling and case base handling
iii). Workflow management and conflict resolution

The SLAF has extensively utilized the UAVs and aerial reconnaissance to analyze the battle damage and the aftermaths of the operations, the ground commanders were provided with a real time data link to the battle front. The decisions the commander takes can be very prompt as he sees his battle front live. The artillery and air attacks have been coordinated with the help of these. However the researchers in more advanced countries like Russia and USA seek possibilities to automate the collection and utilization of intelligence in information gathered from many different platforms like multi agent systems and the same will be correlated in several different ways. This will help the human being to make better use of raw sensor data from existing multiplatform, multisource, real-time collection systems. In furtherance this can be utilized to automate intelligence information processing for assessment, cueing, electronic attack, and battle damage assessment.

The AI research and development is utmost important and to be promoted in every academic forum where the new innovations will automatically flow in to the system in the days to come. According to the authors of automated Intelligent Pilots for combat simulation (Randolph M. et.al, 1999) "TACAIR-SOAR is an intelligent, rule-based system that generates believable humanlike behavior for large-scale, distributed military simulations. The innovation of the application is primarily a matter of scale and integration. The system is capable of executing most of the airborne missions that the U.S. military flies" The system is currently deployed at the Oceana Naval Air Station WISSARD (what-if simulation system for advanced research and development) Lab and the Air Force Research Laboratory in Mesa, Arizona. However the Sri Lankan context is very different. The combat aviators are required to physically attend the real situation. Several combat units in Sri Lankan forces will not have a chance to do simulator training due to certain restraints. This will hamper the combat readiness of a Sri Lankan combatant. Present day the AI methodologies are being applied to support decision making at all levels of military operations. Applications being studied include assessing force readiness, reliability and capability; planning complex missions; and integrating data from multiple sources. It is imperative that the application of AI in Sri Lankan context be seriously considered and establishes the AI teaching and learning culture in academic forums. Also it is important to have a proper infrastructure for AI research and development while testing in real time engagements. For this purpose the writer recommends to enact an AI assisted military operations coordinating center with liaise foreign and local academic forums and expertise private

organizations in order to keep the applications up-to-date to enhance the operational potential of Sri Lankan military.

V. CONCLUSION

With the long lasted 30 year war in Sri Lanka, Military has a point to ponder to have a proper joint coordinating center as in many developed countries. This is paramount important to coordinate the usage of AI applications in various disciplines. Especially it is important to understand that the successful war effort in 2009 was due to the cooperated and coordinated battle management of the tri services through lament technology. The same can be developed further though AI if integrated correctly. In a non-conflict scenario the competency maintenance can be done through AI integrated Battle Management Simulation Center where the following roles can be simulated to give adequate training to the combatants and military staff

a). Maritime surveillance
b). Low Intensity Conflict management
c). Boarder protection
d). Against Drug trafficking and human smuggling

The automated data gathering and analyzing should no longer be restricted only to military; the opportunity should be given to the nonmilitary application. This system can be utilized to understand the changes in sea water level or temperature variation. For this purpose the researcher intends to emphasize the importance of a central command and research facility with the appropriate scholars in many disciplines. Especially the Defence Universities like Kotalawala Defence University (KDU) to be introduced and linked with the proposed research facilities in AI and the same to be incorporated with the present day applied AI in different forms. Also the writer concludes that the applied AI can be a potential tool to enhance the combat readiness and operational potential of the combat units, hence that the hypothesis been proved. However the operational potential purely depends on the applied nature of AI and the training of units.

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ACKNOWLEDGEMENT

I extend my profound gratitude and sincere thanks to Prof. Asoka Karunanada for his inspiration and guidance in motivating me to select AI as my research area.

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