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FOREWORD



It is my greatest pleasure and delight to unveil the Volume 7/2022 of the Defence and Security Journal of the Defence Services Command and Staff College (DSCSC), Sri Lanka for the seventh consecutive year. The journal was initially launched as a platform for student officers to exhibit their views, foster a wider understanding and to publish the findings of their analytical studies on contemporary security paradigms and controversies.

Further, this journal is a testimony of contributing to the field of defence and security through research by the student officers, with an emphasis on the national security of Sri Lanka. In a similar vein, the authors have rightly fathomed the present global, regional, political, and security undercurrents along with their developments inclusive of their nexus to the present security texture.

Therefore, this volume contains articles which provides extensive understanding of vital facets of security concerns emanating from conventional and unconventional means. It also integrates the evolving technology as a force multiplier and key issues radiating from regular and irregular threats whilst providing sound guidelines and recommendations to higher defence and policy management to prepare suitable action plans.

I wish to extend my sincere gratitude to the able editorial board headed by Doctor Jorge Cook for their untiring commitment and dedication in bringing out this stimulating publication.

BKGML Rodrigo RSP psc IG

Major General

Commandant

Defence Service Command and Staff College, Sri Lanka

COMPARATIVE CASE STUDIES OF TRANSFORMATION IN NAVIES OF SMALL ISLAND NATIONS

Commodore Buddhika Liyanagamage

ABSTRACT

The Sri Lanka Navy (SLN) is facing evolving and emerging maritime security challenges ranging from drug trafficking via sea routes; marine pollution; human smuggling; illegal, unreported and unregulated fishing; concerns over the emergence of maritime terrorism with asymmetric tactics; and shifting of piracy and armed robbery in its maritime domain. The possibility also exists of illegal exploitation of natural resources due to the lack of available resources to cover its entire maritime domain. In addition, global warming resulting in climate change and sea-level rise could negatively affect security in the Indian Ocean Region (IOR) neighbourhood. This case study looks at how smaller island nations - Seychelles, Mauritius, New Zealand, and Singapore - have equipped their Navies to face the evolving maritime security environment by utilizing available resources. Ultimately, this study recommends that Sri Lanka and its Navy establish effective security measures by implementing strict maritime laws, research and development, maritime partnerships, joint maritime surveillance with the Sri Lanka Air Force, bi-lateral agreements with neighbours to counter Transnational Organized Crimes (TOC), and other non-traditional security threats.

Keywords: Maritime security, Small Islands, Terrorism, Sri Lanka Navy

1. INTRODUCTION

Sri Lanka is geo-strategically situated in a vital connecting node that connects East and West maritime traffic. This strategic location has made the country a major hotspot in the Indian Ocean that fascinated foreign invaders since ancient times as great powers had a keen interest in the country (Kulathunga, 2020). As far as the present situation is concerned, the Sri Lanka Navy shoulders greater responsibility in ensuring maritime defense. At the start of the Tamil insurgency in early 1980s, the Sri Lanka Navy (SLN) was only a ceremonial navy with 4,000 men with few patrol boats which were insufficient to halt Tamil separatist groups from utilizing the North and Northwestern seas around Sri Lanka. However, with the acquisitions of a number of Fast Attack Crafts and other offensive advances, the Navy was able to dominate the sea. Further, with more acquisitions, new strategies, and tactics, the visionary leadership, support of the government, and the fighting spirit of personnel, the Navy was able to defeat the LTTE sea tiger wing at sea.

The concept of security of a country has been defined based on the state's external threats vis-à-vis security. Further, the security concerns of a small state largely depend on the interactions of superpowers or powerful states (Jayasekera, 1991). Historically, small states are subjected to the deterrence theory of powerful states. Being a small island nation and having a small navy, Sri Lanka should possess a relatively strong and active navy that can dominate the maritime domain of Sri Lanka amalgamating Land power and Airpower to face the evolving threats.

2. RESEARCH QUESTION AND METHODOLOGY

This paper explores the main challenges other small state's Navies face and the role of their respective Navies in countering these evolving challenges. Hence, this case study compares how four small island nations-Seychelles, Mauritius, New Zealand, and Singapore-have transformed their navies to face evolving maritime threats. It finds how these small navies have countered their limitations effectively to address evolving threats, and where the Sri Lanka Navy can learn from them. The findings, assumptions, and arguments of the case study would ask the question: Whether the Sri Lanka Navy can adopt similar mechanisms to augment available resources to counter evolving maritime security challenges effectively. This study expects to identify the most viable options that the Sri Lanka Navy has to embrace after the comparison of the four small island navies. The research was carried out as a case study. Secondary sources such as books, published journals, papers, and web articles were referred to compare small island navies in the world.

3. LITERATURE REVIEW

Sea power has become the most fundamental aspect of security and prosperity of many nations as navies are linked to the predominant phenomenon of globalization due to interconnectedness. In the late nineteenth century, Alfred Thayer Mahan opined on the connection between sea power, economic prospects, war, and the need to have a strong navy to link the global economic system (Cave, 2012). Conversely, Sir Julian Corbett stated that a stronger navy would deny another maritime state access to resources of seaborne trade (Cave, 2012). Similarly, Theodore Roosevelt was also a firm believer in having a strong navy to achieve sea power. Moreover, sea power enables a nation to secure both littoral seas and open oceans as well

as provides naval support for Humanitarian And Disaster Relief (HADR) operations (Solan, 2017). Hence, command of the sea is very vital for any navy where sea control and sea denial are vital concepts in the 21st century.

The Indian Ocean Region (IOR) is a vast theater connecting the East and West gaining importance due to increased global ship traffic which bridges all shipping lanes. This geopolitical significance, along with the possession of key natural resources has made this region a hotspot in world politics (Roy-Chaudhury, 1998). Additionally, changing security dynamics in the IOR and the threat to the freedom of navigation from non-traditional activities have increased uncertainty to concentrate more on maritime security to ensure a stabilized region for the global economy (Baruah, 2021).

Despite the above developments, the major Sea Lane which connects the East and West is at the border of Sri Lanka's Southern Territorial Sea and comes within Sri Lanka's 24 nautical miles Contiguous Zone.

The slightest disruption of SLOC may have a significant impact on global trade (Joseph, 2015). Therefore, having well-trained and technically skilled personnel, and a modernized navy with better surveillance systems is very important as Sri Lanka's maritime area is very decisive compared to the land, to face potential conventional and non-conventional maritime threats (Liyanagamage, 2018). Accordingly, Sri Lanka Navy's Maritime Strategy 2025 aims to modernize the Navy not only to face the domestic challenges but identify the importance to be stronger in order to face regional threats in a broader sense.

Geoffrey Till (2003) writes, "a small navy is one with both limited means and aspirations." Further, Till argues that automatically categorizing a small navy as a weak navy or a large navy as a powerful one is inaccurate; for example, despite Singapore being a small island nation, its Navy is much more powerful than some blue-water navies such as the Australian Navy. Hence, Till suggests considering the geographic range, function, size of the fleet, capacity, advances in high technology, and reputation as indicators to determine whether a navy is powerful or weak, regardless of size (Mulqueen et al., 2014).

The transformation of small navies must be carried out systematically with efficiency, effectiveness, and productivity. Mulqueen and Warburton (2016) argue, "Systematic innovation ... provides small navies a coherent framework to more closely align their mission, strategy and operational

achievements to needs and skills ... while enhancing military capability.” With a nod to real-world economic constraints, Mulqueen and Warburton (2016) note that governments should carefully profile expenditure cuts without hampering national security and for “small navies operating [under] modest ... defense budgets while facing imminent fleet replacement ... the challenge is especially onerous.” Further to the systematic transformation, small island nations face a variety of security issues that need prompt counter action. In hindsight, countries with high economic stability can focus on transforming their navies, whereas countries with slow economic growth must carefully balance their defense budgets and threat perceptions to achieve maritime objectives.

3.1 Seychelles and Mauritius

Seychelles and Mauritius are two small island nations with relatively smaller navies. Both nations have been plagued with Transnational Organized Crimes (TOC) for years, mainly maritime piracy. These two maritime nations have had serious challenges because of the large EEZ, troubled territorial waters, tiny islands, the geostrategic environment, national interests, and security imperatives. In addition, Seychelles and Mauritius heavily depend on their blue economy (sustainable use of ocean resources for economic growth), and the small navy/coast guard in each country has a major role to play in ensuring maritime security, which directly affects their respective economies. Similarly, the navies/coast guards of Seychelles and Mauritius are critical in combating maritime threats to ensure regional security as well as national security.

The issue of Somali piracy affects both Seychelles and Mauritius. Both these countries are politically very stable and prosperous countries with good governance and effective law enforcement - unlike Somalia. The lack of a government and a proper judicial system in Somalia has put additional burdens on Seychelles and Mauritius as they have undertaken prosecution and jailing of pirates in their countries (Malcolm and Murday, 2007).

At the same time, Seychelles and Mauritius lack sufficient resources to combat security issues. In addition, the small population, large coastline, and a weak GDP, as illustrated in Table 1, highlight some of the key factors affecting Seychelles' and Mauritius' security.

Table 1. Comparison between Seychelles and Mauritius

Area	Seychelles	Mauritius
Population	84,700	1.3 million
Total land area	451 km ²	2040 km ²
EEZ	1.3 m km ²	1.9 m km ²
GDP	USD 1.56 billion	USD 13.55 billion

Source: Malcolm and Murday (2007)

Nonetheless, Seychelles and Mauritius have managed to overcome maritime security challenges. Both Seychelles and Mauritius have turned to sustainable economic development efforts, especially in the blue economy, as they believe sustainability could increase or would be a central route to maritime security if they have stable economies. Seychelles and Mauritius have implemented “a combination of development and implementation of new strategies, the establishment or reform of security structures, embracing multinational partnerships, alongside the implementation of a variety of networking practices” (Malcolm and Murday, 2007). These networking practices are an important element these small nations have implemented as can be seen through collaborating in capacity-building initiatives, membership and active participation in international Small Island Developing States (SIDS) working groups, and maritime partnerships with regional countries.

3.2 Seychelles’ Response to Maritime Security Issues

Seychelles has many organizations under the Seychelles People’s Defense Forces (SPDF) to ensure maritime security. Under the SPDF, the Seychelles Coast Guard fights against piracy, the Air Force provides maritime surveillance, and the elite anti-piracy unit of the army is combating TOC groups. To regulate maritime activities, the Seychelles Maritime Safety Administration (SMSA) has been established, and it operates independently from the Maritime Police Investigation Unit that handles safety and security issues at sea (Malcolm and Murday, 2007). This combined organization structure under SPDF has enabled easy command and control. Figure 1 depicts the Seychelles anti-piracy structure.

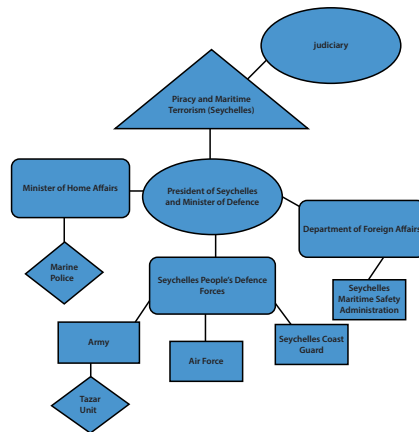


Figure 1: Seychelles' key anti-piracy governance structure (Malcolm and Murday, 2007).

At the same time, Seychelles' government has introduced new strategies both domestically and internationally to further strengthen security. First, the reform of the Seychelles judiciary resulted in a reduction of corruption. Second, international mobilization, support of the Indian Ocean Commission, maritime cooperation, and maritime partnerships with neighbours such as Comoros, Madagascar, and Mauritius have helped to ensure maritime security. Third, the establishment of two regional centers for fusion and operational coordination has also enhanced cooperation.

3.3 Mauritius' Response to Maritime Security Issues

Similar to the initiatives of Seychelles' security forces and other agencies to ensure maritime security, the Mauritius government has also taken various measures to ensure effective maritime security. The establishment of an Anti-Drug and Smuggling Unit (ADSU) to coordinate with the Mauritius National Coast Guard brings easy command and control. Similarly, the integration of the Maritime Air Squadron, the Patrol Vessel Squadron, and the Marine Special Force to combat TOC creates a dynamic operational environment. The Mauritius Revenue Authority and the ADSU's joint operations have enabled the capture of drugs, which revealed a need for regional strategy. The establishment of the Police Helicopter Squadron, the acquisition of fast interceptor craft, and getting a medium-sized OPV and Dornier maritime patrol aircraft from India, and a Radar network with AIS facility further strengthened detection capabilities (ibid).

The practice of close cooperation with the United States, India, and with neighboring countries has also resulted in improved capacity building in the maritime domain. To gainfully utilize resources, Mauritius conducted a maritime capability audit in the IOR and presided over sub-regional organization to increase the development of the nexus between maritime safety and security. Like Seychelles' anti-piracy structure, Mauritius has also introduced a new structure for anti-drug trafficking as shown in Figure 2.

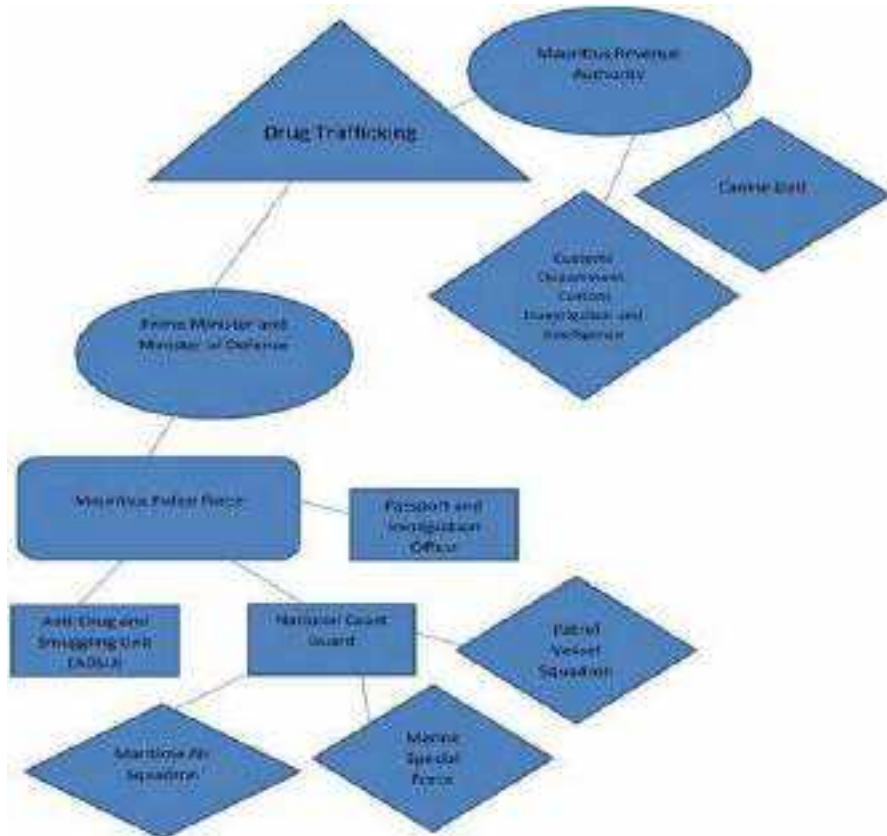


Figure 2: Mauritius' key anti-drugs trafficking governance structure (Malcolm and Murday, 2007).

3.4 The Royal New Zealand Navy

New Zealand is an inherently maritime island nation with one of the largest EEZ. The Royal New Zealand Navy (RNZN) has 11 major vessels and has set an exquisite “goal of being the best small nation navy in the world” (Paget, 2016). Though small in size, the RNZN is capable of operating throughout the Asia-Pacific Region, including the Southern Ocean. It also interoperates

with the United States and Australia to mitigate its limited resources. The primary role of the RNZN involves customs patrols and combat surveillance in the EEZ. The challenges to the RNZN include an EEZ that is 15 times the total land area; the world's ninth-longest coastline; and 99 percent of its trade is via sea. The great distance to its nearest ally, Australia (1,609 kilometers), and to major international trade markets also makes it even more difficult for the RNZN to achieve its missions - to say nothing of its ambition to be the best small navy on Earth.

In response, the RNZN has increased its combat force by upgrading its fleet with the USD 296 million projects. The two Anzac class frigates of the RNZN have vertical launch missile systems, high caliber guns, torpedoes, sonars, missile defense systems, shipborne helicopters, and the endurance to remain at sea for long periods. In addition to the Anzac class frigates, the RNZN has two OPVs, which can remain in sea for much longer periods, and four inshore patrol vessels (IPV) that operate close to the coast. The IPVs conduct boarding operations and have a crew of 20 with four additional government agency personnel. Induction of a littoral warfare support force further strengthens the RNZN fleet, which conducts mine clearance, diving operations, survey, search and rescue/recovery operations, underwater explosives ordinance disposal, and workshop facilities. To support its fleet at sea, the RNZN has two logistic ships capable of sea lift/amphibious support; a command and control center; additional crew, logistics, medical facilities including a self-contained hospital with surgical facility, carrying vehicles, cargo, and tanks; and conventional port infrastructure (ibid). This increased force structure has enabled the RNZN to face evolving maritime challenges in its domain.

The protection of New Zealand's maritime resources is another primary role of the RNZN. Commercial fishing harvests 1 billion NZD of fish each year, and the Quota Management System (QMS) prevents depletion of fish stocks. Under the QMS, the Commanding Officer of any RNZN ship is considered a fishery officer with legal powers under New Zealand's fishery act. In addition, the RNZN conducts combined maritime patrols with other nations, especially Australia, to improve maritime security. The implementation of the Western Pacific Fisheries Convention has also provided additional protection for the marine environment as Pacific Islanders are obliged to respect the prevention of marine resources (Paget, 2016). Another initiative implemented by the RNZN is maritime cooperation domestically and internationally in countering evolving threats to New Zealand. The 2016 defense white paper of the New Zealand government specifies,

New Zealand will continue to protect and advance its interests by maintaining strong international relationships, with Australia in particular, and with its South Pacific partners, with whom it maintains a range of important constitutional and historical links. While New Zealand has an array of international relationships, it makes independent policy decisions consistent with its values, interests and size (NZ Defence White Paper, 2016)

Additionally, the RNZN gets support from the Royal New Zealand Air Force for surveillance in the region to augment its limited capabilities. Similarly, New Zealand's agencies maintain sufficient reserve personnel to provide support in customs and bio-security operations, HADR, and in response to natural disasters with sufficient equipment. Further, the RNZN and other maritime agencies like customs and border protection combine to counter human smuggling and drug/fire arms trafficking into New Zealand. Maritime diplomacy and partnerships, including the Pacific partnerships, are "designed to strengthen multilateral relationships with regional friends, partners and allies, and to maintain and enhance regional security and stability" (Paget, 2016). Apart from the Pacific partnerships, the RNZN has participated in many multilateral exercises, multinational operations, and support efforts to counter challenges, safety operations to protect trade and SLOCs, and counter piracy and maritime security operations. To further enhance cooperation, the establishment of the Joint Task Force enables effective, efficient, credible, and increased combat utility (Paget, 2016). The close defense cooperation with the U.S. Navy, with the RAN, and with other navies has brought successes in enhancing operating environment capability.

3.5 The Republic of Singapore Navy

The Republic of Singapore Navy (RSN) is a powerful navy though small in size. In 1999, U.S. defense analysts rated the RSN above much larger Southeast Asian giants as the "number one naval force in the region" (Kho, 2014). The RSN has a unique ability for force projection into distant waters, though limited in size, because of its fleet of submarines, and its "deft use of technology, human capital and diplomacy" (Kho, 2014). The RSN has only 4,500 naval personnel and 30 ships, dedicated to upholding Singapore's five foreign policy principles: the good-neighbour policy, relevance and usefulness, sense of community, multilateralism, and defense. The close geographical proximity to neighbours, as well as its traditional and non-

traditional security threats, have made Singapore emphasize more interstate cooperation via strict implementation of international law in dealing with challenges (Kho, 2014).

The RSN aligns with regional and international security partnerships as its secondary focus while its primary focus centers on protection of SLOCs and seaward defense. When moving toward multilateralism, Singapore became a maritime regional hub of security cooperation, hosting the WPNS, the Multilateral Tactical Training Centre Exercise, the 17th Proliferation Security Initiative Exercise Deep Sabre, and the ReCAP meeting on Regional Cooperation Agreement on Combating Piracy and Armed Robbery against ships in Asia, where the SLN is also a partner (Kho, 2014). Figure 3 shows how Singapore inclined toward multilateralism from bilateral initiatives.

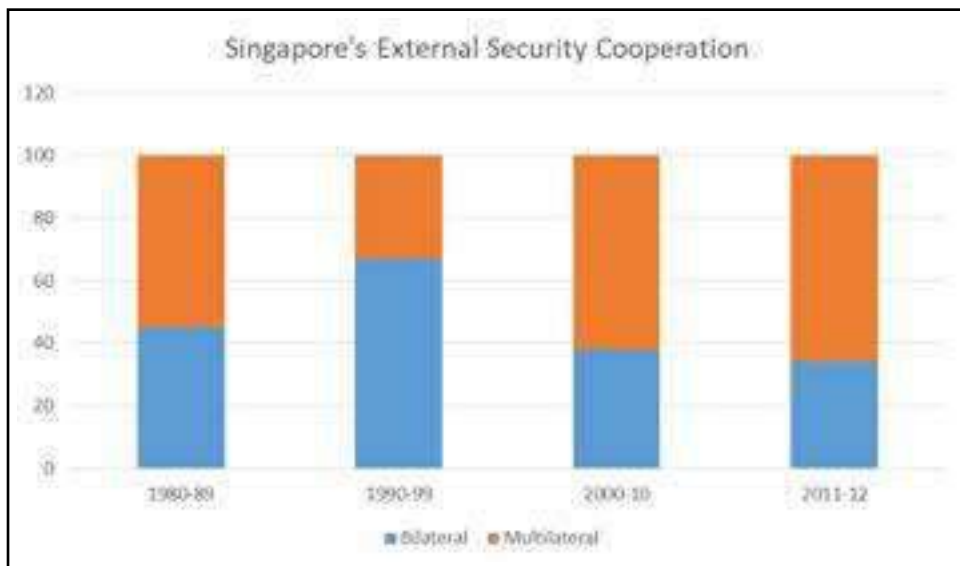


Figure 3: Scope of Singapore's external security cooperation (Kho, 2014).

Another key initiative made by the RSN is to depend more on technology as a force multiplier without compromising overall operational effectiveness to offset its limitations. Swee Lean Collin Koh points out, "For example, through extensive shipboard automation the Endurance-class landing platform docks are manned by a crew of 65 as opposed to 130 onboard in the old Country-class landing ship tanks" (Kho, 2014). Acquiring eight new littoral mission vessels from Australia, the RSN combined integrated bridge systems and a lean crew to counter their manpower shortage as a key strategy (Yeo, 2017). Similarly, the development of the unmanned surface vessel to improve homeland defense and maritime security is also

another achievement by the RSN (Singapore Navy, 2018). The enhancement of offensive and defensive missile systems onboard the RSN ships-the supersonic anti-ship cruise missile, and the land-attack cruise missile, for example-are known to be the best in the region. Additionally, the RSN's network-centric integrated knowledge command and control, unmanned technologies, and air-independent submarine propulsion are also new technological advances of the RSN.

In addition to these innovative technological solutions, indigenous developments and cost cuttings have enabled the RSN to compensate for other shortcomings. The RSN not only optimized available capabilities but reduced expenditure of the defense dollar. Before deciding on acquiring new defense equipment, the RSN think tanks explore the feasibility to upgrade the existing equipment through indigenous solutions instead. The development of an indigenous climate-optimized ship paint scheme that lasts longer than the previous old non-tropical version, is one good example. The RSN has not only saved money but also manpower by merging two separate landing squadrons as a single unit, combined maritime security task force with civilian agencies, the coast guard, the police, and the port authority (Kho, 2014). These innovations greatly contribute to overall operational effectiveness of the RSN.

Along with security cooperation, partnerships with other maritime nations, technological advances, the RSN's ability "to punch above its weight, through deft utilization of technology, human capital and diplomacy, as well as selective contributions to niche areas of multilateral security," (Kho, 2014) allowed it to overcome physical limitations. Overall, Singapore is contributing purposefully to ensure international and regional security.

4. ANALYSIS

After the discussion of how smaller island nations and smaller countries with weak economies have and are transforming into more dependable sea units with the capability to address evolving security issues, findings from these case studies can be beneficial to figure out a suitable model for the SLN. The comparison of the four countries' navies/coast guards reveals that Seychelles and Mauritius can be categorized as smaller nations with only a small coast guard. As Singapore and New Zealand are bigger than Seychelles and Mauritius not only in size but also in GDP, they can be considered as capable of supporting much more powerful navies.

Though Singapore has a smaller coastline than New Zealand, its navy is more powerful than the RNZN. Singapore is the only country of the four to have submarines and is superior in GDP, too. The naval and air assets and manpower of the RSN are well above the RNZN's, but both Seychelles and Mauritius have smaller coast guard forces with fewer personnel. Though the GDP of Mauritius is higher than that of Seychelles, there is not much difference between the two countries in maritime assets. These nations demonstrate that close collaborations make a huge difference to a maritime nation's capabilities. Table 2 summarizes strategies adopted by Seychelles, Mauritius, Singapore, and New Zealand in order to have an effective maritime security environment regardless of resources.

Table 2. Analysis of the four case studies prepared by the author.

Strategy	Seychelles	Mauritius	New Zealand	Singapore
Issues *	<ul style="list-style-type: none"> *Piracy. *Illegal fishing. *Small population. *Small coast guard. *Large coastline. 	<ul style="list-style-type: none"> *Drug trafficking. *Piracy. *Illegal fishing. *Small population. *Small coast guard. *Large coastline. 	<ul style="list-style-type: none"> *Largest EEZ. *Limited resources. *Small navy. *99% maritime trade. * 1,609 kilometers to nearest ally. 	<ul style="list-style-type: none"> *Limited population. * Small navy/coast guard
Initiatives *	<ul style="list-style-type: none"> Reformed security structures. *Multinational partnerships. *Capacity building. *Active participation in SIDS working groups. *Emphasis to increase blue economy. *Strengthened judiciary. *Reduced corruption. 	<ul style="list-style-type: none"> *Reformed security structures. *Multinational partnerships. *Capacity building. *Active participation in SIDS working groups. *Emphasis to increase blue economy. * Anti-drug smuggling unit. *Created Marine Special Force. *Joint operation between law enforcement agencies. 	<ul style="list-style-type: none"> *Quota management system of fishing. *Strict on Illegal fishing. *Counter TOC initiatives. *Maritime diplomacy enhancements. *Multilateral relationships. *Enhanced regional security and stability. *Safety operations. *Enhanced capacity of pacific islands. 	<ul style="list-style-type: none"> *Force projection into distant waters. *Practicing foreign policy principles. *Focus on deterrence and defense principles. *Interstate cooperation. *Implementation of international law.
Maritime cooperation /partnerships	<ul style="list-style-type: none"> * Regional countries. 	<ul style="list-style-type: none"> *With U.S. and India. * Regional countries. 	<ul style="list-style-type: none"> *With U.S. and Australia. *Combined maritime patrols. *Pacific partnerships. 	<ul style="list-style-type: none"> *Multilateralism and security cooperation. *Alignment with regional and international security partnerships.
Capacity building	<ul style="list-style-type: none"> *Regional countries. 	<ul style="list-style-type: none"> *With Indian Navy and the US Navy. 	<ul style="list-style-type: none"> *Defense cooperation with U.S., France, and Australia. 	<ul style="list-style-type: none"> *Defense cooperation with the US and ASEAN. *Symposia, workshops, regional Recap centers.

Strategy	Seychelles	Mauritius	New Zealand	Singapore
Defense enhancements	*Regional centers for fusion and operational cooperation. *New anti-piracy structure.	*New Police Helicopter squadron. *New interceptor craft. *MPA. *New OPV. *Radar network with AIS. *New anti-drug trafficking structure.	*Increased combat force capabilities. *Ships with more endurance to remain in sea. *Less crew onboard ships. *New littoral warfare support force. *New logistic vessels to support other sea units. *Upgrade of fleet. *Reserve personnel for bio security. *HADR operations. *Established joint task force. *More emphasis on electronic lines of communications.	*Use of technology as a force multiplier. *Extensive shipborne automation. *Integrated systems. *Development of USVs. *Reduction of crew. *Indigenous developments. *Innovative technical developments. *Optimization of available resources. * Feasibility of upgrading existing equipment before importing. *Merging units/forces/task groups, etc. *C2 systems. *Missile systems. *Air-independent propulsions.

5. RECOMMENDATIONS

- Seychelles initiatives such as legal reforms, Maritime Safety Administration, and jointness among Army and Airforce with the Navy and the Coast Guard are very practical initiatives for Sri Lanka to consider.
- Sri Lanka could follow Mauritius’ anti-drug trafficking model as drug trafficking has been a concern to the entire country. Further, close cooperation with the neighbours and like-minded nations have benefited Mauritius, and Sri Lanka can also implement similar strategies.
- Establish Quota Management Sector in the fisheries to avoid depletion of fish stocks and regulations to prevent IUU fishing similar to New Zealand. Further, the SLN can also empower Commanding Officers as fishery officers to monitor illegal activities in the maritime domain.
- Like the RNZN, the SLN can also conduct joint maritime patrols with her powerful neighbour India and apply a similar approach with India to counter Indian fishermen poaching illegally in Sri Lankan waters.

- The SLN, similar to the RNZN must get support from the Air Force for surveillance, and maintain HADR readiness and response. Additionally, the SLN should combine with other maritime agencies like customs, narcotic bureau, State Intelligence, and Coast Guard to counter human smuggling and drug/fire arms trafficking.
- Enhance maritime diplomacy and partnerships to strengthen multilateral relationships with regional friends, partners and allies, and to maintain and enhance regional security and stability like New Zealand.
- The SLN should follow the unique ability of the RSN for force projection into distant waters, through its fleet and deft use of technology, human capital and diplomacy using five foreign policy principles.
- Innovative technological solutions, research and development initiatives, indigenous developments and cost cuttings have yielded successes to the RSN. Similarly, the SLN should also follow the RSN way to minimize the unnecessary financial expenditures.

6. CONCLUSION

The transformation of small navies must be conducted systematically without hampering operational effectiveness and national security. Countries with good economies may acquire new equipment and ships. However, for those countries with weak GDP, careful planning and optimizing available resources are very important factors. Seychelles and Mauritius have leaned towards sustainable economic development as a tool for greater maritime security advances. The RNZN has concentrated more on regional and international cooperation while the RSN has mainly relied on technological advances. The SLN is on the verge of transformation and needs to apply these aspects to counter a weak GDP, a small navy, a large maritime domain, active TOC, illegal fishing, and a large naval force with more land-warfare oriented sailors. It is recommended, from the four case studies, the SLN apply maritime cooperation initiatives, capacity building measures, defense enhancements, optimum utilization of resources, innovations, integrations, and right sizing of manpower in order to transform itself into a more powerful navy.

Also noteworthy is the example of Singapore, a nation that has successfully mitigated tensions between neighbours through its foreign policy. Singapore

has been practicing five foreign policy principles—the good-neighbor policy, relevance and usefulness, sense of community, multilateralism, and defense—with its neighbours and superpowers without aligning with a single country. If Sri Lanka adopts a similar approach, it can be neutral if there is a war between China and India. Other than non-aligned status, Sri Lanka can take a lesson from how Seychelles and Mauritius are overcoming their limitations. Both these countries have implemented new strategies such as the reduction of corruption, effective law enforcement and proper judiciary systems, good governance, prioritization of a sustainable blue economy, multinational partnerships, and active participation in International Small Island Developing States' working groups to have better relations with the IOR countries.

Other than foreign policy initiatives, the initiatives by the Singapore Navy to enhance maritime security is a good example for all small developing navies to counter probable security concerns in the IOR. The RSN overcomes its limitations to have a better maritime security in its waters through the use of submarines for power projection, deft use of technology as a force multiplier, strict implementation of international law, regional and international security partnerships, memberships in maritime organizations, indigenous developments, reduction of expenditure by optimizing available resources, and cost cutting by reducing manpower. These initiatives summarize the basis of the recommendations for the SLN and on which it can improve.

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INDUCTION OF RADIO FREQUENCY IDENTIFICATION (RFID) TECHNOLOGY FOR SUSTAINMENT: COMPREHENSIVE GUIDELINES FOR SRI LANKA ARMY

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ABSTRACT

This study aims to provide comprehensive guidelines for the induction of RFID application to the Sri Lanka Army. Even though more mechanisms were implemented to enhance the Army's operational readiness with the advanced technological background, those systems did not reach expected outcomes due to a lack of necessary guidelines. Further, there was a lack of policies, procedures, and necessary means to identify and analyse needs to induct suitable RFID systems to manage men and equipment within the Army. During the research, the main concern was given to identify the User awareness, readiness, job relevance, and security of the RFID application used. To gather data for the close-ended questioner was used. A limited number of interviews were conducted with personnel involved in the field of Information Technology and the Inventory Control Process of the Sri Lanka Army. Data gathered from the questionnaire was the main instrument providing quantitative data. Secondary data was collected from books on this subject matter, publications, research studies, journals, and websites published by the local and foreign intellectuals of the subjects. It presents rich data results from literature review and questionnaire methods. The data was analysed using MS Excel. Finally, the researcher identified that even though the workforce is ready to transfer to RFID applications, leading infrastructure and relevant policies are needed for further enhancement. The workforce that is willing to use RFID need sound knowledge of the RFID applications. Based on those findings, comprehensive guidelines are recommended to set out a framework to induct an RFID system for the sustainment of the Sri Lanka Army. By enhancing the capabilities and developing the system, Sri Lanka Army can provide an effective and efficient service with higher productivity.

Keywords: Radio Frequency Identification Device, User readiness, User awareness, Operational readiness, Security

1. INTRODUCTION

The management of military personnel and inventories in both war and peace is essential to ensure the forces' operational and administrative security and proper function. In that, identifying the location of troops, the proper inventory procedures for military equipment, and monitoring mechanisms are essential to confirm the accountability and security of troops and inventories in forces at all aspects of the operation (Manzoor & Cong, 2009). It is vital to ensure security and avoid the possibility of arms leakage due to the manual entry of data into computer systems or books (Sri Lanka Army, 2015). Thus, it is essential to have suitable electronic inventory procedures to monitor and audit the military establishment's arms and ammunition.

The proper audit and monitoring mechanism of small arms in all aspects of the operation will ensure that the weapons belonging to security forces will not be used for criminal activities under any circumstances. Atkinol(2007) shows that identifying the location of the friendly force during urban fighting by utilising an RFID mechanism will enhance the protection of one's own forces and enhance the cooperation among the troops. Thus, it is suitable to have a Radio Frequency Identification Device (RFID) based mechanism which can be used to effectively manage men and material within the Sri Lanka Army. It will facilitate the enhancement of the operational readiness and the capacities of troops in any circumstances. All data gathered will be regularly updated to a database and this will lead to a close monitoring to manage troops in the field and military inventories in the stores.

1.1 Background of the Study

In the past, different methods were used to identify objects and products. Initially, people used different names for different objects to identify the value of their communications and provide helpful information to each other. With the Industrial Revolution, many innovations were introduced to the identified and monitored inventory and stock procedures. With time, computerized inventory systems were identified and this made a significant impact on military inventory procedures. The first RFID was used in a friend or foe identification system by the British during the Second World War, and in 1974 the first barcode reader was introduced by British supermarkets since both public and private sectors use various versions of RFID for their relevant operation in services (Michael et al., 2009).

By analysing the current situation in the country and the future application of technology for military operation and inventory procedures, the Sri Lanka Army needs a much-advanced system to manage and monitor the movement of troops and equipment on the ground. Thus, to achieve effective and accountable monitoring and identification procedure, it is essential to have an efficient RFID mechanism. In that aspect, the comprehensive guideline for the implementation of RFID is essential. Thus, this study focuses on providing comprehensive guidelines for Sri Lanka Army to induct radio frequency identification (RFID) technology for sustainment in its operation.

1.2 Research Problem

With technological developments, the Sri Lanka Army also introduced many advanced technological methods to manage troops and equipment in the field. Most existing systems do not fulfil the expected outcomes. For example, the Sri Lanka Army Signal Corps introduced the automated weapon management system in 2009 to ensure proper documentation and inventory procedure. Further, according to the Army performance report (Sri Lanka Army, 2015), the issues related to small arms need to be solved to ensure the accountability and security of the arms. The automated system that exists is concerned about documentation, while physical availability needs to be checked manually. Thus, it is an RFID mechanism to monitor equipment and troops that will enhance the forces' operational readiness. The lack of policies, procedures and necessary guidelines needs to be identified and analysed to induct suitable RFID systems to manage men and equipment within the Army.

1.3 Research Questions

Research questions based on the objectives and research problem are:

- How does RFID affect the improvement of the efficiency of the SL Army?
- Can RFID be used to track the troops and the equipment of the SL Army?
- What is the level of user awareness in the RFID solutions in the Army?
- Does the SL Army have policies and procedures to implement RFID solutions?

1.4 Research Objectives

With a thorough study on the topic, the following objectives have been identified:

- Explore the ways of improving the efficiency of the SL Army by adding RFIDs
- Identify the methods of tracking troops and equipment and considering the impact on security
- Identify the level of user awareness of RFID application in the troop's management and inventory control

- Identity the readiness to use RFID applications in terms of policies and procedures
- Provide recommendations for the proper usage of RFID applications for the sustainment of the Sri Lanka Army

2. LITERATURE REVIEW

Radio Frequency Identification (RFID) is generally defined as a small tag consisting of a small chip and an antenna that transmits radio waves from the RFID reader, functioning as a sender, processor, and information storage (Jones et al., 2007). The first RFID application was introduced by the Los Alamos Scientific Laboratories in 1977. Thereafter, RFID technology and its usage were developed from a simple mechanism to a more advanced technological application. Thus, its effect enhances the supply chain management of developing trades (Wang, 2012).

2.1 RFID Systems

The RFID device contains a scanning antenna and a transceiver, a transponder, and the RFID tag. The scanning antenna and transceiver is a wireless communication mode that receives and transmits the identification signal simultaneously. The transponder is the device that connects the Tag and receiver of the system. The most important component is the tag used for monitoring objects. The tag is attached to the object and carries the unique identification number (Aktinol, 2007). Adeniyi 2016 explains that Radio Frequency Identification (RFID) is the term used to identify the non-contacting technologies which are used radio waves for the automatic identification of objects, including people.

2.2 RFID Applications in Security Forces

Access control is one of the major reasons where RFID applications are used. In the modern context, most of the high-security areas that belong to the military are secured by using RFID applications and devices. The security forces usually use an access control method powered by RFID applications to ensure the security of the premises (Smiley, S. 2017). Aktinol (2007) shows that RFID application has become an essential element of current logistics and the military by the US Marines. It is widely used to reduce wastefulness and improve the maintenance of general supplies. By implementing RFID

in inventory control of armoury, the military obtains assistance by having a tighter inventory control.

US Marines Corps use RFID applications to monitor small arms deliveries to soldiers in combat situations and elsewhere. Atkinol also mentions that RFID technology is beneficial to screen and keep in touch with small arms for the duration of combat situations. It also ensures the proper distribution of all kinds of small arms during the combat situation where the distribution rate is very high among the troops. Generally, many applications are used in such situations, such as barcode solutions, but there were many disputes found in that method. For example, a barcode would be unworkable and cumbersome in a situation where many soldiers are in want of small arms and there is limited time available for the reader to swipe the code. To avoid such failures, the RFID tags can be fixed to the wooden or plastic parts of small arms such as rifles and machine guns to avoid uninterrupted contact with the weapons' metal components.

3. RESEARCH PHILOSOPHY

Before carrying out any empirical study, it is necessary to identify the research approach and paradigm to carry out the sequential study. Research philosophies can be categorized as positivism, interpretative, realism, and pragmatism. This study can be characterized as positivism research philosophy because the researcher identified proper objectives and research questions. Furthermore, the researcher can identify a clear relationship between variables (Saundar at el,2015).

3.1 Research Approach

Plans and procedures used for data collection and analysis were based on several assumptions known as the research approach (Collis and Hussey, 2009). Two research approaches can be identified. In the Deductive research method, available theories and appropriate research, strategy is used to develop the hypothesis, and then the study is carried out to accept or reject the hypothesis. This study mainly focuses on finding the relationship of induction of radio frequency identification (RFID) technology for sustainment. Thus, researcher uses the deductive approach to find the relationship with the factors towards the RFID application in the SL Army.

3.2 Research Design

This study will follow the mixed-mode research style to present the findings, which initially examined the common opinion related to RFID security, job relevance, applicability, and user awareness of the RFID system. Questionnaires were distributed among the staff who work in the service unit in the army to identify organizational readiness, users' awareness, applicability, job relevance, and security and safety about the RFID system. Further to the recommendation of the RFID application, the interview was carried out by using expert staff officers working in the field of IT. Moreover, to make comprehensive guidelines for RFID application for sustainment, secondary data was collected from research articles and books related to the RFID application in various fields.

3.3 Sampling

The soldiers working in Central Arms Depot were selected to collect relevant information regarding user awareness and job relevance. In that process, 50 army personnel from various ranks were engaged. Further study about necessary developments needed to implement RFID were obtained by interviewing Staff officers directly involved in small arms control. To find the system's organizational readiness and safety, the experts in signal corps were selected during the study. In that, 50 army personnel directly involved in the implication of an automated system for Central Arms Depot were selected.

3.4 Data Collection Method

During the study, structured questionnaires were used as the primary data collection method. To collect the demographical and general data of the participant, ten close-ended questions were prepared. To find user awareness, five close-ended questions were used. Moreover, to measure job reliance and organizational readiness, five close-ended questions were used. The safety and security of the RFID application were examined using a further five close-ended questions. Interviews were conducted to find the comprehensive guidelines for the RFID applications. For the ease of understanding and gather reliable data, Sinhala translated questionnaires were distributed among the participants, while all the interviews were conducted in the English medium. Other than the demographical and

general questions, all other questions were designed according to Sekaran and Bougie (2013), with a five-point Likert scale to study how strongly they agreed or disagreed with factors.

3.5 Conceptual Framework

The conceptual framework of this study is as follows:

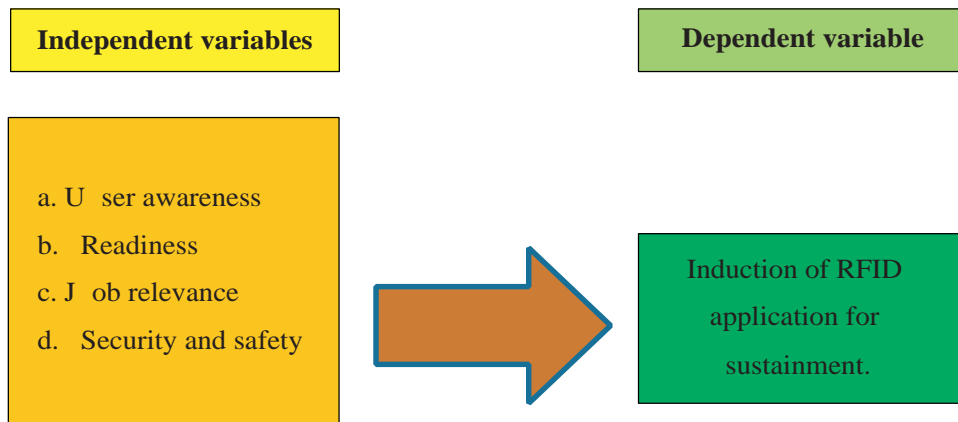


Figure1: Conceptual Framework

Source: Developed by Author, 2021

3.6 Analysis of Qualitative Data

The questionnaire was shared, and the gathered quantitative data was analysed. It showed that there was a positive trend towards implementing RFID application to enhance user awareness, readiness, job relevance, and security. Further, it was identified that the knowledge, skill, technology and lack of relevant policies are a major challenge that affects the effective employment of the RFID application in future operations. Thereby, to study further on this matter, the researcher conducted three structured interviews with SLSC and SLAOC Senior Officials involved in the operational and decision-making process in new technology and inventory control.

4. FINDINGS AND DISCUSSIONS

4.1 Findings

According to the data presentation of the research, most key findings were discovered under the general information gathered under the questionnaire. Accordingly, Army personnel involved in the material management and field of IT are between the ages of 26 - 35 years. They are a relatively young workforce and would be needed to be mature in the effective use of RFID application in the future. Moreover, the majority of the workforce had an excellent educational background which was rich with technical qualifications. As per the research findings, major research outcomes have been identified to prove the research objectives. This study mainly focused on user awareness, job relevance, readiness, and security while implementing RFID applications in Sri Lanka Army. In addition, the in-depth study mainly addressed identifying issues related to RFID applications in the tracking of troops and equipment and challenges of using RFID applications in terms of policies and procedures for sustainment. The following findings were important for this study to achieve research objectives and provide recommendations for future applications.

4.2 User Awareness

User awareness is the most required factor during the implementation of the RFID application to the organization. Even though the staff working in the Sri Lanka Army have background knowledge in the field of IT and other supportive systems, they do not have sufficient knowledge to handle the RFID devices.

4.3 Readiness

Before implementing new technology related to RFID application, consideration must be given to the organizational readiness towards the new system. During the research, the organizational support, budgetary allocation, higher-level commander's intent, and availability of organizational resources are monitored according to the need for RFID application.

4.4 Job Relevance

According to the analysed data, it was possible to identify that RFID application is very much valuable for military applications. Data gathered shows that RFID can be used for the inventory control process. During the inventory control, many ledgers and many manual methods are used for the accuracy and safety of the material. Thus, RFID application can be easily used to minimize the time consumption and ensure the safety of the items without mistakes. By minimizing the time of issuing items to the troops, the Army's operational readiness may increase. It is not only for administrative activities that RFID applications can be used. They can also be used for operational activities, but most of the personnel do not have sufficient knowledge of it.

4.5 Security and Safety

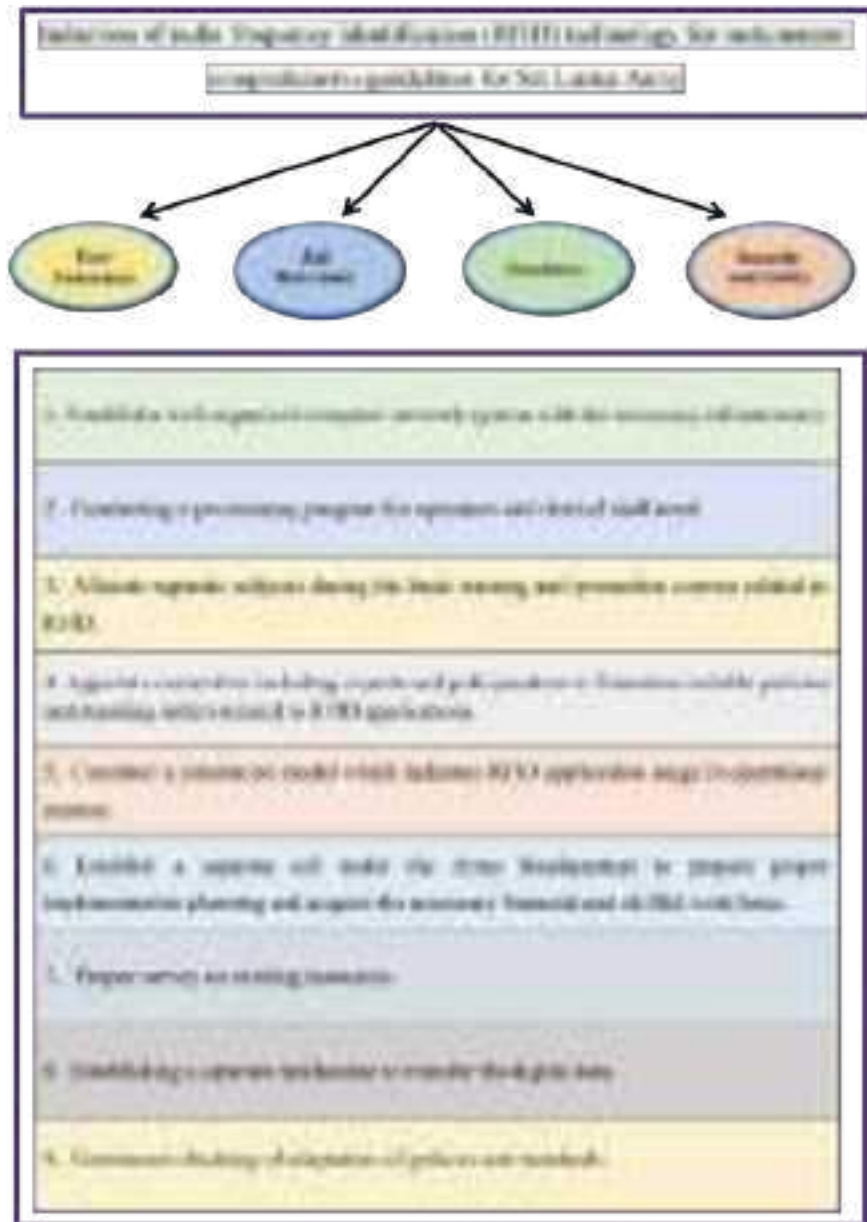
In any military organization, security and safety are the most important factors. Moreover, the operational security of every operation must be to achieve the relevant objectives in operation. Lapses within the system will jeopardize all the operational status within a short time. RFID application is unique in nature as it is difficult for someone else to track. Thus, the operational secrecy can be maintained without any disturbance. During the study, it was identified that most of the responders marked that the RFID application would enhance operational security during the operations. Further, it was highlighted that a separate military channel was needed to operate RFID applications to minimize the threats and ensure the system's security.

5. RECOMMENDATION AND CONCLUSION

During the research, the main concern was the user awareness, readiness, job relevance, safety, and security of using RFID applications for operational and administrative purposes. In that aspect, key findings were discovered to formulate comprehensive guidelines for RFID application in SL Army.

The study is based on the army personnel working in the field of IT and inventory control processes. According to the finding, it was obvious that the workforce involved in IT and material management are well experienced and have sound knowledge with technical qualifications related to the

field of IT. They are well experienced in their subject area. The researcher recommends having an advanced enlistment process that concerns the IT knowledge and experience in the relevant field. A computerised network system is an essential part of the RFID application. Thus, it is required to have a sophisticated computerised network system that can be handled the RFID application. Moreover, to ensure the smooth functioning of the system, it is recommended that a well-organized computer network system with the necessary infrastructure to function the RFID applications be obtained.



To enhance the knowledge related to RFID application, conducting a programme for operators and clerical staff is essential to provide subject knowledge during the basic training and promotion courses. This will enhance ground troops' knowledge of RFID applications. Further, it is necessary to have a monitoring mechanism to check the policies and standards laid down to mitigate digital vulnerabilities. Moreover, before implementation in operational matters, it is important to commence RFID applications in the inventory control process and for administration purposes, to gain experience. To have smooth functioning of the system, it is required to establish a separate cell under the Army Headquarters.

This study was conducted under the Covid 19 pandemic situation. During the data collection process, the researcher faced many difficulties in collecting relevant data. As a future research suggestion, the same research can be conducted by taking many participants and using a statistical data analysis tool to improve the outcome.

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FEASIBILITY OF UTILIZING SLAF AIRCRAFT TO IMPROVE EFFECTIVENESS OF ARTIFICIAL RAINMAKING OVER SRI LANKAN CATCHMENTS

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ABSTRACT

As a tropical island nation, Sri Lanka receives its annual rainfall by means of monsoonal, convectional, and depressional rainfall. Further, it directly impacts economy, agriculture and power generation in the country. The adverse effects could have been seen during the severe drought periods in 2001, 2004, 2012 and 2014. Artificial rainmaking has emerged globally as a viable solution to mitigate the severity of the drought.

Artificial rainmaking was experimented within Sri Lanka in 2019 with a Thailand specialized group as a project of the Ceylon Electricity Board. This study was carried out as a case study on artificial rainmaking and examined the problems concerning the utilization of SLAF aircraft to achieve its anticipated outcome. The researcher used a qualitative approach to the research. Primary data collection was done through organized interviews of open-ended questions and the secondary data collection was done from the cloud seeding operation data and various literature.

The researcher concluded by giving recommendations for the feasibility of using SLAF aircraft for artificial rainmaking operations in Sri Lanka.

Key Words: Cloud seeding, Rainmaking, Catchment area, Aircraft, Sri Lanka

1. INTRODUCTION

The history of artificial rainmaking goes back to 1946 with the experiments to produce clouds and rain. The concepts of cloud condensation were developed, and various experiments were conducted on whether human activities in artificial nature can make rain. Within Sri Lanka, rainmaking had been carried out in 1980 during an extreme drought.

Cloud seeding and rainmaking were initiated for different purposes. Most of the countries in the world employ cloud seeding techniques for drought remediation. In addition to that, increasing snowpack for deriving freshwater and hail suppression is done in European countries. Further, Russia used cloud seeding in a particular case to remove radioactive pollutants out of the sky and away from the population by forcing rain (Fontana, 2013). However, artificial rainmaking to increase the accumulation in water reservoirs that

generate hydroelectricity is also conducted in some countries, for example, India, Venezuela, South Korea and Thailand (Simms, 2010; Shivaji Rao, 2007; Chirapant, 2020).

The principle of cloud seeding is to provide a favourable atmosphere with tiny particles to attract available humidity and become condensed and grow to be a cloud. These tiny particles are called Cloud Condensation Nuclei (CCN). The current cloud seeding operations in the world use Silver Iodide (AgI) as the most common ingredient. It is amplified with dry ice during seeding operations. Hygroscopic cloud seeding is the other method that uses finely powdered salt (NaCl) together with Urea, calcium oxide (CaO) and dry ice. This technique originated in Thailand and is more suitable in tropical countries where the air is too warm to create ice crystals (Adulyadej, 2005).

In March 2019, the Ceylon Electricity Board projected a cloud seeding trial exercise under the supervision of the Department of Royal Rainmaking and Agricultural Aviation (DRRAA) of Thailand. The project aimed at increasing rain for the catchment area of Lakshapana complex, Castlereagh and Maussakele. The project was conducted with a group of experts from the Ceylon Electricity Board, the Meteorological Department, Mahaweli Authority and Sri Lanka Air Force. The medium of delivering the seeding material was conducted by a locally modified light transport aircraft of the Sri Lanka Air Force. Aircraft, aircrew, specialist team and required equipment and seeding material were assembled at Ratmalana airport, where SLAF undertook flight planning and conducted the cloud seeding operation. Subsequently, in May 2019, another trial operation was carried out without DRRAA specialists. However, the second operation was not successful in making rain over the designated catchment area.

1.1 Problem Statement

As a case study, this research focused on the rainmaking operation conducted between March and May 2019. The project was planned to increase the rainfall over catchment areas where water reservoirs are situated for hydropower generation. Such rainfall enhancements are getting common all over the world as a solution for drought conditions due to global warming (Griffith and Solak, 1999; Kim et al., 2020). However, in March 2019, the first operation resulted in only 7.5mm for roughly 45 minutes of rain falling over the Maussakele region. The project's planned goal was not met.

Furthermore, another trial exercise was conducted in May without the actual presence of the Thailand specialised group. Favourable conditions were not met, and the second exercise was abandoned without results.

A light transport aircraft serving in Sri Lanka Air Force was utilised for the particular rainmaking operation with some modifications to disperse seeding materials out to the immediate surrounding atmosphere. The aircraft was stationed at Ratmalana airport. It took about 20 minutes for the aircraft to reach the initial seeding area and an additional 10 minutes to reach the catchment area. Further, approximately 1000kg of seeding material were airlifted per sortie.

2. LITERATURE REVIEW

2.1 Artificial Rainmaking

Humans have long attempted to increase rain by lighting fires, firing cannons, producing electric discharges with kites, firing guns and rockets, ringing church bells, and praying. However, in recent years, methods based on physical processes of rain formation, such as the fact that a suitable cloud can be made to release its precipitation by introducing artificial nuclei, have been practised. The possibility of expanding this technique to produce economically increased rainfall has sparked a lot of interest as well as much debate. Further, advanced experiments on using Pulse Laser technology to stimulate rain are also in progress in some countries (Ohshiro, 2018).

According to Pelley (2016) and Choudhury (1987), the following assumptions incorporate modern rainmaking experiments:

- That the presence of ice crystals in a supercooled cloud, or the presence of relatively large water droplets, is required to initiate the collision and coalescence process. For the reason that these agents are naturally deficient, some clouds precipitate inefficiently or not at all.
- This deficiency can be corrected by artificially seeding clouds with dry ice (solid carbon dioxide) or silver iodide to produce ice crystals or by introducing water droplets or large hygroscopic nuclei such as powdered salt.

The cloud seeding process used in need of undermentioned applications.

2.2 Increasing Precipitation

Cloud seeding would be most commonly used to increase precipitation, which is possible with both warm and cold clouds. There are two primary methods for increasing precipitation. One, hygroscopic seeding, has an impact on warm cloud processes. The other type of seeding, glaciogenic seeding, initiates cold cloud processes. Though both techniques can be helpful at times, one can be used more effectively than the other in most cases. Furthermore, either technology can be used from the ground (ground-based) or an aircraft.

2.3 Enhancing Snowfall

According to Silverman (2001), Glaciogenic seeding can be used to increase precipitation from stratiform and orographic clouds as well. In such cases, seeding can be done using either ground-based or airborne methods. Increased snowpack and spring runoff increase subsequent water supplies for hydropower. In addition to reducing the need for expensive alternative energy sources, cloud seeding increases water/snow availability for recreational and environmental purposes.

2.4 Enhancing Rainfall

During the warm seasons, efforts to increase rainfall are typically directed at convective clouds. While such clouds can theoretically be seeded using ground-based equipment, targeting them from an aircraft is much more efficient and accurate. It is usually possible to affect the cloud by releasing a seeding agent in sub-cloud updrafts or by dropping seeding agents directly into the cloud's upper regions. Warm-season glaciogenic seeding is commonly used to treat supercooled cumulus clouds, either by releasing the ice-forming seeding agent into the updraft beneath the actively growing cumulus or by dropping the nucleating agent directly into the supercooled cloud top. The seeding agents can create ice at much higher temperatures than the natural process. This is how glaciogenic seeding gives the treated cloud an advantage in precipitation production.

When clouds do not grow tall and cold enough to produce precipitation, it may be possible to stimulate precipitation growth by seeding these warm clouds with hygroscopic seeding agents. Through the stimulation of warm

cloud precipitation processes, this approach can be pretty successful. Hygroscopic seeding is typically performed by aircraft flying in sub-cloud updrafts to influence the initial cloud droplet development that takes place in this area.

2.5 Cloud Seeding Methods

According to the atmospheric conditions, suitability and geographical conditions, Malik et al. (2018) described three methods by which cloud seeding could be done: Static Cloud Seeding; Dynamic Cloud Seeding; Hygroscopic Cloud Seeding.

2.6 Static Cloud Seeding

This process entails dispersing a chemical into the clouds, such as silver iodide. The silver iodide acts as a crystal, allowing moisture to condense around it. The water vapour is already in the clouds, but silver iodide makes rain clouds more efficient at discharging their water. The time window for cloud seeding tends to be limited to the static mode of cloud seeding, which has been shown to trigger the predicted changes in cloud microstructure, such as improved absorptions of ice crystals, decreased supercooled liquid water content and faster precipitation element generation in both cumuli and orographic clouds. Those clouds are generally formed continentally, and the cloud base is relatively cold. The maximum temperature of clouds ranges from -10 0C to -25 0C.

2.7 Dynamic Cloud Seeding

Dynamic cloud seeding aims to increase vertical air currents, which allows more water to flow through the clouds and result in more rain. Ice crystals are used in dynamic cloud seeding, up to 100 times more than in static cloud seeding. Since it is dependent on a series of events operating correctly, the mechanism is called more dynamic than static clouding seeding. According to Malik *et al.* (2018), dynamic cloud seeding is less dependable than static cloud seeding.

2.8 Hygroscopic Cloud Seeding

Hygroscopic cloud seeding aims to increase rainfall by encouraging the coalescence process with salt nuclei flare burning or a fine spray of highly concentrated salt solution. Hygroscopic seeding could give benefit from increasing rain either by introducing embryos to which rain droplets form or by expanding the initial size of rain droplets and their distribution to accelerate the cloud condensations process (Cooper et al., 1997). Generally, static cloud seeding is considered cold cloud seeding and hygroscopic cloud seeding is warm cloud seeding.

2.9 TECHNIQUE ADOPTED IN SRI LANKA

Royal Rainmaking Technology was invented by His Majesty King Bhumibol Adulyadej of Thailand. The technology was patented in 2005 after long-lasting experiments in Thailand as well as in other countries. The unique feature of the Royal Rainmaking Technology is that the atmospheric condition requirements are more suitable to be employed in tropical and sub-tropical countries, where the temperature is moderate to high and the available relative humidity is above 40%. These preconditions are suitable for warm cloud seeding.

According to the Thai King (2005), there are mainly three (03) basic steps in rainmaking; triggering, fattening and attacking. However, he comprehensively described cloud seeding in warm clouds, cold clouds, and combinations in six (06) steps.

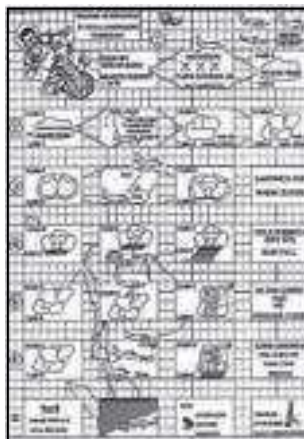


Figure 1: Royal Rainmaking Technology

Source: US 2005/005.6705 A1 Patent Application Publication Mar. 17, 2005 Sheet 2 of 4

In the Sri Lankan context, the requirement was to enhance rainfall in the catchment areas of Maussakele and Castlereagh reservoirs. There, the conditions were more suitable for warm cloud seeding as per the assessment of DRRAA experts. They considered employing only triggering, fattening and attacking in four steps adding Dry Ice as a Cold treatment for rain.

Cloud seeding around the world is conducted in either of two ways, by light aircraft or by ground-based systems. Targeting clouds using aircraft is more efficient and precise, but it is also the most expensive method. Ground-based systems generate fine particles that burn the granular form of the chemical; they are carried downwind and upwards by air currents. Another method of delivery from the ground is rocket launchers, which are commonly utilized in China (Jones, 2011). However, according to Gasser (2016) and Munoz (2017), it was identified that hydrographic seeding is more effective for a confined area of the catchment. In contrast, ground generators or rockets disperse seeding chemicals to the atmosphere but would have given less effectiveness in triggering rain clouds.

During the rainmaking operation conducted in Sri Lanka, the Y-12 II aircraft was utilized to deliver seeding material. SLAF was able to modify one of its Y-12 II aircraft with the consultation of DRRAA – Thailand. The DRRAA utilizes a variety of aircraft according to different phases of seeding and distance from the airfield to the seeding area. They use Cessna 208 Caravan, CASA C-212-100/300 Aviocar and CASA CN-235 aircraft for cloud seeding operations in Thailand (DRRAA, 2021). Similarly, small aircraft are widely used for the method of cold cloud seeding, which utilizes silver iodide (AgI) flares.

4. METHODOLOGY

4.1 Research Design

An inductive approach was used in the study to find solutions to the existing phenomenon. Thus, it helped to find answers to the exploratory research questions methodically. The study was conducted through a case study strategy to develop an inductively derived solution from the collected data. It expected to gather the required data based on interviews and a systematic literature review. Further, it used qualitative data to explore why specific observable facts are required, and the study had paid attention to similar

cases of cloud seeding in different countries and used the data to derive contributing explanations.

The researcher developed the theoretical framework based on literature-identified factors of cloud seeding and artificial rainmaking. As a result, the following conceptual framework helped to uncover and test answers to the study's research questions.

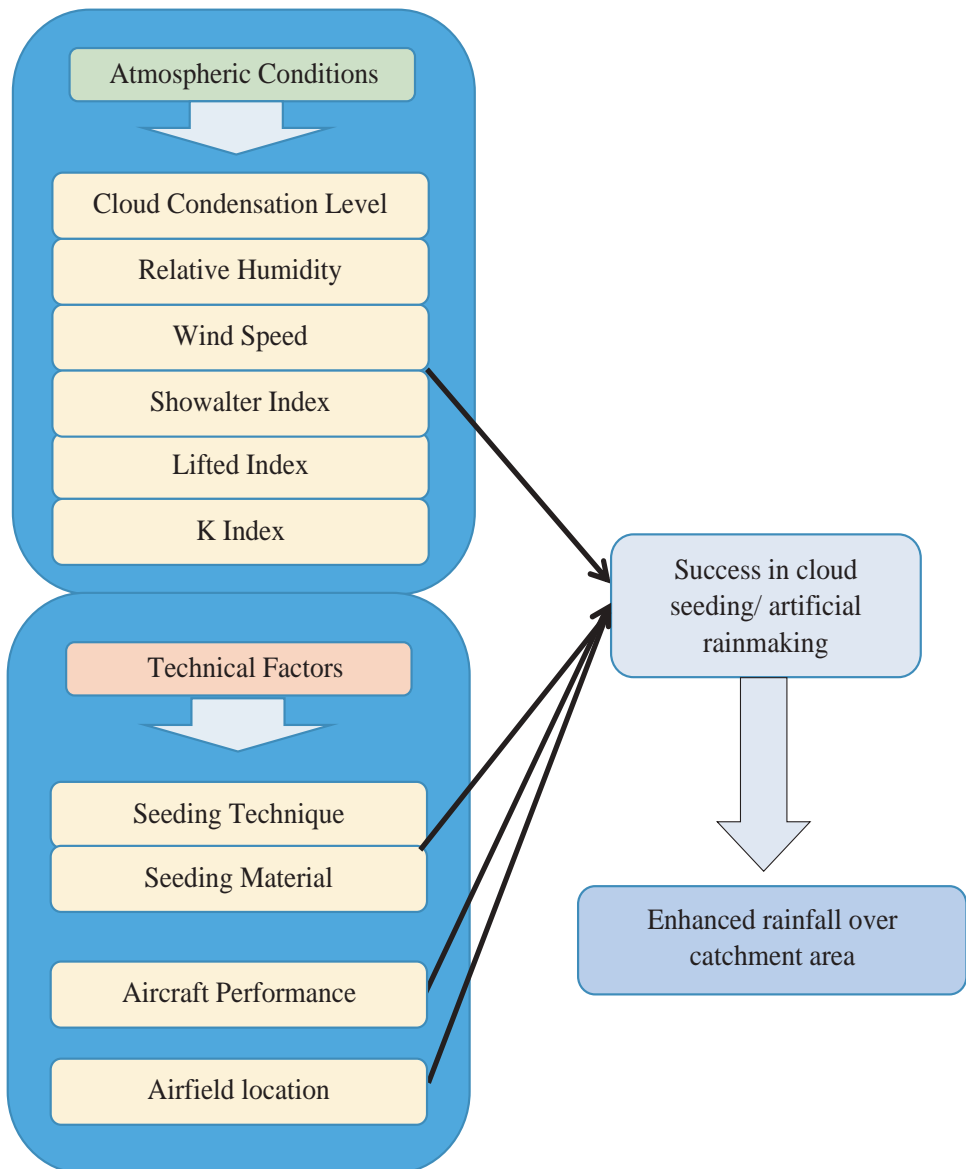


Figure 2: Conceptual Framework

Source: Author (2021)

5. FINDINGS AND DISCUSSION

5.1 Atmospheric Conditions vs Technical Factors

According to the literature, it was found that atmospheric conditions have a prominent and direct influence on cloud seeding, irrespective of the geographic location. Humidity plays a significant role in cloud seeding decision-making; subsequent atmospheric factors such as Cloud Condensation Level (CCL), Lifted index, Showalter index, K index, and wind speed affect indirectly and latently on deciding and conducting cloud seeding.

Cloud seeding operation in Sri Lanka was conducted considering all the factors of nature required to enhance natural rainfall. The engineers of CEB decided on the intended target area as per their requirement of augmenting rainfall to hydropower generation. The time period selected to conduct the cloud seeding operation was during the inter-monsoon; generally, southwestern Sri Lanka experiences afternoon thundershowers due to being surrounded by the ocean and high temperatures in morning hours that trigger convective currents to create rapid rising thunder clouds. The topography of the country gives a boost to the vertical build of the cloud since the mountain ranges facing the winds help the rise of humidified air above the catchment areas of Maussakale and Castlereagh. In those conditions, the rain would fall towards the west of Samanala and Haputhale mountain ranges, leaving no rain towards the east of the mountain range at Maussakale and Castlereagh.

The patent received by King Bhumibol for the invention of a specific cloud seeding method indicated different techniques of utilising chemical or seeding material for different scenarios of geographic and environments. It described the use of calcium oxide (CaO), urea and dry ice to traverse the thundercloud over a mountain and develop over an intended target area before it matures and fall as rain. However, the analysis revealed that the specialist team of DRRAA and CEB engineers failed to adopt the postulated techniques in King Bhumibol's rainmaking model. Applying the most suitable seeding technique together with optimum use of the aircraft would have provided expected rainfall to the catchment area. Further, the employment of the SLAF aircraft was the primary factor in such an outcome.

5.2 Aircraft Capability

Cloud seeding and weather modification could be done in various ways. It was evident that most countries and operators prefer to use aircraft to disperse seeding materials directly into the atmosphere or to the developed cloud. In the Sri Lankan operation seeding was carried out using SLAF light transport aircraft Y-12. Comparing the aircraft utilisation of Thailand and Jordan relating to this study, Thailand DRRAA utilised a range of aircraft as per the cloud development prediction and real-time weather radar observations. As per King Bhumibol's model, DRRAA mainly used at least two (02) light aircraft for each phase of operation. Further, as per the expected rainfall and area of catchment, DRRAA used larger aircraft which was incorporated with primary light aircraft. This availability of aircraft gave a higher probability of making rain over an intended area as the scientists have the flexibility and quick application of seeding materials as real-time weather radar provided the accurate development of thunder clouds.

During the analysis, it had arisen that the fact of aircraft capability in the means of weight carrying capacity and advanced avionics such as GPWS, Weather radar and autopilot systems affected the rainmaking operation in Sri Lanka. From the view of crew and aircraft safety, it seemed very important to utilise a plane with such advanced avionics and sensors where the pilots had to fly inside clouds in between mountainous terrain at low altitudes. Lack of visual or ground references could make the pilots' decision making restricted to a narrow flight path so that they are unable to penetrate the clouds and reach the intended target area of the catchment.

Finally, it was clarified that if the number of aircraft utilised in Sri Lanka had increased to more than two or a larger capacity carrying aircraft used for the seeding process, it would alter the operation results. Nevertheless, according to the analysis, larger aircraft could not operate safely at low levels over the mountainous area. Hence, it is not feasible to use An-32 or C-130 aircraft in cloud seeding operations in Sri Lanka. Further, the light aircraft should be equipped with advanced avionics and sensors as discovered during the analysis.

5.3 Airfield Location and Distance to Catchment Area

Aircraft have a prime disadvantage and limitation on the dependency of a suitable airfield to take-off and landing. In addition to that, specific

operations like the rainmaking project and the availability of appropriate storage facilities for chemicals (seeding material) are to be considered. Endurance or the loitering time of the aircraft is an inherently limiting factor that decides the distance an aircraft can travel from its originating airfield.

From analysing the secondary data, it was found that the outcome of the rainmaking operation of Sri Lanka did not have an effect on the airfield location and distance to the catchment. It is further justified by the literature that, since the target catchment area of Sri Lanka is about 40-50 nautical miles from Ratmalana airport, Y-12 light transport aircraft would not have any difficulty reaching the seeding area and return with sufficient loitering time over the planned area. Considering the airfield locations in Sri Lanka, the Ratmalana airfield is the most suitable and closest location for the specific seeding and catchment area. Even if a closer location is available, the material reloading time would be expended when using one Y-12 aircraft for cloud seeding.

However, primary data obtained through interviews suggested that rainmaking could be utilised to enhance rainfall for agricultural requirements in the country. In that perspective, the airfield location would have significant importance rather than operating from Ratmalana airport as it was done during the rainmaking operation in 2019.

Since this particular case of enhancing rainfall over Maussakale and Castlereagh reservoirs was solely done on the requirement of CEB, as the aircraft was operated from Ratmalana airport, the airfield location and distance to catchment did not have any significant effect in Sri Lanka.

5.4 Synergy of Stakeholders

Cloud seeding and artificial rainmaking are conducted for various applications around the world. Literature indicates that enhancing hydroelectricity power generation is just one application. In contrast, most countries utilise cloud seeding to augment agriculture and irrigation systems, weather modifications to prevent fog, hail storms and alter adverse weather affecting a specific region.

The analysis revealed that planning, coordination and effective use of limited resources of rainmaking operation would give more benefit to agriculture and irrigation in drought areas in Sri Lanka, especially during dry seasons.

However, during the Sri Lankan rainmaking operation, the DRRAA team and CEB specialists omit the importance of utilising the technology as well as the SLAF aircraft for a more significant benefit for the country. In this context, primary data suggests the need for the establishment of a panel of specialists from all relevant fields of authority such as the Ministry of Power and Renewable Energy, Department of Meteorology, Department of Irrigation, Sri Lanka Air Force and scientists in related fields.

6. CONCLUSION

During the study, it was found that there are atmospheric factors as well as technical factors that affect the success or failure of artificial rainmaking. According to literature and data from Thailand and Jordan, it was further identified that cloud seeding using aircraft is more effective rather than other ground methods. Additionally, the cases compared with the Sri Lankan case where the operation was conducted according to a standard process of warm cloud seeding invented by King Bhumibol of Thailand.

The researcher isolated the technical factor, which focused on the aircraft that could not deliver the required weight of seeding material within the suitable time to the assigned cloud seeding area and the catchment area. Further, the SLAF Y-12 aircraft was not equipped with weather radar, GPWS or autopilot system, which limited the pilots' decision making and flying inside clouds in dangerous terrain over the central hills of Sri Lanka. In addition to that, the distance from the airfield to the catchment area was identified as a factor of influence in successful rainmaking operations. However, in the Sri Lankan context, it was not affecting the cloud seeding operation conducted in this particular case.

While assessing the failure factors of the SLAF aircraft used in the Sri Lankan operation in 2019, the researcher found the conditions for the feasibility of utilising SLAF aircraft in future cloud seeding operations.

- SLAF Y-12 aircraft would be suitable to undertake cloud seeding operations as they would modify or upgrade and install advanced sensor systems like weather radar, GPWS and autopilot systems. When the pilots get more information and warnings about their environment, the seeding process will be successful.

- SLAF Y-12 aircraft have limited cargo capacity. In order to deliver seeding materials to the assigned cloud seeding area and the catchment area without delay during the sequence of cloud seeding phases, SLAF would employ at least two modified or upgraded Y-12 aircraft in each stage of cloud seeding.

7. RECOMMENDATIONS

Studying all the factors and conditions that support enhancing effective rainmaking over Sri Lankan catchments by SLAF aircraft, the following recommendations were made to suit the feasibility of SLAF Y-12 aircraft utilisation in future cloud seeding for rainmaking operations:

- To modify available Y-12 aircraft or to purchase upgraded Y-12 aircraft with weather radar, Ground Proximity Warning System and autopilot system. It is further recommended that these aircraft are to be dedicated for the cloud seeding operations in Sri Lanka.
- To employ a minimum of two Y-12 aircraft for each phase of cloud seeding operation.

In addition to testing the feasibility and draw recommendations on utilising SLAF aircraft, the following recommendations were made after analysing primary and secondary data:

- To conduct further research on artificial rainmaking using other methods such as ground-fired flare rockets and drones to acquire upper atmosphere data and remotely disperse seeding materials.
- To study expanding the benefits of artificial rainmaking for irrigation and agricultural purposes.
- To establish a coalition organisation to develop artificial rainmaking in Sri Lanka comprising of experts from the Ministry of Power and Renewable Energy, Department of Meteorology, Department of Irrigation, Sri Lanka Air Force and scientists in related fields.

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THE FUTURE OF URBAN WARFARE: THE DEVELOPMENT OF TRAINING STRATEGY

Major MGJS Manangoda, RWP psc SF

ABSTRACT

People try to live together creating community groups. With population growth there is the provision of mutual support which helps to develop their livelihood. As a result of growing different community groups, different kinds of cities are created, and people move to those urban cities from rural areas. Therefore, different threats are caused to the urban localities so that urban communities are required to be prepared for different forms of urban warfare threats in order to sustain their lives. This research focuses on the future of urban warfare with a special reference to the development of a training strategy. In order to conduct this research, two key areas such as training curriculum development and the infrastructure development related to urban warfare training were identified. The study followed a mixed method approach, and the primary data was collected by both qualitative and quantitative methods. The quantitative data was collected through a questionnaire survey and a structured questionnaire which were instruments in data collection. The qualitative data was collected through interview methods with a support of an interview guide. The sample group for the questionnaire survey were soldiers of an Urban Fighting Squadron of Sri Lanka Army Special Forces, and the interviews were conducted with the urban fighting and counter terrorist specialists. The study outcome showed insufficiency of the current training curriculum and training infrastructure for urban warfare training in countering contemporary threats.

Key Words: Urban Fighting, Special Forces, Training Curriculum Development, Training Infrastructure Development.

1. INTRODUCTION

In ancient times, most people moved into the rural areas. With population growth, people try to move to urban areas from rural areas. In the past, social conflicts were different, and people tried to acquire other lands to fulfil their space requirements. However, it changed with time and people now try to fulfil their other requirements rather than acquiring large land areas. This is a key change that occurred with the development of the urban community. In the present context, the urban community moves to mega cities. Their lifestyle is complicated on a daily basis, and all those complexities direct people to engage in different terrorist activities to fulfil their needs and requirements. The War concept has changed from jungle warfare to urban warfare. In the present context, people try to move to megacities rather than living in jungle areas or rural areas. In past, World War I and II, Vietnam War, and others, occurred due to the desire to capture large areas

of land, but in the present-day context, like the Syrian War, Mumbai attack, Donetsk Airport attack, and others, they targeted specific points or urban areas instead of capturing large areas of lands.

After the successful completion of three decades of terrorism, the Sri Lanka Armed Forces are shifting from jungle operations to urban operations. The main reason is that most of the security operations take place in urban terrains and also there can be numerous terrorist activities in urbanized terrains. Hence, the Sri Lankan Army (SLA) Special Forces (SF) established the Urban Fighting Squadron (UF Sqn) in 2012 having understood future threats. The SF have got the capability of fighting on any platform with a high degree of capabilities.

Hence, the main tasks of the UF Sqn are to conduct specialized surgical urban operations such as Military Operations in Urban Terrains (MOUT), Limited Direct Action (DA), Intelligence Base Operations (IBO), Counter Insurgency Operations (COIN), Special Reconnaissance and Surveillance (rec & surv), Search and Rescue Operations (SAR), Seizure of Vulnerable Points (VP) /Key Facilities, Assist Disaster Relief Operations and Training and Development Urban Fighting (UF) skills within SF. To maintain a high degree of professionalism and to face future threats in any urban terrain, urban fighters are required to undergo training involving the development of personal skills, firing techniques, Closer Quarter Battle (CQB) capabilities, mission planning, use of modern surveillance devices and equipment, and intelligence gathering. SF's UF Sqn was established to effectively counterterrorism in any urban environment. Consequently, identifying the level of existing training curriculum is of utmost importance to find out the gap through an in-depth analytical study in order to develop and enhance capabilities to cope successfully with dynamic urban warfare in Sri Lanka in the future. Therefore, this research focuses on encountering future urban warfare by developing a training strategy with a distinctive reference to an UF Sqn of Sri Lanka Army Special Forces.

2. RESEARCH OBJECTIVES

The research mainly focuses on three objectives:

- To identify the future of urban warfare in the context of Sri Lanka and identify the existing urban warfare training challenges.

- To identify the level of the existing urban warfare training of the UF Sqn of SF
- To identify specific training areas which need improvements and development of a training strategy to overcome future challenges.

3. RESEARCH QUESTIONS

The research questions are:

Main Question

- How is an urban fighting training strategy developed in order to enhance urban fighting capabilities in UF Sqn of SF?
- What are the existing challenges of urban warfare and how does it affect Sri Lanka?

Sub Questions

- What is the level of the existing urban fighting training of the UF Sqn?
- What are the specific training areas that need improvement in order to face contemporary challenges?

4. DEVELOPMENT OF TRAINING CURRICULUM FOR URBAN WARFARE

The urban operations are more difficult than other warfare because of their nature and high complexity. Most of urban warfare strategies are not successful, but western armies learnt how to do it well confidently. However, the complexity of urban warfare is not new, and those complexities can be overcome through hard training, changing combat mind-sets and the technological innovations (Betz & Stanford-Tuck, 2019). The Israeli Defence Force (IDF) is the largest urban warfare training in the world, and this is a good opportunity to train urban fighting operation using CQB tactics. IDF is the most important training programme and urban fighter should focus on high moral standards integrating other tactics (Niksch, 2017). Therefore, the training strategy to develop training related to urban warfare should focus on skill enhancement, development of technical aspects and focus on intelligence to take actions as quickly as possible (Niksch, 2017).

The most important revision of the operation doctrine of the warfare is urban operations (Joint Chiefs of Staff, 2013). The proposed Rules of Engagement (ROE) try to protect the civilians and non-combatants in the battlefield. Specially, in the urban operations, it is important to focus on the mission objectives and that is the only way of achieving mission objectives (Joint Chiefs of Staff, 2020). Those doctrines mainly target tactics, techniques and procedures (TTPs), Standards Operating Procedures (SOPs), operational designs and doctrines (Blanchford & Ti, 2020). The successful operations mainly focus on a wide range of well-organised procedures and that is the main urban warfare training challenge in order to overcome the future of urban warfare in context of Sri Lanka. The military forces should give special consideration to Urban Operations (UO) (Niksch, 2017).

The UF Sqn of Sri Lanka Army requires unique skills since the force structure, equipment and method of conduct vary from one to another. Therefore, it is imperative that each member of the SF UF Sqn should possess a number of different skills common to all (battle and non-battle related), while there are some other expert skills to be mastered by those permanently assigned, with such tasks which include insertion techniques, Urban combat specializing on CQB, Engineering, Night fighting, Weapons handling (Proficiency of handling all types of weapons), Operating in an NBC environment, Navigation, Air mobile capabilities, Communication, Employment of sniper elements, GIS, First aid and lifesaving, Modern unarmed combat and disarmed techniques, Assault pioneer tasks, Swimming, Basics of firefighting techniques, Driving proficiency, IT literacy, Language proficiency and Intelligence gathering (Sri Lanka Army Special Forces, 2020). There is an arrangement for UF Sqn of SF to improve these skills to enhance their urban fighting skills.

4.1 Training Infrastructure Development Related to Urban Warfare Training

Few nations have entities moving toward the best guidelines. In spite of the fact that it has countless little destinations for rehearsing CQB, the United States at present has no entity for preparing enormous units in practical metropolitan conditions (Spencer, 2017). Similarly, Britain's urban training regions are by and large viewed as deficient by its clients. There is a fake Afghan town in the Stanford Training Area in Norfolk, U.K., run by the Operational Training Advisory Group, which is a forward-thinking entity and for the most part persuading depiction regarding working conditions

in the Helmand territory(U.K. Service of Defense, 2011).

France has offices at CENZUB in Sissonne, which include an enormous number of all-around planned structures, and a standing resistance power which can play out an assortment of 'enemy forces' roles: regular, irregular, and hybrid (Betz and Stanford-Tuck, 2019). A senior non-charged official from a U.S. Marine Corps who visited the office in 2017 was especially dazzled by the general level of earnestness with which the French treated metropolitan preparing, commenting that a critical part of this quality preparing is that the resistance power is set up with quality troopers who plan and battle with the will to win. It might be said that this preparation has a component of 'free play' in that while prearranged as it were, the CENZUB staff make conditions with the expectation of complimentary thinking on the two sides (Betz and Stanford-Tuck, 2019).

4.2 Development of Training Strategy for Future Urban Warfare

In order to overcome future challenges of UF Sqn within the urban fighting environment, they should receive special training on urban fighting like CQB tactics, as they are the main tactics which are needed to improve the successful engagement in combat in urban environments(Niksch, 2017). Several researchers have recommended the 'Commando 21' structure for the more prominent role in training and pre-deployment preparation for the urban warfare (US Army, 2017). In addition, the infantry troops need to be updated with the specialised trainings including individual tactics and techniques as well as the randomness of tactics and techniques in urban warfare. There should be a flexibility of the leaders when selecting tactics from giving options too, which means that all should centre on the training and development (Earl J. Catagnus, Jr. et al., 2005).

5. CONCEPTUAL FRAMEWORK

According to the literature finding the development of a training strategy for future urban warfare can be conceptualised as follows:

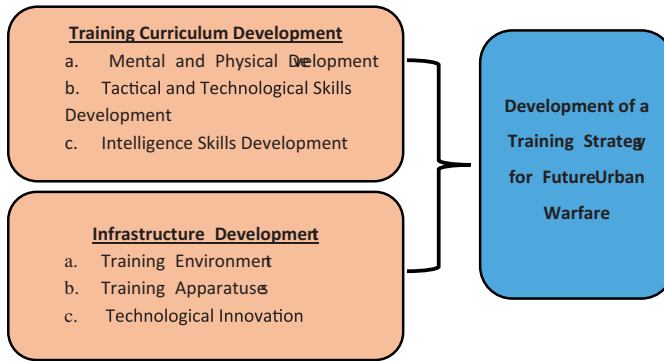


Figure 1: Conceptual Framework

Source: Developed by Author

6. METHODOLOGY

The operationalization table is developed based on the related literature findings and formulated the conceptual framework as a skeleton of the questionnaire.

Table 1: Operationalization Table

Ser	Variable	Indicators	Measures	Source
(a)	(b)	(c)	(d)	(e)
1	Training Curriculum Development	a. Mental and Physical Development. b. Tactical and Technological Skills. c. Situation Awareness and Intelligence Skills.	Likert Scale	(Betz & Stanford-Tuck, 2019; Nicksch, 2017; Sri Lanka Army Special Forces, 2020).
2	Infrastructure Development	a. Training Environment. b. Training Apparatus. c. Technological Innovation.	Likert Scale	(Spencer, 2017; U.K. Ministry of Defence, 2011).
3	Development of Training Strategy for Future Urban warfare	a. Individual Tactics and Techniques. b. Randomness of Tactics and Techniques. c. Pre-Deployment Preparation.	Likert Scale	(Earl J. Catagnus, Jr. et al., 2005; US Army, 2017).

Source: Developed by Author

This study was conducted by using the mixed method approach and the research philosophy which is applicable to this study is pragmatism. Both qualitative and quantitative research methods were used in the study. The research approach is deductive, and the study was conducted to prove the existing theories using the collected data. The research followed the survey strategy, both qualitative and quantitative data were collected through the survey method. The time horizon is cross-sectional, and the cross-sectional time horizon was used to observe the data or information at a specific time point. Finally, the data collection and the data analysis were done following the data collection and analysis techniques (Saunders, et al., 2009). The researcher first identified the future of urban warfare in the global context. The focus is then on the study of the nature of threats that might be faced in the Sri Lankan context.

Thereafter, the existing training challenges of the UF Sqn to face aforesaid threats were identified. Once these challenges were identified, an analytical framework was created to understand how to develop a training strategy in order to enhance the capabilities within UF Sqn soldiers to effectively operate in any urban environment. The research approach analyses the level of existing training by collecting data from Officers and soldiers of the UF Sqn of SF. Thereafter recommendations were given based on the study findings.

This study focuses on the development of a training strategy with a special reference to an UF Sqn of SF for future urban warfare. Hence, 80 UF Sqn soldiers were selected representing various ranks using the convenient sampling technique. In addition, ten officers with expertise in the field and different appointments were selected for the focused interviews using the judgement sampling technique. Importantly, the urban fighting training strategy module was interlinked at the discussion. In this study, the survey method and interview method were used to collect data from the selected samples. The primary data for the study was collected through questionnaires. Additionally, the information was collected from the focused interviews with the senior officers who possessed expertise in the field. The quantitative data was analysed using both graphical and statistical techniques and the Microsoft Excel was used as the software package for data analysis. The qualitative data was analysed using the thematic analysis method.

7. DATA PRESENTATION AND ANALYSIS

According to the quantitative and qualitative analysis, it was clearly identified deficits exist in the current training curriculum and the training infrastructure for urban warfare training in facing contemporary threats. The primary research findings emphasize that the existing urban warfare training is not sufficient to achieve the current warfare requirement. However, according to the respondents' views, the mental and physical development training remains at a satisfactory level and the existing methods are effective to improve the mental and physical development for urban fighting by improving shooting skills during training. The respondents were satisfied with the existing tactical training and imparting of theoretical knowledge. In contrast, they were not highly satisfied with the existing technology, combat training tactics and urban fighting training strategies, techniques and technology against future urban warfare threats. In addition, the respondents were not satisfied with the existing intelligence skills training to face future urban warfare threats. In the context of training infrastructure, the respondents were not satisfied with the existing training environment, training apparatus and technology innovations for urban warfare training.

8. DISCUSSION

National Defence, NDIA's business and technology magazine elaborates modern training of urban warfare. The synthetic learning environment is designed to teach humanitarian aspects of war, including all combat tasks, interactions with residents among others. According to the primary research findings, the training environment and the training curriculum are the most important aspects in proper training programmes to face the urban warfare threats.

Magnuson, (2019) emphasizes that in urban warfare realistic training, management of civilians, critical role for engineering and electronic warfare assets, command and control, surveillance and target acquisition challenges, tunnel warfare, robotics, high casualty management are also vital training components for soldiers to acclimatize with urban battlefield. According to Nicksch, CQB tactics play a crucial role in achieving political objectives in urban warfare. In an increasingly urbanized world, policymakers must understand that fighting in urban areas is different from fighting in a wide, open field (Nicksch, 2017). The primary research findings emphasized the insufficiency in the existing training, and the importance in considering the

related training aspects like mental and physical development, tactical and technological skills development, and intelligence skills development.

A few countries possess facilities to reach the ideal standards. Although it has a large number of small sites for practicing CQB, the United States currently has no facility for training large units in realistic urban environments (Spencer, 2017). Likewise, Britain's urban training areas are generally considered inadequate by its users - too small and too much like a central European village, the sort of urban environment the army envisaged it would need to fight in when they were built in the 1980s (U.K. Ministry of Defence, 2011). However, France has facilities at CENZUB in Sissonne, which possess a large number of well-designed buildings of various types, and a standing opposition force able to perform a variety of 'enemy force' roles: regular, irregular, and hybrid (Betz and Stanford-Tuck, 2019). The primary research findings emphasized that training infrastructure is one of the important aspects of urban warfare training and it should be developed with setting proper training environment, training apparatus and technological innovations.

According to the William McRaven, Special Operations Forces (SOF) claim six principles such as speed, surprise, purpose, security, repetition and simplicity. SOF's direct focus is to achieve relative superiority while conducting direct action operations. The McRaven model only focuses on tactical operations of the special operations to reach the relative superiority. Hereby the McRaven framework is studied to understand the way of achieving relative superiority through the principles of special operations.

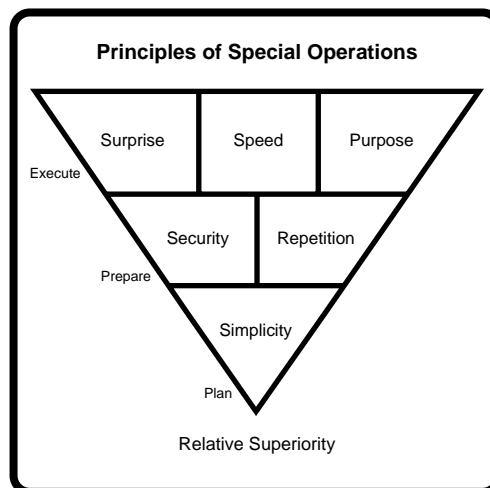


Figure 2: McRaven's Model of Special Operation Forces

Source: (McRaven, 1996)

According to the primary research findings, it was found that training curriculum development and training infrastructure development are essential aspects in achieving the key principles of SF operations.

9. CONCLUSION

The first research objective was to identify the future of urban warfare in the Sri Lankan context and to identify the existing urban warfare training challenges. When considering the above research objective, the warfare situation has changed from jungle warfare to urban warfare over the time and Sri Lanka will face such situations in the future. Though Sri Lanka lacks experience related to the urban warfare, the country has to prepare to face the future threats. Sri Lankan military forces in general and SF in particular should have proper urban warfare training to face future urban warfare threats. However, they have to face a number of training challenges such as lack of financial strengths, relevant infrastructure, advanced training, among others.

The second research objective was to identify existing levels of urban warfare training of the UF Sqn of SF. There is a separate UF Sqn in the SLA SF and there are separate urban fighting training programmes to groom them to reach the next level. However, the existing training and the infrastructure is insufficient to face future urban warfare requirements. The training infrastructure in particular should be developed to the next expected level of the UF Sqn training.

The third research objective was to identify the specific training areas which is required to enhance and develop a training strategy to overcome future challenges. According to the experts' opinion, training should be developed to the next level by adding specialised training programmes which are widely discussed in the next section.

10. RECOMMENDATIONS

10. 1 Infrastructure Development

To improve shooting skills during the urban fighting training, it is recommended to build killer houses in 4 SF by utilizing local resources. It is immensely beneficial to enhance CQB capabilities of the soldiers. Further, to develop accuracy and speed reaction of live firing, a MILO target simulator should be installed in the killer house. To achieve that purpose, it is required to get assistance of the Army Research and Development (R&D) Department, Panagoda. Thereby the simulator system can locally be developed as per the requirement.



Figure 3: Killer House



Figure 4: MILO Target Simulators

To enhance confidence training, Fast Rope Insertion and Extraction (FRIE) training, Special Patrol Insertion/Extraction (SPIE) training and orientating soldiers with super surface of the urban environment, it is recommended that climbing walls be built with a multi-purpose rappelling tower. Enhancement of soldiers' super surface training activities will help to coordinate joint training with Air Force personnel. Training regarding the immediate insertion and extraction in urban environment should be mandatory in UO.



Figure 5: Fast Rope Insertion and Extraction (FRIE) Training, Special Patrol Insertion/Extraction (SPIE) Training



Figure 6: Mock Tower Training

It is recommended to enhance mock training with different situational activities for that it is required to acquire re-adjustable pellets. This will facilitate the construction of structure such as bus stands, railway stations, harbours or any kind of infrastructure. This will help in enhancing on the job training of soldiers. It is recommended to develop 4 SF underground range for night fighting training. It is essential to enhance sound absorption systems for 4 SF underground firing range for small arms firing.



Figure 7: Underground Range for Night Fighting

It is recommended to build and complete an urban fighting village in 4 SF as a model urban city complex as training infrastructure by covering surface, sub surface and super surface which will enable soldiers to get the training and orientation of the urban settings. This should be blended with vertical, horizontal, exterior, interior, and underground forms superimposed on the natural relief, drainage, tunnel systems, vegetation, stories building and urban obstacle systems. For this purpose, assistance can be taken from the SLA Engineer Service Regiment (ESR) and also the building structure can utilize shipping containers at a low cost. This will immensely benefit the understanding of the complexity of the urban environment.



Figure 8: Urban Fighting Village

10.2 Intelligence Gathering Development

For the intelligence training, it is recommended to include an intelligence gathering training module in UF Sqn block syllabus under the supervision of Military Intelligence Corps (MIC). Special consideration should be given to the urban surveillance techniques.

Acclimatization to urban terrain is important with the use of modern surveillance equipment such as spy cameras, acoustic sensor, passage detection sensors, computerized 3D module and tracking systems. Therefore, a considerable number of soldiers need to follow relevant courses with the assistance of Sri Lanka Army Signal Corps (SLASC). Also, essential surveillance equipment needs to be purchased to face future UO.

10.3 Technological Innovations

It is recommended to develop a mobile operation room utilizing a Uni-Baffle vehicle with the assistance of Sri Lanka Electrical and Mechanical Engineer Regiment (SLEME). It should consist of IT equipment with digital screen, surveillance drone cameras and radio communication equipment. This can be utilized for dual purpose - operational and training. This will help practise the decision-making process, especially during the FTX. Thereby the soldiers will be able to acclimatize with the new technology as well as the decision-making process.



Figure 9: Mobile Operation Room Vehicle

To enhance the soldier's situational awareness, the use of technological innovation will make urban fighting training realistic. Hence, computerized simulator systems can be used in the present context, but its software is costly in the international market. Hence it is recommended that simulator

software for urban fighting training be developed with assistance of the SLA R&D Department. This will help to increase situational awareness and quick decision-making ability which is paramount important for UO.

10.4 Training Curriculum Development

Once the basic urban fighting course is completed, it is recommended for soldiers to follow training modules on Joint UO training module with Air Force, Enhance Computer and information literacy module including Geographic Information Systems (GIS), Legal consideration and understanding legal environment during or in UO, Joint FTX module such as Exercise Cormorant Strike specially in urban terrains.

It is recommended to introduce specialized courses with soldiers' experiences such as Rappel Master Course, Anti-terrorism Detachment Course, CBRN course, Urban Sniping and Sharp Shooter Course, Modern unarm combat course. Advance demolition and medical course.

It is recommended to acquire more foreign courses pertaining to the urban fighting training and by sending a considerable number of soldiers to such courses to acquire new TTPs from abroad and inculcate them in UF Sqn training syllabuses.

10.5 Provide Advance Urban Training through Foreign Training

It should be provided a number of foreign trainings to SLASF soldier to gain advanced training about UO.

10.6 Improve the Instructors Capability to Provide Better Training to Combats

In order to reach international standards, local instructors should be groomed via foreign instructors. Foreign trainers have more experience in urban fighting, and have participated in many advanced training programmes to improve their skills. Therefore, foreign trainers should combine with local trainers for the latter to learn through observation and experience.

10.7 Development of Special Training Framework

Urban fighting training is an essential requirement to face the contemporary threats in the Sri Lankan context as well as the global context because there will be many recent experiences and evidence of future threats. Therefore, a special training framework should be developed to improve the urban fighting capabilities of other regiments under the supervision of SF to face the sudden urban fighting threats. The intervention will increase the urban fighting strength of the SLA by 50%.

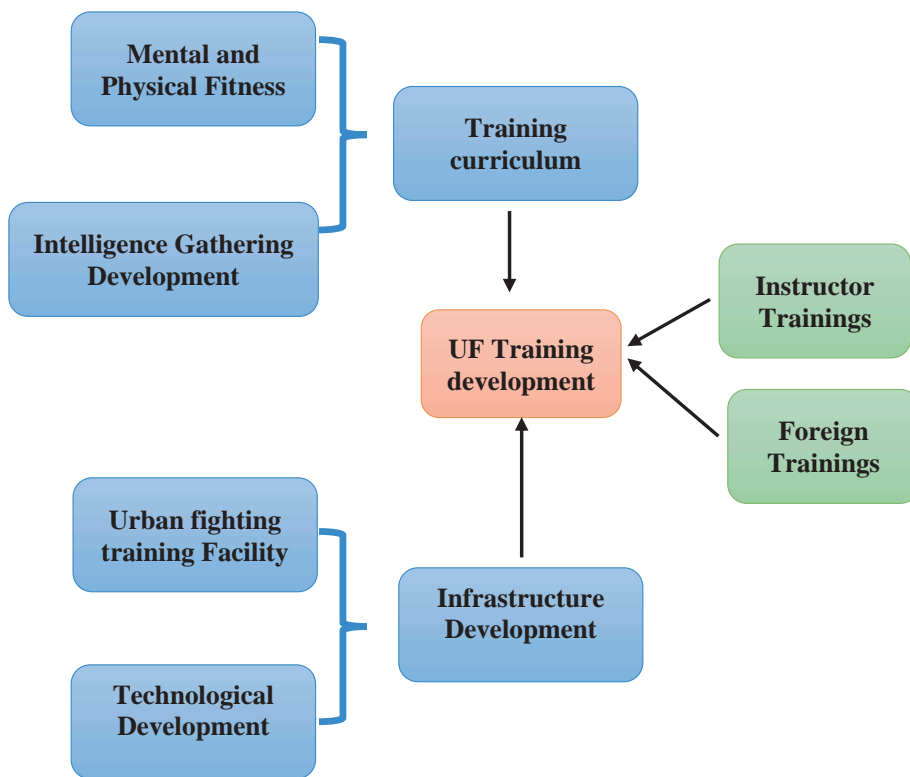


Figure 10: Urban Fighting Village

Source : Developed by Author

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TECHNOLOGY IN MODERN WARFARE AND FUTURE ROLES FOR SOLDIERS

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ABSTRACT

Rapid advancement of technology not only serves to change how battles are fought but who does the fighting as well. Front line soldiers, although still vital, have slowly been pushed off the top spot of being most critical to the success of a mission. Technology has been seen, in some aspects, to replace the soldier from his services. As the 21st century unfolds the greatest advances in technology are originating from the Information Technology community, which has now been referred to as the 'fifth dimension', or Cyber warfare. Similarly, the enemy of today has also undergone a huge transformation and is not affiliated to a state, and does not have global objectives, other than the ideological fantasies it wished to announce to the world. The idea of a 'Global Terror Network' has almost been realised. Therefore, the role of the soldier varies from theatre to theatre depending on enemy structure and modus operandi. The conflicts of today are very population centric and therefore require human to human contact to establish relationships, build trust and exploit the weaknesses of the enemies by separating them from their population. In humanitarian crises 'boots on the ground' are needed to secure and reassure populations. In peacekeeping, particularly in developing nations, soldiers will be needed to monitor and enforce the peace. This can only be achieved by soldiers. This is their biggest strength, and it is set to be a contributing factor to their continued use on today's and tomorrow's battlefields. Technology can reduce risk, be replaced for periods of time, and assist the soldier, but the overarching strength of that human contact is and will be a continued constant in the battles of today and in the future. As for the future and the role of soldiers, it still remains unclear, but soldiers do have a job in the battlefield.

Key Words: Technology, Warfare, Soldier, Future

1. INTRODUCTION

“I know not with what weapons World War III will be fought, but World War IV will be fought with sticks and stones”
Albert Einstein

Since the end of the Second World War, warfare has changed dramatically. This rapid advancement of technology not only serves to change how battles are fought but who does the fighting. Front line soldiers, although still vital, have slowly been pushed off the top spot of being most critical to the success of a mission. Technology has been seen, in some aspects, to replace the average foot soldier and with it remove the need to feed, water, and pay that individual for his services. Technology does not get tired

and has no personal problems which can affect performance. Due to this advancement, it has changed the ways in which our enemies fight with us. With nuclear deterrence a global threat, force on force conflicts are very unlikely in the future.

The aim of the paper is to discuss the future roles for soldiers with technology in modern warfare. This research is based on the following objectives:

- Discuss the future roles for soldier with technology in modern warfare
- Highlight the human involvement and human role in future warfare through recommendations.

2. LITERATURE REVIEW

2.1 The Current Battlefield

The modern battlefield is almost unrecognisable to the battlefields of the past. Warfare has advanced to fill almost all possible environments, from space, through the sky, and to the very depths of the sea. From economics to cyber style attacks, warfare is no longer restricted to a pre-determined field where two generals pitch their wits against one another until the victor emerges triumphant. Today, anything and anywhere can be turned into a venue of conflict.

As the 21st century unfolds the greatest advances in technology are originating from the Information Technology community, which is now referred to as the 'fifth dimension', or Cyber warfare. Although this is undoubtedly going to be a significant element in the future conflicts, it has slowly started making an appearance in today's current battlefield.

Furthermore, the ways in which wars are fought have altered drastically. Not only through location but methods as well. The advancement of technology has made a huge impact in the manner in which enemies can attack one another. The shift from 20th to 21st century warfare has possibly seen the greatest shift in warfighting styles (Mulang, 2015)

2.2 The Enemy of Today

The enemy of today underwent a huge transformation during the late 20th and early 21st centuries. The nuclear deterrent in the world has seen a stalemate between all major nuclear Nations. The threat, and subsequent fall out, of such a conflict would have far reaching global impacts that make the idea of a nuclear conflict unthinkable. Not only through loss of life and infrastructure but economic collapse of an entire country would see the rest of the world, and in particular superpowers and emerging super powers, unable to rebuild after such a catastrophe. In this current global economic crisis this notion simply cannot be entertained, thus a different and new form of enemy has emerged.

The enemy who is not affiliated to a state, and had no global objectives, other than the ideological fantasies it wished to announce to the world. This pattern of non-conventional enemies is now a common trait in the 21st century conflicts across the globe. The idea of a 'Global Terror Network' has almost been realised. Under a banner of collected ideals, groups of terrorists are able to 'legitimise' their actions, most notably through attachments to religious extremism.

The enemy of today wears no uniform or badge of recognition, the enemy of the modern battlefield has total impunity to act and behave in whatever fashion it so desires under whichever code of conduct it chooses. It has no boundaries and therefore tracking of such an enemy becomes a physical as well as political challenge, as nations are often thrust together in order to track and neutralise the threat from within each other's borders. Information is the currency of this modern enemy and it is traded by nations and armies in the constant cat and mouse game played by states and this elusive enemy (Sales, 2012).

3. FUTURE ROLES FOR SOLDIERS

3.1 The Modern Soldier

It is vital that, in order to best predict the future role of the soldier, attention must be paid to what constitutes today's modern soldier. The role of the soldier varies from one theatre to another. Dependant on enemy structure

and *modus operandi*, the soldiers' role will often need to be continually changed in modern environments due to the complex and everchanging environment of his surroundings. A soldier is no more a simple tool to inflict damage on his enemy. He must act within the confines of the media-controlled world. The soldier must possess the ability to adapt his actions, even in a matter of minutes, from fighting wars, to peace enforcement and peacekeeping. This is a complex challenge and the soldiers of today must be fully aware of all that is around them.

Technology only serves to enhance awareness of the environment, however there is no form of technology that can replicate an experienced soldier's 'gut feeling'. Only a physical human soldier can identify the 'presence of the abnormal and absence of the normal'. The intuition that a soldier brings into the equation is a vital part of deciding future action.

No current technology is available or indeed in production that has this war winning function. The technology of today compliments this function and technology, in conjunction with its human operators, can win a battle but no war can be won with this approach alone. It is the symbiotic relationship forged between both man and machinery that can achieve overall victory (Roland, 2016).

3.2 Strengths and Weaknesses of the Modern Soldier

The apparent strengths and weaknesses are obvious to many military commanders, and as such the development and utilisation of new technology is being implemented to plug these gaps. It is not currently looking to remove soldiers from the battlefield, but merely act as a force multiplier. Soldiers require much to sustain themselves in combat. This additional training and logistical burden must be understood and planned prior to any deployment as the sustainability of force levels in a particular location will directly affect the progress and ability to achieve mission success. Soldiers in the physical form, require Rest and Recuperation (Barry & Kenny, 2021)

The conflicts of today are very population centric and therefore require human to human contact to establish relationships, build trust and exploit the weaknesses of the enemies by separating them from their population. This can only be achieved by soldiers. This is the biggest strength, and it is set to be a contributing factor to their continued use on today's and tomorrow's battlefield. Technology can reduce risk, be replaced for periods

of time, and assist the soldier, but the overarching strength of that human contact is and will be a continued constant in the battles of today and in the future.

3.3 Cyberspace and its Effects on Modern War

It is a form of information modern warfare that sometimes is seen as analogous to conventional warfare. Cyber warfare can take different styles or motivations such as; military, terrorism, civil, public sector and non-profit research, but all simply breaks down to discovering information or attempting to disable another's technological equipment for the advantage of friendly forces or financial profit. This cyber threat is more volatile and unstable, and one that threatens global security more than other threats. With the advancement of technology, a large part of a nation's defence systems runs autonomously from computers networked together to allow for ease of use, depth of protection and decreased involvement of humans, which can ultimately mean a more cost-effective operation. It does leave it very vulnerable if not properly protected.

In order for cyberspace to become a domain of war it requires militarisation, and in this lies the biggest argument as to whether or not it has become a legitimate way and means of waging war. However, with the increased use of technology and this emerging digital age it is almost impossible not to see a future where all things 'cyber' will play a role, whether it does incite violence or not.

3.4 Advancement of the Soldier

It is now time to look at what roles soldiers will play in future conflicts. There will have a role but it is necessary to make predictions into what areas these might be in.

The current significance of 'non-state' actors will play a role in future conflicts. The rise of radical, well-funded, groups will be a constant presence in the future of conflict, and this requires humans to act smarter in their approach. When facing a stateless enemy there emerges many problems, notably geographically fluidity, and a lack of recognised uniforms or flags.

It is hard to predict what the future of conflict will look like, but trialling

and testing various methods that look to replace humans on the battlefield will reduce the risk and threat to life. The humans still maintain a significant advantage over robots in that the visual ability of a robot remains limited. A human being can distinguish targets easier and add 'reality' to a situation far clearer than any current robotics. This explains why drones still maintain human contact and the ultimate decision to strike remains at a human pilot's discretion. The ability of robotics on the battlefield currently offers a significant amount of data that still requires human analysis to make an informed decision. It is very understandable that this form of warfare will make nations and its leaders extremely nervous but the rapid evolving technology is getting to the point now where human decision making is all too rash and illogical. Numerous countries are exploring possibilities to remove humans from the line of fire. The advancement of robotics is possibly the single greatest expansion that has been seen in modern years (Leaders, 2011).

There are too many ongoing projects across the world which demonstrate the innovation and capability of next generation weapons and military assets. Robotics are clearly where the future is heading. The current trend has been to rely on computers to relay information which allows for decision making. Robots are different to computers. Robots are machines that are built upon what scientists and researchers call the 'sense-think-act' paradigm. They must have the three key components to qualify, notably 'sensors' to monitor an environment and detect changes in it, 'processors' or 'artificial intelligence' that decides how to respond, and 'act' accordingly. This appears to be the way the world is heading, and not just in military terms, but the application and funding for this market is heavily placed inside the parameters of the defence establishment, and allows greater capacity for growth (Ehrenreich, 2011).

4. RECOMMENDATIONS

With the advancement of technology in relation to warfare it is impossible to predict what the next significant development will be. Clearly robotics and their continual investment will play a large role in future conflicts. There is much development across the globe and governments are investing billions of dollars into this industry, with their secretive nature ensuring that technology does not get copied by others. The protection of this technology is paramount to the success of developing nations in the future. Soldiers will increasingly become a part of the protection phase and it is very likely to see

the recovery of any lost or 'downed' technology being recovered by soldiers in order to protect its secrets. Intelligence still plays a key role in the future of warfare. It is just a matter of how it is gathered that has been altered. The advancement of satellite systems and camera equipment continually increase on the battlefield through requirement, and allow for governments to look into areas which used to be considered off limits.

4.1 Human Involvement

Humans continue to be a presence on or around the battlefield. Their ability to analyse remains imperative in decisions to strike. Artificial Intelligence is developing at such a rate that soon the human brain will not be able to process the huge amounts of data gathered and make a decision in the time required. For developing nations or non-state actors, time is still available due to their weaker technological abilities. However, in the future if two developed nations, with similar technical abilities go to war, it might become apparent that humans are not, in principle, required. Technology at present, in a combat role, is utilised to strike less advanced foes. In doing so humans are able to have the luxury of time to develop the picture and deduct possible scenarios. If equal technology was pitted against another it is possible that Artificial Intelligence will rapidly develop in order to meet the time sensitive demands of the decision-making process.

All technology is born from necessity, and the necessity has been to build equipment that removes humans from the battlefield to decrease its risk in order to maintain public support and reduce casualties. This coupled with greater optics means that technology is developing along these lines. It is possible that weapon systems will be acting against a perceived threat without any human cover. If this was to take on a nuclear capability to act quickly as a response to a threat, humans remain the creators of such tech, safety and control measures will no doubt be implemented to ensure at least a check from human commanders is established prior to any action.

4.2 Human Role

Human role in future conflict is still cloudy. There remains the unarguable fact that only physical soldiers can hold ground and interact on a local level with citizens of a nation. If warfare is continued to be thought of as it was in the past, then there will always be a role for humans. In a humanitarian

crisis 'boots on the ground' are needed to secure and reassure populations. Similarly in peacekeeping, particularly in developing nations, soldiers will be needed to monitor and enforce the peace. Technology in all these cases will be present to support the soldier on the ground and develop the intelligence picture whilst reducing risk. However, if technology advances faster then there is the potential to lose touch with how wars can be fought.

5. CONCLUSION

This is an exciting and altogether confusing time for warfare, and the employment of soldiers. Personal protective equipment, vehicles, sensors and medical advancements have all seen a dramatic improvement in recent years. Today's soldier is better equipped, trained and supported through a wealth of technology. Thus far the advances have been made against a predominantly unadvanced enemy.

Technology is going to be a continual and unavoidable part of future conflicts, and the race for superiority will drive nations to excel in this field. It is still uncertain to predict future trends of technological increase, because as stated most technology is developed through necessity, so to predict technological advancement is the art of predicting the future itself. Whatever the future may hold, conflict is to remain. Mankind will always have reason to fight, and kill those from another belief or state. It is the matter of how this killing will take place.

Robotics and the removal of the physical being on the battlefield continues to be today's focus. Coupled with increased level of protection both of the person and the equipment it is possible to assume that this will continue whilst humans are required to maintain their presence on the battlefield. Technology is a vital role for any defence force in today's conflicts, as it defines their ability and shapes the speed and success of their mission. As for the future and the future role of soldiers it still remains unclear, but one thing that is guaranteed is that in the present, soldiers still have a job.

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DEVELOPMENT OF THE FRAMEWORK OF THE DISASTER ASSISTANCE AND RESPONSE TEAM (DART): AIR CRASH SEARCH AND RESCUE OPERATIONS IN SRI LANKA

Squadron Leader Chanaka Maligaspe

ABSTRACT

The Sri Lanka Air Force (SLAF), being the only air arm capable of providing aircraft assistance to air crash Search and Rescue (SAR) operations in Sri Lanka, has a unique role to play whilst it bears huge responsibility in aircraft Search and Rescue operations. The re-organization of the Jungle Rescue teams into Disaster Assistance and Response Team has expanded the work scope where prominence of aircraft SAR operations have diluted within the SLAF. The researcher has derived the conceptual framework on par with the study objectives which enable the understanding of dependent/independent variables. This qualitative study used the inductive approach and interpretivism philosophy. Findings divulged that SLAF is currently lacking in necessary capabilities/capacities to exert SAR operations particularly in maritime domain. The DART framework also requires reviewing and restructuring. Eventually the researcher has presented recommendations in order to overcome constraints and to establish an effective DART framework for the SLAF in order to attend to SAR operations efficiently.

Key Words: Search and Rescue, Disaster Assistance and Response Team (DART), Maritime Domain

1. INTRODUCTION

Aviation became an integral part of modern globalization due to its unique ability to operate swiftly in the third dimension. Therefore, the contemporary world has seen highly dense airspaces full of aircraft across the world operating for various purposes. This has led to cause an increase in air crashes around the world over the years, where it demands high skill and trained personnel in turn to rescue aircrew and the personnel in distress, in the quest of saving lives and properties.

As the sole air arm capable of providing aircraft support to air crash search and rescue (SAR) operations in Sri Lanka, the Sri Lanka Air Force (SLAF) has a unique role to play whilst it bears a huge responsibility in aircraft SAR operations within the search and rescue region (SRR). A separate unit comprising experts in different areas are kept onstandby 24x7, 365 days to meet any unforeseen circumstances.

2. BACKGROUND OF THE STUDY

The SLAF forms an integral component within the Aeronautical Rescue Coordination Centre (ARCC) which functions as a rescue unit within the Colombo SAR Region (SRR) along with Sri Lanka Army (SLA) and Sri Lanka (SLN). The Disaster Assistance and Response Team (DART) was initially introduced as the Jungle Rescue unit and subsequently changed to DART in 2018 given that it encompasses a wider array of operations in addition to the air crash rescue operations.

The SAR service is related to the Alerting Service, although directly not coming under the purview of Air Traffic Services (ATS) since it does not fulfil any of the objectives of ATS (ICAO, 2018). Thus the service rendered by agencies other than Air Navigation Service Providers (ANSPs) ensures close cooperation with relevant ATS units, and is maintained through the establishment of agreed procedures. Guidelines and practices for SAR have been considered vital in the event of an aircraft accident or in a situation of distress (ICAO, 2018).

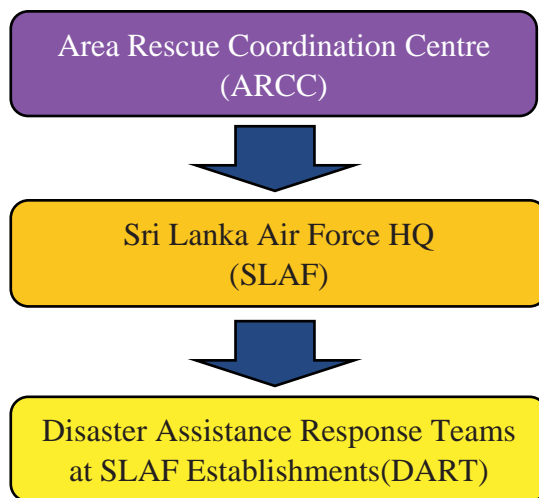


Figure 1: SLAF's involvement in SAR operations of Sri Lanka

Source: Author (2021)

3. RESEARCH PROBLEM

The SLAF has identified the necessity of swift response during any disaster situation in the country as the only air arm of the government which is

readily available for such a response, particularly during aircraft crashes. Thus, SLAF is responsible for initiating and conducting SAR operations in respect of the SLAF military aircraft besides being an integral part of overall SAR operations of the country within the area of responsibility (AOR). All SAR operations are to be conducted under the command and direction of the Director Air Operations (DAO) while local Base/Station commanders would exercise functional control (BATCO, 2018).

The Jungle Rescue (JR) units in all SLAF establishments were providing SAR services for aircraft in distress situations either military or civil. However, this organization has been reformed as DART with the objective to establish a robust mechanism to prevent and mitigate the effects of disastrous situations (SLAF, 2018). This has expanded the work scope of the JR teams and encompassed a wide array of objectives/tasks to be discharged during any disaster situations whilst SAR operations have become one of the areas, where the researcher observed that the prominence of aircraft SAR operations have been diluted under the DART functions.

The SAR services in Sri Lanka is systematized by following the standard and recommended practices (SARP) established by the ICAO. The overall responsibility for the administration and operations of SAR operations within Colombo SRR lies with the Civil Aviation Authority (CAA) of Sri Lanka (CAASL, 2020). The SAR Point of Contact (SPOC) is designated as the Colombo ARCC. The SLAF being the only air arm capable of providing aircraft assistance, has been obliged to provision of SAR as situations demand. Thus, the SLAF is required to provide SAR assistance for civil/military aircraft within Colombo SRR and demands to be equipped with the required gear and skilled/trained personnel.

Therefore, it has become imperative to evaluate issues about the existing work scope of the DARTs. With that backdrop, the objective of this study is to evaluate the capabilities, procedures and preparedness of the DARTs in SLAF to providing SAR services within the AOR.

ICAO Annex 11 (2018), has defined SAR as performance of distress monitoring, communication, coordination and SAR functions, initial medical assistance or medical evacuation, through the use of public and private resources, including cooperating aircraft, vessels and other craft and installations. The Indian Air Force (IAF) (2012), has termed recovery of aircrew in distress who have abandoned their aircraft as combat SAR. This is more relevant to the circumstances that could arise during times of war.



Figure 2: SRRs within the IOR and Pacific region

Source: Australian Maritime Safety Authority (2020)

4. METHODOLOGY

The essential guide of the study is the conceptual framework that illustrates what the researcher expected to find through the study. The study was based on five exploratory research questions and designed in line with an inductive approach. According to the literature review, the conceptual framework was derived to find and test answers for research questions.

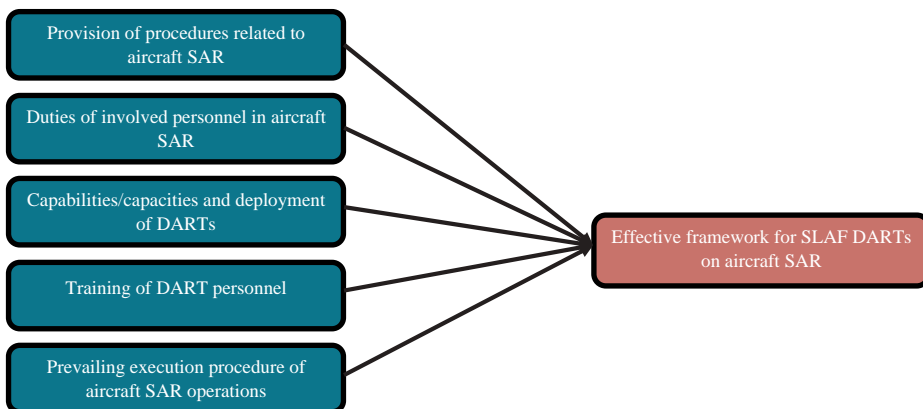


Figure 3: Conceptual framework

Source: Author (2021)

5. FINDINGS

5.1 Demographic Details

Demographic details of the interviewees have been illustrated as depicted below.

Table 1:Details of interviewees

S/No E	xpertise of the Field	Total
(a)	(b)	(c)
01	Air Vice Marshalls from SLAF	01
02	Captains from SLN	01
03	Wing Commanders from SLAF	02
04	Wing Commanders from BAF	01
05	Wing Commandersfrom PAF	01
06	Wing Commandersfrom IAF	01
07	Officials from CAASL	01

Source: Author (2021)

Demographic information of questionnaire respondents have been illustrated below.

Table 2:Demographic details of DART personnel in the sample

S/No D	escription	Total
(a)	(b)	(c)
01 N	o of DART personnel	103
02	Male	103

Source: Author (2021)

5.2 Ranks Composition of DART Personnel

Rank distribution of the DART personnel has been illustrated in Table 3.

Table 3:Rank composition of the DART

Officers	SNCOs	CPLs L	ACs
10 2	0	30	43

Source: Author (2021)

5.3 Previous Experience in SAR Operations

DART personnel's previous experiences in SAR operations have been illustrated in Figure 6. It is to be underscored that only 10% of the sample have real time experience whereas 42% neither have experience nor training in SAR engagements.

Rank distribution of the DART personnel has been illustrated in Table 3.

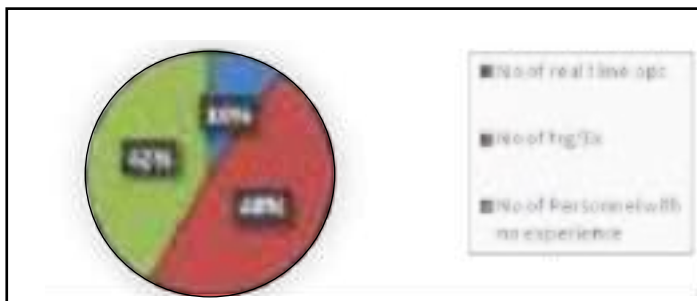


Figure 4: Experience in SAR operations

Source: Author (2021)

5.4 Awareness on Aircraft SAR Operations

Awareness on Provisions of DART, the majority (87%) of the sample have been aware on DART provisions in relation to aircraft SAR operations. However, it was understood that these provisions are not being fully conformed to the ICAO/CAASL provisions, cognisant that the main objective of the DART is to attend in HA/DR. Thus, it is to be underscored that DART provisions related to aircraft SAR operations are necessary to be reviewed and outlined in par with the CAASL provisions. Further, all respondents have indicated their consent to be educated in this regard.

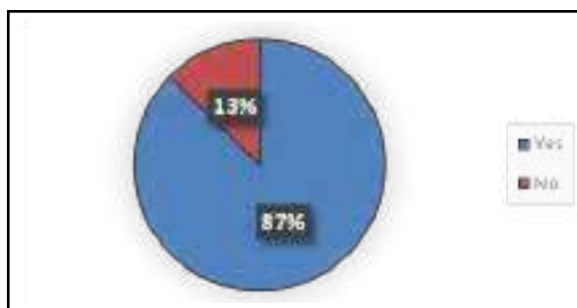


Figure 5: Awareness on DART provisions related to ac SAR operations

Source: Author (2021)

5.5 Duties related to Aircraft SAR

Respondents divulged that the majority (97%) of the sample are aware on their JDs/Orders/SOPs. However this figure does not depict the authentic context which was explored by the researcher during an interview with a DART specialised Officer. There, it was revealed that except for RSF personnel whom were deployed in DART team I, other members have been frequently changed and a separate group of men have not been allotted. Further, DART team II and III changes daily according to a monthly roster and each member is briefed on their assigned tasks in the 'morning duty handing over briefing'.

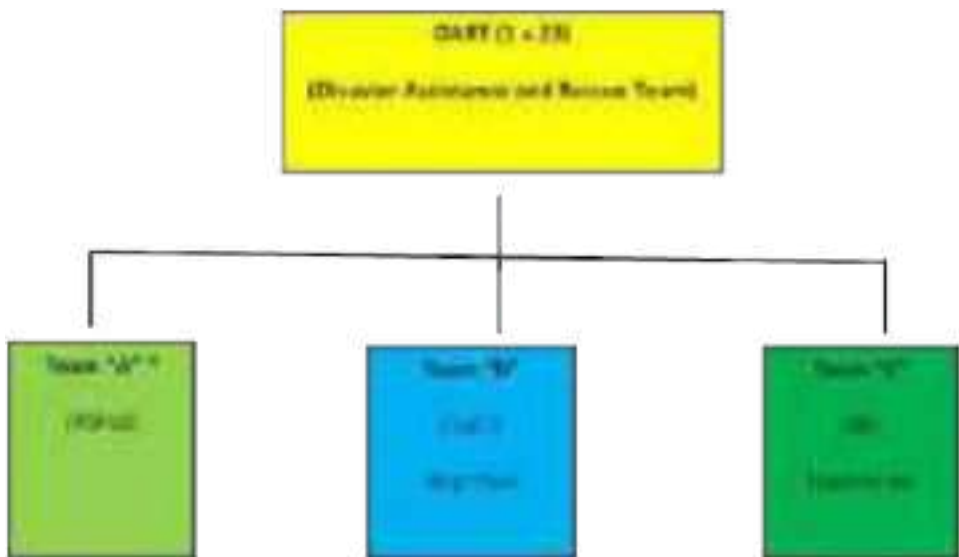


Figure 6: Divisions of SLAF DART deployment

Source: SLAF (2021)

5.6 Self-Belief on Competency in Ac SAR

It was found that each member does not separately go through these JDs/Orders/SOPs in the current practice. This was particularly significant as only 10% of the sample indicated that they are competent in Aircraft SAR operations whilst the rest are not. However, according to the responses, 96% of the sample have been deployed for DART duties while conforming to their respective job speciality of individuals.

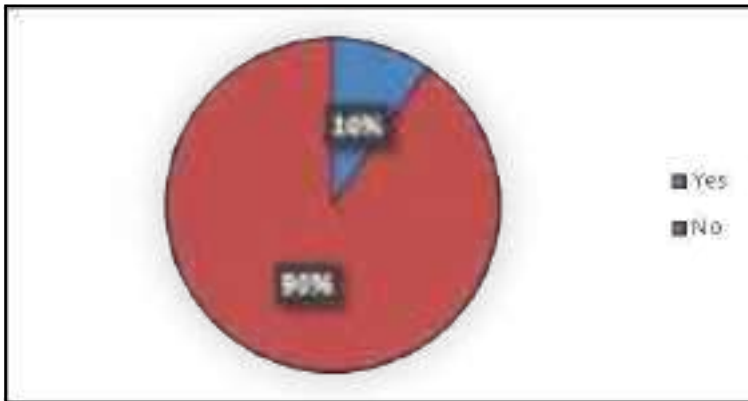


Figure 7: Self-belief on competency in ac SAR

Source: Author (2021)

5.7 Type of Duties to focus other than Ac SAR

According to 96% of the sample, DART personnel are being tasked with HADR related duties other than aircraft SAR. This is reflected in the concentration of the DART personnel that have been diversified due to other allotted tasks apart from aircraft SAR. In return mental readiness of the DART members has not been focused on specifically in aircraft SAR, where the reaction time of individuals would be increased in a real time situation. Furthermore, 80% of the sample indicated that they have not been provided with a separate place to of accommodation during flying operations. CAASL representative (2021), has underpinned that SAR personnel are necessary to be allotted with a suitable place of accommodation during flying operations and should not be assigned for other duties during their tour of duty owing to the preceding facts.

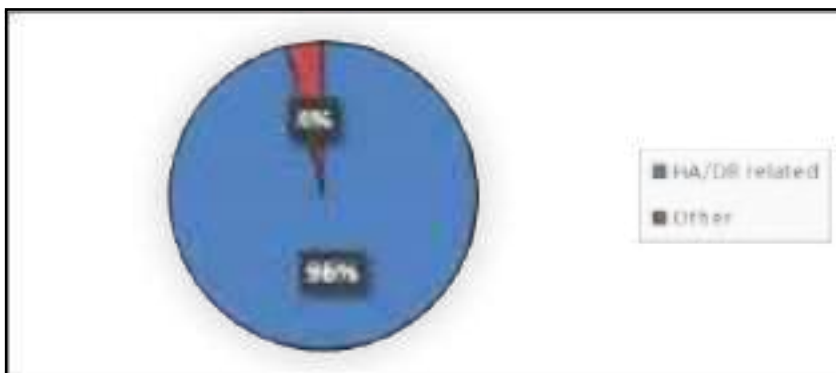


Figure 8: Type of duties to focus other than ac SAR

Source: Author (2021)

5.8 Training Programmes on Aircraft SAR Services

According to the respondents it was revealed that 23% of the sample received training related to aircraft SAR either locally or abroad whilst 77% did not. According to the IAF representative (2021), personnel who were deployed for SAR services have been given specialised training prior to being deployed in the IAF. Further, he stressed that each member of the SAR team within respective air bases are highly trained and constantly evaluated for their readiness and application through simulated exercises.

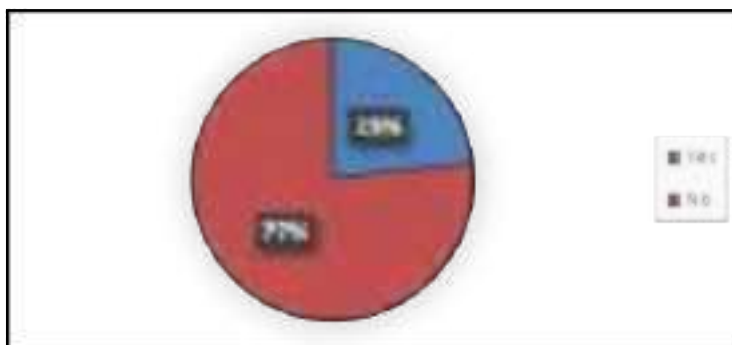


Figure 9: No of personnel in DART who have received training related to ac SAR ops

Source: Author (2021)

However, all respondents positively indicated that SLAF has provided them awareness/training programmes in relation to the array of DART duties with principal focus on HADR operations. Moreover, all respondents stated that these programmes have helped them to work in an ac SAR operation. However, researcher found that sort of a paradox while reading between lines of these two statements and correlating preceding para.

5.9 Participation in Simulation Exercises

The majority (58%) of the sample have attended simulated exercises or drills related to ac SAR, whilst 42% have not attended such exercises at their respective Base level. Thus, it was understood that despite simulation exercises being conducted at air bases all DART members have not got the opportunity to attend such events mainly due to nature of the DART duty roster which functions on a rotation basis.

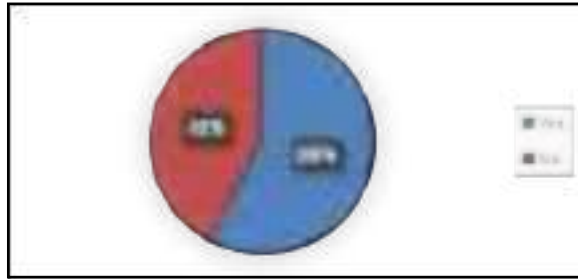


Figure 10: Participation on simulation exercises at Academy/Base level

Source: Author (2021)

On Joint Exercises on Aircraft SAR, it was revealed that none of respondents have participated in joint exercises related to ac SAR operations. However, the interviewee from IAF (2021), indicated that the IAF conducts such exercises at Air Command level at least once a year. Further, he stressed that IAF and Indian Navy (IN) collaboratively conduct such endeavours during air-maritime exercises.

5.10 Execution of SAR Operations

It was noted that the execution of SAR operations are carried out according to a four-step method in the SLAF and same has been illustrated in figure 13.

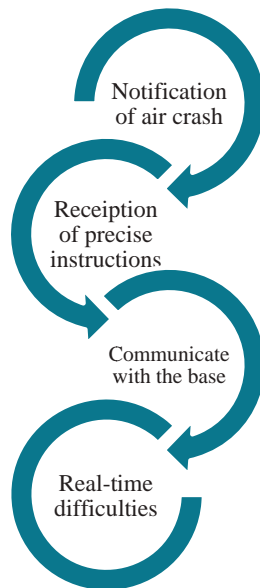


Figure 11: Execution of SAR operations in SLAF

Source: Author (2021)

5.11 Mode of Communication SAR Operations

Inherently, effective communication is essential during SAR ops in order to launch a series of prompt action. Owing to such a backdrop, 48% of the sample indicated that they communicate using the provided communication equipment whilst 23% and 19% respectively communicated through ATC and Regiment units. This is mainly during post situation communication. It was noted that air-ground, ground-air and ground-ground communication is encompassed in this regard. It is to be underscored that the DART Officer in charge relaying instructions to subordinates under his purview during an actual situation required a chain to be established.

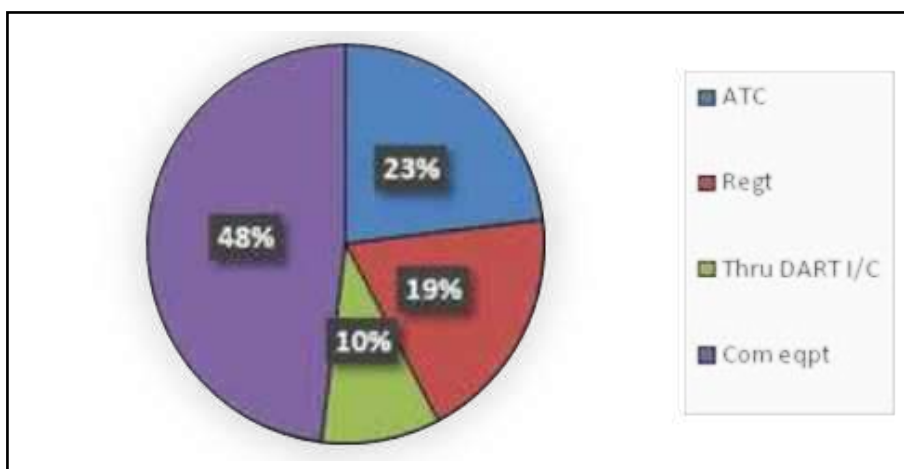


Figure 12: Mode of communication SAR operations

Source: Author (2021)

5.12 Difficulties encountered during SAR Operations

It was revealed that ten (10) personnel of the sample have real time experiences in relation to SAR operations. Further, among them four (04) personnel indicated that they have encountered difficulties with transport. Further, other difficulties that were encountered were communication, identification of crash sites and accessibility to the site with heavy vehicles. This is a common fact that most rescuers encountered while reaching the crash site.

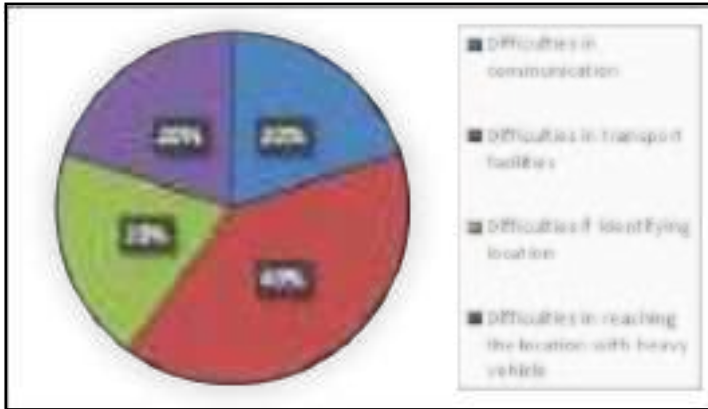


Figure 13: Difficulties encountering during SAR ops
 Source: Author (2021)

5.13 Capabilities and Capacities

According to respondents from the Bangladesh Air Force (BAF) and Pakistan Air Force (PAF) (2021), dedicated rotary wing platforms are available for providing SAR services in respect of civil and military ac in distress. However, according to the respondent from SLAF (2021), SLAF has limited capabilities/capacities to attend such SAR operations considering the extensive SRR. Further, he underpinned that SLAF platforms are not operable at night, possess less amount of training and less experience in handling equipment. It was noted that PAF and BAF have system and human integration to conduct SAR ops. BAF is the main stakeholder in respect of SAR operations in Bangladesh while PAF plays a supporting role to the civil aviation authority.

Table 4: Details of SAR platforms available in regional Air Forces

Type of Platform (a)	BAF	PAF	SLAF
	(b)	(c)	(d)
B-212 A		Ivert 3	B-206
B-206 M		i-171 B	-212
AW 119 A		ugusta B	-412
AW 139		Z-9	Mi-17
		Sea King B	-200

Source: Author (2021)

It is to be underscored that according to the responses, regional Air Forces have signed MOUs with CAA of respective countries while the SLAF is yet to have such an MOU. Further, it was found that the PAF has been conducting SAR exercises within PAF on a weekly basis whilst BAF conducts them once in two weeks. These exercises are conducted by SAR squadrons. Further, joint exercises also conducted involving external agencies such as Army, Navy and Civil aviation authority once every month.

The absence of an integrated mechanism on SAR in Sri Lanka with involvement of external agencies is a serious concern that needs to be addressed. Further, lack of joint exercises at frequent intervals has limited SLAF's exposure to attend to large scale aviation disasters where regional Air Forces have significantly improved.

6. DISCUSSION

6.1 Procedures for Rescue Units

SLAF forms an integral part of the SAR organization of Sri Lanka while termed as a SAR unit by the CAASL (2020). DART represents individual rescue units at air bases level within the SLAF (SLAF representative, 2021). However, it was found that SLAF DART personnel are not thoroughly educated on procedures related to SAR which have been promulgated by the CAASL as indicated earlier. Thus, the researcher opined the necessity to inculcate CAASL SAR procedures to DART personnel through training/awareness programmes.

6.2 Capabilities and Capacities Required to attend SAR Operations

SAR units should be provided with adequate facilities to afford such operations (CAASL, 2020). However, SLAF representative (2021) indicated that SLAF's capabilities are limited principally to provide MSAR services though capable within the mainland. Moreover, it was revealed that adequate technologically advanced apparatus was necessary for SLAF's DART. Thus, researcher opined to augment necessary technological advancements into SLAF's DART.

6.3 Centralised Control

IAF (2015), has indicated that centralized control of SAR operations through respective FICs/ACCs, while the SLAF representative (2021), revealed that such extent was not imbedded within the SLAF or Sri Lanka. The methods of receiving air crash notifications by DART, reflects the non-availability of centralized control. Besides, this has critically impacted the non-reception of precise instructions on DART or duplication of instructions which restricts the DART's effective employment in aircraft SAR operations. Thus, researcher opined the need to establish a unified command and control structure in view of alleviating and/or cease such circumstances and the impact it is having on DART operations. Based on the preceding findings a model framework has been developed to improve the effectiveness of the DART in aircraft SAR engagements.

7. RECOMMENDATIONS

The following recommendations are made in view of creating an effective framework for SLAF's DART in relation to aircraft SAR.

- To inculcate ICAO/CAASL provisions related aircraft SAR and SAR actions among DART personnel through the conduct of systematic training/awareness programmes in order to augment professionalism of DART personnel to engage in aircraft distress situations.
- To introduce common SAR action plan by the Directorate of Air Operations based on CAASL's SAR manual which would eliminate disparities and different practices adapted at the air bases level and same requires to be disseminated at tactical levels.
- To review and restructure of SOPs of DART in respect of aircraft SAR in line with CAASL SAR manual with the objective of attaining the desired end results on conducting SAR operations.
- To provide a proper dedicated place for DART personnel assigned for SAR duties to be accommodated during flying operations at each air base which needs to be equipped with necessary communication equipment.
- To obtain specialised training programmes from foreign Air Forces for personnel involved in SAR operations in view of bolstering their know-

how in relation to aircraft SAR. These programmes would entail firefighting, sea rescue, jungle and land rescue, and participation in foreign combined SAR exercises.

- To acquire dedicated SAR platforms through a smart-stretched re-fleeting for SLAF in view of endeavouring maritime SAR operations within the SRR.
- To induct consensus approach between external agencies within Sri Lanka and offshore in order to sign MOUs in order to yield efficient SAR services within the SRR.
- To study the establishment of collective maritime SAR mechanism in Sri Lanka involving SLN, SLCG and CAASL to provide extensive SAR services within the SRR, as a further research area.

8. CONCLUSION

The SLAF originally established Jungle Rescue units in all SLAF establishments with a view of providing SAR services for aircraft in distress situation either military or civil. However, this organization has been transformed into DART with objective of establishing a robust mechanism to prevent and mitigate the effects of disastrous situations.

The study found that fundamentals of the aircraft SAR procedures, commitment and awareness of the DART crew regarding SAR actions have been reduced as the main focus of the organization is diversified. Consequently, this resulted in unpreparedness, and communication lapses during air crashes have slowed down the reaction time during SLAF aircraft accidents in the recent past.

The study has identified that the work scope of DART has been diversified into two spheres of HADR operations and aircraft SAR engagements. Thus, HADR operations are predominantly concerned with natural and man-made disasters whilst aircraft SAR were found to be less concerned. Moreover, the study found that currently the majority of DART crew are not aware of ICAO/CAASL regulated provisions on SAR and schematic know-how on engagements in SAR operations which induced critical implications on professionalism of DART. Furthermore, a less or non-integration of ICAO regulated SAR actions is also contributing to the preceding issues.

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EFFECTIVE UTILIZATION OF FUEL THROUGH A DIGITIZED FUEL CARD SYSTEM FOR STAFF CARS IN SRI LANKA ARMY

Major Upul Wawegedara

ABSTRACT

System changes are essential for management activities and the cost-efficiency of an organization. Sri Lanka Army (SLA) as the main military establishment of the country uses a manual fuel management system for fuelling and related activities. Suggestions to digitize the manual systems arose at different times and digitized internal management system was a viable suggestion. Yet, the use of digitized internal management system has been delayed due to an array of reasons. Against this backdrop, it is essential to identify the existing limitations of manual fuel management system and to identify the viability of new technological advancements to overcome those limitations. As there is growing tendency towards digitization technology, this research explores the feasibility of introducing a computer-based Digital Fuel Card system to identify and improve the effective utilization of fuel of the SLA staff cars. The research assesses the effectiveness of digital fuel card management system for SLA staff car users based on the perspectives of various stakeholders such as Army officers who use staff cars, car drivers, and staff officers who use the existing manual system. As a data collection method to collect primary data, a questionnaire survey, and simple random sampling was used. Secondary data was gathered from government agencies. The SPSS package was used to evaluate the frequency distribution. Furthermore, it was discovered that four determinants Privacy, Efficiency, Fulfillment, and Reliability are associated with officers' willingness to accept the SLA digital fuel card system. It also indicated that the findings of this study on officer determinants are sufficient to justify the relationship between officers' willingness to adopt and determinants. All of the determinants have a positive relationship and an impact on officer willingness. Therefore, the researcher concludes that, the best way to implement a digital fuel card system integration is with mobile applications. This will assist all staff car members in increasing efficiency, decreasing downtime, receiving real-time alerts, and lowering costs in order to digitize fuel card system.

Key Words: Efficiency, Fuel, Fulfillment, Privacy, Reliability, Sri Lanka Army

1. INTRODUCTION

System changes are essential for management activities and the cost-efficiency of an organization. Today, many companies face many challenges due to competition and increased operational costs (Schoemaker, 2008). They focus on minimizing their operating cost by a significant level to increase their profitability or manage their service effectively. Technology plays a vital role in creating innovation and new systems to convert manual operations to automation systems. The fourth industrial revolution supports

new technology such as cloud computing and the Internet of Things (IoT). Suseelan et al. (2015) mentioned that the automation system supports better management of different organizational internal control systems and saves time with accurate reports under different business status sets. The researcher has also identified that manual activities have taken more time and many activities to manage with flawed frauds arrangement system. It has been identified that it is more challenging to control their costs when using manual systems than automation systems.

The Sri Lanka Army (SLA) plays a significant role in ensuring national security in Sri Lanka. Since, they are spending a considerable amount of money on fuel allocation for their officer's staff cars. Also, they are using manual fuel management systems for their fuel management activities.

Sri Lanka Army Officers of Grade I and above are entitled to have a staff car with 625 litres of fuel per quarter. Presently, the Sri Lanka Army provides 1,493 staff cars for the use of officers. According to the evaluation of existing staff cars' manual fuel management system it has been identified that there are lengthy procedures and manual activities to get fuel coupons printed, distributed, and accounted for. Further, fuel coupons are available in 5, 10, and 15-litre categories. Thus, pumping in between cannot be done, and this practice gives room for widespread malpractices. The manual operations are traditional activities that result in time-consuming, incorrect records, and fewer opportunities for monitoring due to the complexity involved. A response to mend this gap of the Sri Lanka Army staff car fuel management has been a timely requirement for system changes in fuel management by moving forward to the digitized card system.

This study supports identifying new digital fuel card management systems to apply the existing manual fuel management system to effectively utilize fuel, accountability and establish an appropriate overseeing system within the Sri Lanka Army.

Therefore, this study focuses on the research problem: What is the stakeholder's view on adopting a digitized fuel card systems for staff cars in the Sri Lanka Army? Hence, this study aims to analyze the effectiveness of introducing a digital fuel card management system for the fuel management of cars allocated to army officers concerning the views of different stakeholders, such as Army officers who have been allotted the cars, the car drivers, and staff officers who are responsible for operating the existing manual system. The objectives of the study are to identify the impact of

e-service quality parameters on officer's willingness to adopt the digitized fuel management in staff cars, to determine the relationship between e-service quality parameters and officer's willingness to adapt. Furthermore, the study looks to provide recommendations to enhance the e-service quality to upgrade officer's willingness to adapt.

A fuel management system helps create an effective internal control system for the organization with a cost-efficient strategy. This study helps to identify an effective digital system for fuel management activities that supports reducing operational costs, saving time, and finding accurate records under a different set of actions. This system also supports all the Sri Lanka Army stakeholders to easy operations through a better system. Finally, this study helped to find information about system development.

2. RESEARCH QUESTIONS

The study focuses on two categories of research questions, both major and specific:

2.1 Major Research Question

What is the likely influence of e-service quality parameters on conceptualized Service-Action-Process related research variables on Stakeholder preference to adapt digitalized fuel management in staff cars in Sri Lanka Army?

2.2 Specific Research Questions

- What is the impact of e-service quality parameters on officer's willingness to adapt towards digitized fuel management in staff cars in the Sri Lanka Army?
- What is the relationship between e-service quality parameters and officer's willingness to adapt?
- What are the recommendations to enhance the e-service quality to upgrade officers' willingness to adapt?

3. RESEARCH OBJECTIVES

The objectives of the study are as follows:

- To identify the impact of e-service quality parameters on officer's willingness to adapt towards digitized fuel management in staff cars at SLA.
- To determine the relationship between e-service quality parameters and officer's willingness to adaptation.
- To provide recommendations to enhance the e-service quality to upgrade officer's willingness to adapt.

4. METHODOLOGY

4.1 Conceptual Framework

Based on a literature review, variables likely to influence public value have been identified in terms of situation, actors, and processes. A questionnaire was designed, and a survey was conducted to measure public value and Situation-Actor-Process (S-A-P) related variables in the fuel card digitalized system for staff cars. The study proposed an S-A-P based conceptual framework for analyzing the stakeholders' perceived value of a digitalized fuel card management system.

SERVQUAL, initially established by Parasuraman et al. (1998), has been utilized in a number of studies to evaluate service quality from both an IS and a marketing viewpoint. SERVQUAL was recently modified by Parasuraman et al (2005) to evaluate service quality in web-based settings. This was termed 'e-service quality' (e-SQ). The E-S-QUAL scale, a multi-item scale for measuring e-SQ, was developed due to their research. Figure 1 shows the conceptual framework of this study.

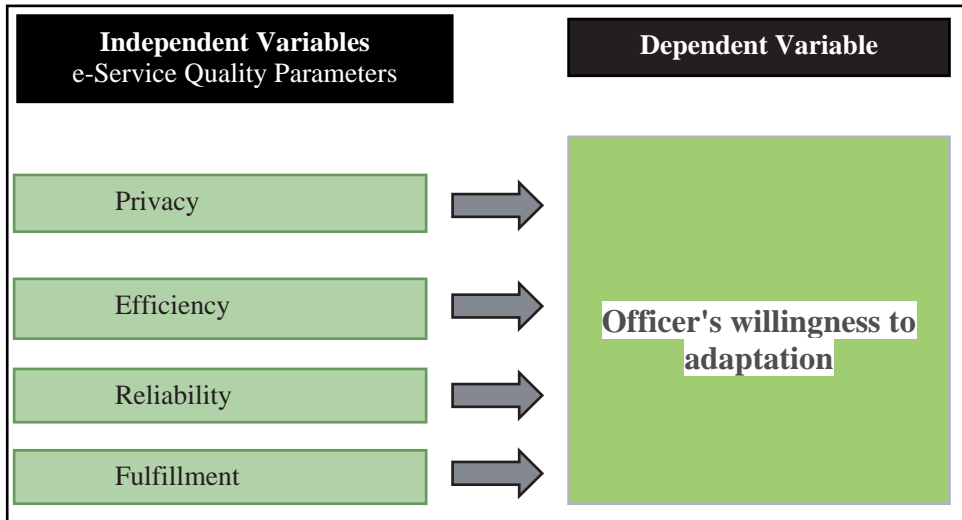


Figure 1: Conceptual Framework

Source: (Developed by author, 2021)

4.2 Population and Sampling

In this study, a questionnaire survey was used to prove research objectives, and this study focused on experiments research strategy. A mixed-method approach was used as the methodology consisting of both quantitative and qualitative data collection and analysis. The sample sizes were 25 Army Grade one and above officers, 25 car drivers, and 20 staff officers operating the existing manual system.

4.3 Data Collection

Primary data was collected using a questionnaire survey. A survey instrument is a constructed questionnaire developed by Gupta et al (2017), that has been validated and checked for reliability. Questions have been prepared to adhere to previous research studies. Secondary data such as population sizes, number of fuel cars etc. The questionnaire that was used for field research comprised the following three distinct sections:

- Respondent Demographics: Questions in this section aimed to capture the age, service experience, and rank of the Sri Lanka Army.
- Stakeholder Preference: This section aimed to measure stakeholder

preference to adapt the digitalized system using the Situation-Action-Process framework scale (Sushil, 2000). Stakeholder preference to adapt three items. Improved Situation (IS), Capability level actors (CLA), and Flexibility of Process Workflow (FPW).

- E-service Quality Measurement: This section comprised the 22 items of E-S-QUAL, measuring the dimensions of efficiency, system availability, fulfilment and privacy.

4.3 Data Analysing and Presentation

In this study, the researcher has identified secondary data collection and different interview output as the primary data by using a proper interview guide. Therefore, a thematic analysis was used to determine proper coding, sub-coding, and themes. A descriptive analysis was done on the problems of the manual fuel management system. The data on preference and service quality was analyzed using a suitable econometric method such as a multiple linear regression analysis using the SPSS software.

4.4 Hypotheses

Following hypothesis has been identified:

- HA1: Privacy influences the stakeholders' perceived value of fuel card management system.
- HA2: Efficiency influences the stakeholders' preference for a fuel card management system.
- HA3: Reliability influences the stakeholders' preference for a fuel card management system.
- HA4: Fulfillment influences the stakeholders' preference for a fuel card management system.

4.5 Reliability Analysis

Reliability of a measure is an indication of the stability and consistency with which the instrument measures the concept and helps to assess the goodness of a measure. The Cronbach's alpha is a reliability coefficient that indicates how well the items in a set are positively correlated to one

another. According to Nunnally (1978), an alpha coefficient of 0.7 or higher is necessary for exploratory research or survey to be considered reliable which indicates that the instruments are reliable.

Table 1: Reliability Test

Variables	No of Statement	Cronbach's Alpha Value
(a)	(b)	(c)
Efficiency	5	0.710
Reliability System Availability	4	0.730
Fulfilment	5	0.724
Privacy	3	0.733
Officers' Willingness to Adopt	5	0.769

Source: Survey Data

5. DESCRIPTIVE STATISTICS

5.1 Determining the Level of Problems of the Manual Fuel Management System

Problems of manual fuel management system include ten indicators. That includes, the manual coupon system the requires lot of paper works and manual system is time consuming. The manual system is not flexible in purchasing the fuel liters that is needed to be purchased, it is a lengthy process to obtain coupons and obtain fuel from Army fuel stations.

Table 2: Problems of Manual Fuel Management System

	Minimum	Maximum	Mean	Std. Deviation
(a)	(b)	(c)	(d)	(e)
As per your opinion the manual coupon system requires lot of paper works	1.00	4.00	2.0580	1.02733
Manual system is time consuming	1.00	5.00	2.5217	1.14543
Manual system is not flexible in obtaining the fuel litres that is needed to be purchased	1.00	5.00	2.4348	1.21846
In obtaining fuel quarterly visits to RHQs to obtain coupons is a hard process	1.00	5.00	2.3623	1.32810
It is a lengthy process to obtain coupons and purchase fuel from petrol stations	1.00	5.00	2.4493	1.30086
It is not quick to update the car owner and the head office about fuel purchasing	1.00	5.00	2.7246	1.25890
The manual process requires lot of agents to complete the process	1.00	5.00	2.3188	.83124
The manual system will not give accurate fuel usage due to coupon system	1.00	5.00	2.2609	.88537
It is a disadvantage that these coupons can only be used in army fuel stations	1.00	5.00	2.2609	.93388
The manual coupons system does not help to build trustworthiness among the stakeholders of this system	1.00	5.00	2.1159	1.06462

Source: Survey Data

Among 69 respondents, not quick to update the car owner and the head office about fuel purchasing is the most significant with the mean of 2.72 rather than other indicators. On the other hand, the lowest mean derived to manual coupon system require a lot of paper work with the mean value of 2.05 representing Table 6.

5.2 Determine the Level of Officer's Willingness to Adopt

In this study, it was found that among 69 respondents, not quick to update the car owner and the head office about fuel purchasing is the most significant with the mean of 2.72 rather than other indicators. As shown in Table 6, the level of Officer's willingness to adapt is low ($M = 2.23$, $SD = 0.952$) because its mean value falls between 1 and 2.5. Similarly, level of all the indicators of Officer's willingness to adopt are low based on the decision rule ($1 < \leq 2.5$). Inability to purchase fuel coupons online without visiting office has the lowest mean value ($M = 1.68$, $SD = 1.091$) in comparison with other indicators. Inability to purchase fuel coupons online without visiting office is a key component of Officer's willingness to adapt that is crucial because it enables them to create an environment of trust and fairness.

Table 3: Officers' Willingness to Adopt

Indicators	Mean	Std. Deviation
Inability to purchase fuel coupons online without visiting office	1.68	1.091
Avoiding a long time to purchase fuel coupons	2.05	1.012
Inability of the system to interact with less number of officers and places	2.42	1.145
System quickly update the information to the car owner	2.17	.906
System has the flexibility to get fuel from multiple service centers within the city	2.20	1.105
Officer's willingness to adapt	2.23	.952

Source: Survey Data

5.3 Efficiency

Table 7 indicates that the mean value of efficiency is 2.23 (SD = 0.656). The mean value falls into first decision rule which means that the level of efficiency is low. The level of all the indicators is low and is depicted by mean values and standard deviations (see Table 7). This shows the speed of customer access service as a result of its ease of use, which is less, leading to save time, effort and to meet customer requirements and properly complete their transactions according to the efficiency of the e-service.

Table 4: Efficiency

Indicators	Mean	Std. Deviation
(a)	(b)	(c)
Makes easy to make the car owner up to date about all the fuel purchases made	2.07	.959
Enable to complete transactions quickly when purchasing fuel from sheds using a Fuel card	2.28	1.249
Fuel card will enable purchasing fuel coupons without visiting the head office	2.31	1.169
Digitalized system (Fuel card) will be simple to use than doing paper works when purchasing fuel	2.45	1.258
Fuel card system will be well organized.	2.26	.720
Efficiency	2.23	.656

Source: Survey Data

5.4 Reliability System Availability

As shown in Table 8, the level of Reliability System Availability is low (M = 2.03, SD = 0.736) because its mean value falls between 1 and 2.5. Similarly, the level of all the indicators of Reliability System Availability is low based on the decision rule (1 < ≤ 2.5). This describes the accuracy of the service delivered. The process and information that appears on the system is not clear, current and complete. The ability to use fuel even without the officer and the intention that the fuel card will work quickly when purchasing fuel, has the highest mean value (M = 2.13 and 2.13 SD = 0.838 and .838) and fuel card will update the car owner about fuel purchases right away, has the lowest mean value (M = 1.66, SD = 1.093) in comparison with other indicators.

Table 5: Reliability System Availability

Indicators	Mean	Std. Deviation
Ability of fuel to use by me even without the officer.	2.13	.838
Fuel card will work quickly when purchasing fuel	2.13	.838
Fuel card will not make problems when I use it	2.10	1.100
Fuel card will update my car owner about fuel purchases right away	1.66	1.093
Reliability System availability	2.03	.736

Source: Survey Data

5.5 Fulfillment

Five indicators have been used to measure the level of fulfillment. Table 9 gives a clear picture about level of fulfilment which indicates that level of fulfilment is low (M = 2.12, SD = 0.963). In addition, the mean value of all the indicators is less than 2.5 which indicates that level of all the indicators of fulfilment is low (see Table 4.10). Table 9 indicates that fuel card will make it easy to obtain fuel from anywhere in the country, has the highest mean value (M = 2.39, SD = 1.087) because the fuel card will make it easy to pump fuel from any Army patrol station.

Table 6: Fulfillment

Indicators	Mean	Std. Deviation
(a)	(b)	(c)
Fuel card will mark all the fuel data just like the manual system	2.10	.987
Fuel card will make it easy to update fuel card from online platform	2.39	1.087
It will quickly update fuel card from the head office than the manual system	2.13	.838
Ability to pump fuel only the amount I need without sticking to coupon values like before	2.10	1.100
No need to provide any paper evidences on the fuel purchases I made	2.01	.931
Fulfillment	2.12	.963

Source: Survey Data

5.6 Privacy

Three indicators were used to measure the level of privacy of SLA Officers. The mean value of all the indicators is 2.08, 2.26, and 2.23 respectively with standard deviations 1.197, 0.699, and 0.869 respectively. The above information is given in Table 10. According to Table 10, the mean value of privacy is 2.19 (SD = 0.600) which indicates that the level of privacy is low. Further, the level of all the indicators of privacy is low (see Table 10). This highlights the unprotected interference and protection of customer’s personal information are at a low level, which preserves the privacy of officers’ and increases their fear when dealing with online services, especially financial information. The second indicator has the highest mean value (M = 2.26, SD = 0.699) which enables it to build trustworthiness with the car owner due to its quick updates about fuel transactions.

Table 7: Privacy

Indicators	Mean	Std. Deviation
(a)	(b)	(c)
Record information about fuel purchasing behavior	2.08	1.197
Enable me to build trustworthiness with my car owner due to its quick updates about fuel purchases	2.26	.699
System will protect all the fuel data purchases rather than manual paper evidences that are likely to lose	2.23	.859
Privacy	2.19	.600

Source: Survey Data

This model summary (Table 11) express privacy, efficiency, fulfilment, reliability system availability as independent variables and Officers’ willingness to adopt as dependent variable. In Table 11 R2 shows the total variation in the depended variable by the independent variable. The score of R2 indicates that privacy, efficiency, fulfilment, reliability and system availability (Independent Variables) explains approximately 49.3% of the variance in Officers’ willingness to adapt (Depended Variable).

Table 8: Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
(a)	(b)	(c)	(d)	(e)
1	.702 ^a	.493	.461	.65041
Predictors: (Constant), Privacy, Efficiency, Fulfilment, Reliability System availability				

Source: Survey Data

Table 9: Regression

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
(a)		(b)	(c)	(d)	(e)	(f)
1	Regression	26.283	4	6.571	15.532	.000 ^b
	Residual	27.074	64	.423		
	Total	53.358	68			

a. Dependent Variable: Officer’s willingness to adopt.
 b. Predictors: (Constant), Privacy, Efficiency, Fulfilment, Reliability System availability

Source: Survey Data

The results in above Table 13 indicates that, efficiency ($p < 0.05$; $\beta = 0.025$), Reliability system availability ($p < 0.05$; $\beta = 0.192$), fulfillment ($p < 0.05$; $\beta = 0.163$) and privacy ($p < 0.05$; $\beta = -0.227$) had not statistically impacted the Officer’s willingness to adopt the digitalized fuel card system. According to the coefficient result, the regression model can be expressed as follows:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4$$

$$Y = 0.025 x_1 + 0.192 x_2 + 0.163 x_3 + 0.227 x_4$$

The constant value according to Table 13 is 1.230, and it shows that the model would be predictable if all the independent variables were zero. According to the model the β value indicates when privacy, efficiency, fulfillment, reliability and system availability increase by one-unit officers’ willingness to adopt increase by 0.25, 0.192, 0.163 and 0.227 respectively.

5.7 Testing Hypotheses

H1: There is a significant impact on efficiency due to the officers’ willingness to adopt. According to Table 13, significance value of efficiency expressed as 0.040, is lesser than 0.05 ($p < 0.05$). Thus, it can be concluded that there is enough evidence to say that there is a significant impact of efficiency on the officers’ willingness to adopt the digitized fuel management in staff cars at SLA.

H2: There is a significant impact from reliability system availability on officers’ willingness to adopt. According to Table 13 the significance value of efficiency expressed as 0.004, is lesser than 0.05 ($p < 0.05$) Thus it can be concluded that there is enough evidence to say that there is a significant impact of reliability system availability on officers’ willingness to adopt digitized fuel management in staff cars at SLA.

H3: There is a significant impact from fulfillment on officers' willingness to adopt. According to Table 13 significance value of efficiency expressed as 0.007, is lesser than 0.05 ($p < 0.05$). Thus, it can be concluded that there is enough evidence to say that there is a significant impact of fulfillment on officers' willingness to adopt digitized fuel management system in staff cars at SLA.

H4: There is a significant impact from privacy on officers' willingness to adopt. According to Table 13 the significance value of efficiency expressed as 0.001, is lesser than 0.05 ($p < 0.05$) Thus, it can be concluded that there is enough evidence to say that there is a significant impact of privacy on officers' willingness to adopt digitized fuel management in staff cars at SLA.

5.8 Relationship between the Efficiency and Officers' Willingness to Adopt

As shown in Table 14, the results indicate that Officers' willingness to adopt is significantly correlated with Efficiency [$r = 0.530$, $p < 0.01$]. The result indicates that efficiency has high positive relationship with Officers' willingness to adopt.

Table 10: The Correlation between Efficiency and Officers' Willingness to Adopt.

Variable (a)	Correlation (b)	Officers' willingness to adopt (c)
Efficiency	Pearson correlation	.530
	Sig.(2 – tailed)	.000
Correlation is significant at the 0.01 level 2- tailed		

Source: Survey Data

5.9 Relationship between the Reliability System Availability and Officers' Willingness to Adopt

As shown in Table 15, the results indicate that Officers' willingness to adopt is significantly correlated with reliability system availability [$r = 0.126$, $p < 0.01$]. The result indicates that the reliability system availability factor has a low positive relationship with HRIS adoption.

Table 11: Correlation Coefficient between Reliability System Availability Factor and Officers' Willingness to Adopt

Variable	Correlation	Officers' willingness to adopt
(a)	(b)	(c)
Reliability System Availability	Pearson correlation	.126**
	Sig.(2 – tailed)	.000
Correlation is significant at the 0.01 level (2- tailed)		

Source: Survey Data

5.10 Relationship between the Fulfillment and Officers' Willingness to Adopt

As shown in Table 16, the results indicate that Officers' willingness to adopt is significantly correlated with fulfillment [$r = 0.179$, $p < 0.01$]. The result indicates that fulfillment has high positive relationship with the Officers' willingness to adopt.

Table 12: Correlation Coefficient between Fulfillment and Officers' willingness to adopt

Variable	Correlation	Officers' willingness to adopt
(a)	(b)	(c)
Fulfillment	Pearson correlation	.179**
	Sig.(2 – tailed)	.000
** Correlation is significant at the 0.01 level (2- tailed)		

Source: Survey Data

5.11 Relationship between the Privacy and Officers' Willingness to Adopt

As shown in Table 17, the results indicate that the Officers' willingness to adopt is significantly correlated with privacy [$r = 0.322$, $p > 0.01$] and it shows a moderate positive relationship with Officers' willingness to adopt.

Table 13: Correlation Coefficient between Privacy and Officers' Willingness to Adopt

Variable	Correlation	Officers' Willingness to Adopt
(a)	(b)	(c)
Privacy	Pearson correlation	.322
	Sig.(2 – tailed)	.588
** Correlation is significant at the 0.01 level (2- tailed)		

Source: Survey Data

6. FINDINGS OF INFERENTIAL STATISTICS

The p-values in regression co-efficient of dimensions and officer's willingness to adopt shows that of all the independent variables were less than 0.05. Hence, this study also discloses the information of this study is sufficient to justify that:

- There is an effect of privacy on the officer's willingness to adopt.
- There is an effect of efficiency on the officer's willingness to adopt.
- There is an effect of fulfilment on the officer's willingness to adopt.
- There is an effect of reliability system availability on the officer's willingness to adopt.

7. CONCLUSIONS AND RECOMMENDATIONS

This research concludes that all four determinants are in association with officers' willingness to accept the fuel system of the SLA. The research findings indicate that the information of this study on determinants of officers' willingness to adopt namely, efficiency, reliability system availability, fulfilment and privacy are sufficient to justify the relationship between

officers' willingness to adopt and the said determinants. Thus, all the determinants have a positive relationship as well as an impact with officer's willingness to accept.

In conclusion, the officers' have to spend time specially to obtain the fuel facility in between their main tasks. Consequently, this can be reduced if the current system is changed. The importance of the declaration of distraction to the main tasks aims to carryout the main tasks of SLA Officers' in an accurate way without spending much time to obtain fuel facilities for the vehicles.

The respondents stated the importance of having proper communication to get things done easily in less time. Secondly, to have a proper understanding and quick feedback. Thirdly, to ensure the accuracy of the information provided. Respondents declared the reasons for having availability is to reduce wastage of time and effort and to fulfill needs as soon as possible.

Empirical findings provide several important managerial implications for SLA by offering them practical guidelines to improve the existing fuel system with the digitized system that can gain employee satisfaction in the SLA. From a strategic standpoint, SLA officials can determine the relative importance of the four determinants in predicting an officer's willingness to adopt. By doing so, SLA officials can determine which determinant(s) they should pay the most attention to.

7.1 Launching the New System Based on Mobile Applications

In the Sri Lankan context, there is very little research related to exploring the ways to evaluate suggestions regarding the current fuel system in SLA. The best way to implement the digital fuel card system is a mobile app for both IOS and Android, so that it could be used anytime and anywhere. This can easily set reminders, upload receipts/documents, and assign multiple users. It will help all SLA staff members to increase efficiency, reduce downtime, provide real time alerts and reduce costs through the digitized fuel card system, which is the easiest and quickest way to manage the entire fuel filling system in SLA.

7.2 Design and Develop Digital Fuel Cards for All Staff Car Users

It is recommended to design and develop a digital fuel card for the benefit of all staff car members of Sri Lanka Army. These digital cards will replace the old fuel books and coupons and save time spent on verifying transactions, collating and update usage information. This design and development task can be delegated to the Directorate of Information Technology Research and Development Wing of Sri Lanka Army.

7.3 Mobile Application for Monitor Fuel Transactions

The researcher has developed a sample mobile fuel monitoring application based on the analysis that was carried out during the research. The mobile application includes basic transaction details, vehicle details and fuel balance of the fuel card. Further, the application supports Global Positioning System (GPS) technology to locate the vehicle in real time. This would facilitate the staff car owner to be up to date with his fuel amount and other relevant details of the vehicle. It is recommended to further develop this mobile application to be integrated with the web-based system.

7.4 Using Expert Knowledge

The importance of using a special software and to get assistance from experts in the field of system design, is because the attractive system and convenient phrases for images need sufficient expertise and experience, to support to establish the system.

7.5 Training Staff

The respondents declared the importance of training staff is to speed up the service required by the officers. This helps to create a special section employing specialist staff in resolving users' issues.

7.6 Evaluating Feedback

The respondents declared the importance of evaluating feedback to minimize errors and improve the reliability and efficiency (Kothari, 2004). Taking into account the quality of electronic services of competitors and the need for improvement on an ongoing basis, commensurate with the requirements of the customers and keeping abreast of evolving needs and assessments of customer satisfaction, there would be information appearing periodically on the website, through customer feedback to improve weaknesses and enhance customer satisfaction. There should be different ways (email, phone, etc.) offered so that the consumer can contact the customer service. Moreover, the problems or concerns will not be solved with a general answer, but with a specific response to the specific problems of each customer.

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ANALYSIS OF THE APPLICABILITY OF ARTIFICIAL INTELLIGENCE FOR SMART SOLDIER CONCEPT WITHIN THE PERIMETER DEFENCE IN SLAF

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ABSTRACT

Modern technology has invaded all organizations and the human lifestyles leading to radical changes in human lives and organizations. Modern technology helps to enhance the efficiency and effectiveness of organizational performances and optimize the number in the workforce in organizations. Currently, the Sri Lanka Air Force has planned to transform the organization, as detailed in Vision 2025, to improve the function of the Sri Lanka Air Force using advanced technology. Therefore, this research investigated the ability to use Artificial Intelligence (AI) to achieve the smart soldier concept in the perimeter defence of Sri Lanka, which is a planned modification to the Sri Lanka Air Force. Technological Adaptation Model (TAM) and the Technological, Organizational, and Environment (TOE) Framework were used to conduct the study. Four independent variables named technology factors, organizational factors, environmental factors and system factors as the independent variable were used. Implementing the AI system successfully was the dependent variable. Strong correlation was shown between technology, and system with the AI system implementation success, but moderate correlation exists between organization and environment with AI system implementation success. Interview results highlighted that Individuals' resistance, Failure of the system, ability to hack and skills of employees are the main challenges with implementing the new system. Moreover, three main themes were identified through interviews named system specifications, human resources specifications and external factors.

Key Words: Artificial Intelligence, Smart Soldier, Perimeter Defence, Technological Adaptation Model, Technological, Organizational, and Environment Framework.

1. INTRODUCTION

Air Base Defense is a specific Regimental duty that must be entrusted to secure the air assets in SLAF (SLAF Doctrine, 2018). Perimeter defence of a particular Air Force installation can be identified as the general all-round defence consisting of Airfield and its related Vulnerable Areas (VAs) and Vulnerable Points (VPs) (Caudill, 2014). Therefore, Commanders consider their actions strategic, operational, or tactical based on whether they achieve the desired objective to safeguard the most valuable assets against the enemy.

The use of technology in defence is timely to provide tremendous assets as well as to enhance the safety and effectiveness of troops during

operations(Headquarters Department of the Army, 2009). AI is considered to be the fourth industrial revolution and it is important to revolutionize the military operations with modern technology. This study further examined that AI is the most suitable way to achieve any mission in warfare, a way of replacing human resources and reducing the risk on human resources of a country. The success of new system implementation in an organization depends on various factors which were identified in this study to understand the applicability of AI to align it with the smart soldier concept. Thus, the research problem was;What are the challenges affect implementing an AI system in SLAF that align with the smart soldier concept and objective was to analyze the applicability of utilizing AI for smart soldier concept in perimeter defence at SLAF.

2. LITERATURE REVIEW

2.1 AI in Defence

Militaries around the world are revolutionizing with the increase in incorporating modern technology in their operations.Improving the decision-making process in military using Artificial Intelligence is a very crucial addition of modern technology to military activities. Developed countries like the USA invest massive funds in AI technology to cover areas such as military and academia, to maintain the economy of the country and increase national security (Mohammad, 2020). Although most of the developed countries try to use AI systems and invest more in them, countries like Sri Lanka use limited AI applications which are yet at an experimental level (Kapugama, 2015).

2.2 Air Base Defence (ABD) and Air Defence (AD)

National air space is most important for a country to protect its national security. Thus, the nation's Air Force must have the ability to conduct its air operations to attain national security objectives. The positive capability of an air operation is always dependent on the security of air assets and operational readiness. The dedicated air base defence system is a solution that can be used to secure its air assets and this creates a feasible environment to carry out aviation operations without any hostile threat. It is not only the principles of defence, but even the use of science, technology and

technological solutions that will act as a force multiplier in Air Base Defence. ABD is most important during peace or wartime that can use to change the condition of warfare.

2.3 The Smart Air Force Concept Sri Lanka

The smart Air Force concept of Sri Lanka Air Force is comprehensively elaborated in the document, Vision 2025. The aim of the smart Air Force is to improve the function of the SLAF and its personnel as a way of facing modern-day global and local challenges (SLAF, 2017). Vision 2025 tries to improve the SLAF with knowledge, technology, productivity, innovation, readiness and core competencies.

2.4 Relationship between AI and Smart Concept

The smart soldier concept will have to be technologically oriented, with much more expertise on its role as compared to generalists. To that extent, it is worth serious consideration that may be taken to convert many more Regiment Wings into specialized Wings to undertake multitasks in order to ensure the optimum utilization of limited manpower. The smart Soldier concept will have to be equipped progressively with modern weapons systems and detection systems, supported by technology-based processes and automation to meet the easy decision-making needs and challenges of the future battlefields. As a basic principle of defense, the centralized command will be feasible with technological support in decision making and the flow of receiving information should be in one line by collecting all the technological assets at the defensive process. In view of that, AI can be introduced to the system as a data collector and decision-maker in any type of security condition.

2.5 The Relationship of System, Organization, Environment and Technological Aspects of AI Implementation

According to correlation and regression results carried out in the data presentation and analysis, the environment did not have any significant relationship with the successful implementation of the AI system related to the smart soldier concept in SLAF. The system had a positive and strong correlation with the AI system related to the smart soldier concept

in SLAF Technology is the second-most strong and positive influence on AI implementation in SLAF which suggests that evaluating the currently existing technological skills must be given a priority in selecting the AI system. As the environment and organizational factors had a positive and moderate correlation with AI implementation in SLAF, the organization should be concerned with both factors when selecting a suitable AI system. In the interviews, the participants highlighted the employees will be the most important part of the technological transformation of the organizations. Interview participants highlighted the importance of using advanced technologies to protect the system from unauthorized persons and actively functioning 24*7. However, the interviewees did not highlight any issues related to the policy, but comprehensively discussed the importance of the AI system for the SLAF and how the SLAF can use AI systems to achieve the function of the organization effectively.

Both interview data and survey data highlighted that ease of use of the AI system and ability to achieve all their daily tasks. This was most important in the AI system if it is to become a success. Moreover, it was highlighted that it is important to maintain the organizational culture to successfully implement the AI system.

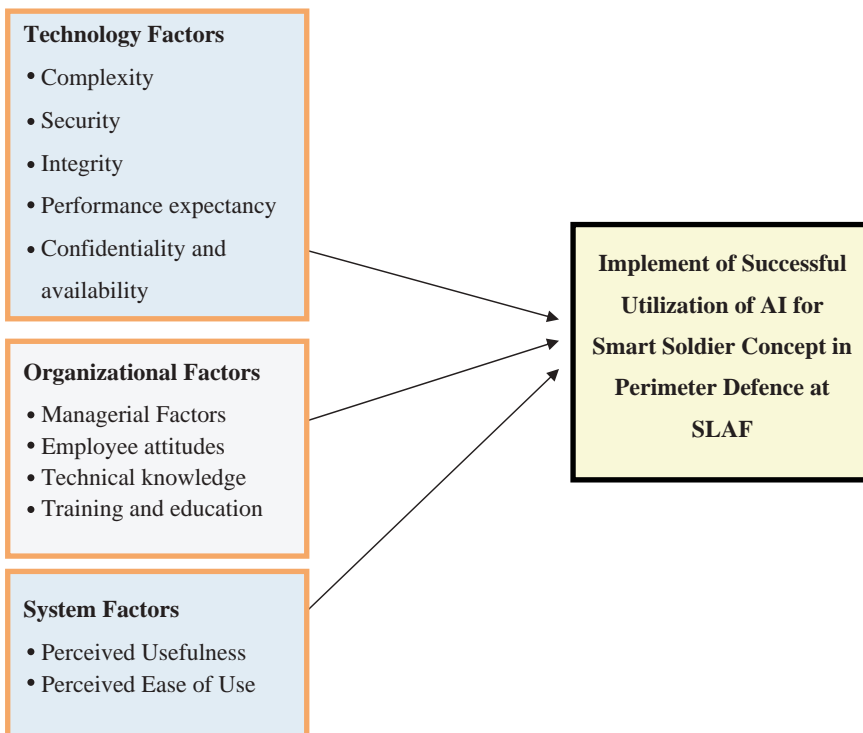
3. CONCLUSION

Three objectives were developed, and the achievement of the objectives are as follows;

- The first objective was to identify the impact of AI for the smart soldier concept to improve defence capabilities of perimeter defence in SLAF. One of the main goals that SLAF can achieve through AI for smart soldier systems is making accurate decisions that may not be sensitive to human practices.
- The second objective was to recognize the major challenges in implementing AI for the smart soldier concept in perimeter defence in SLAF. The primary data highlighted that employees' resistance to change with the new system, lack of basic skills to work with advanced systems and lack of top management support are the main challenges that hamper the AI system implementation successfully.
- The third objective was to identify the most suitable characteristics for an AI smart soldier concept that can be implemented in SLAF perimeter defences in future. It was identified that the availability of the system, power supply

for the system 24*7, ease to interact, confidentiality of the information, system access method with autonomy, centralized system, weapon system, and laser systems are most essential.

This study used TOE and TAM models to identify the factors that affect to AI system related to the smart soldier in SLAF. The research revealed that three contexts of this framework namely Technology, Organizational and Environmental systems are connected and influence the dependable variable of this study. The main factors which influence the usage of the AI system of the smart soldier in SLAF are IT support, complexity, availability, culture/ attitudes, technical knowledge, training and education, language/ age, industry strategy, infrastructure support and Industry Standards and Legal Background, which were mainly identified in this research. Except for the language/ age factor, all other factors had a positive relationship with the usage of the application. The findings of this research study have important implications and value to the managers, IT department of SLAF, and training department, in terms of implementing strong strategies for adapting to the AI application. However, the research result could not prove the relationship between environment and success of AI implementation. Finally, the researcher came up with following conceptual framework based on the result;



4. RECOMMENDATIONS FOR SLAF

The result of the investigation is unique to SLAF as it is concerned with the factors that can affect implementing the AI system successfully. The result supported achieving the Vision 2025 of the SLAF by highlighting important factors to be considered in the research area.

Interviews highlighted the employee resistance in transforming the organization into a new technological development. Therefore, it is essential to use effective communication from the initial stage to pass on a clear view about the organizational transformational process and how it impacts the employees. Otherwise, the negative view can be shared in a particular community and this would impact the success of the technological changes of the organization. The advantage of effective communication in organizational change is getting the support of all the employees and embedded positive views to the employees related to the organization. This also impacts positive attitudes of the individuals.

Most of the literature revealed that the availability of the application is the most important factor which was generated in this study. The organization needs to take this into consideration and find solutions for providing continuous service to the application. It is essential to find the solution and implement them otherwise officers' activities with the application will be a total failure. The organization needs to plan an awareness programme and update their officers on the aforementioned issues with relevant solutions.

The interviews highlighted that some SLAF employees do not have basic skills to work with advanced technology. Also, a survey study showed that the training and development had an impact on technological adaptation. Therefore, before planning and designing a training session, the management needs to collect the problems and views of the officers and needs to address their issues in the training session. As many individuals do have not basic skills to interact with advanced technology like AI systems, the SLAF should identify the weaknesses and strengths of the individuals initially.

Basic technical skills and knowledge to maintain the system and recover the system are highly essential. Therefore, the organization should come up with a suitable approach to provide the necessary basic skills and hands-on experience to work with the system before implementing the system.

According to the views of the participants, the SLAF should implement a sophisticated system with the facilities of Aerial observation, drone system, motion detection system, and face detection for authorization people. System availability is most important after implementing an AI system for operation. Therefore, the SLAF should identify the most suitable level of AI technology for defence system and should implement a continuous power supply method which does not distract the operation. Moreover, a backup system, to store necessary equipment to replace and recover the system are also essential.

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IDENTIFY THE FEASIBILITY OF REFILLING EMPTY CARTRIDGES OF SMALL ARMS AMMUNITION IN SRI LANKA ARMY

Major Sanjaya Karunaratna

ABSTRACT

Excessive spending on ammunition procurement has affected the ability of the Sri Lanka Army to utilize its annual budget in activities that generate a higher return on investment, such as training personnel and acquiring modern equipment. High annual expenditure on ammunition has also resulted in a significant drain on foreign exchange and increased dependence on foreign suppliers.

This study is aimed at identifying the feasibility of the Sri Lanka Army refilling empty cartridges of small arms ammunition (SAA), and its key objectives were to find out the past and present requirements of ammunition in the Army, to study the current refilling process in the Army, to identify the issues with the current refilling process, and to examine how to overcome the current problems in the refilling process.

Further, results indicate that whilst the Army has an SAA refilling depot, this depot cannot produce sufficient volumes of refilled SAA to meet the Army's annual requirements. The study identified several reasons for the depot's inability to meet the SAA needs of the Army, ranging from low manpower and lack of professional training of employees to lack of technology and equipment, poor funding for SAA refilling, the poor state of the SAA refilling factory, and general negligence of the existing refilling process.

Key Words: Small arms ammunition, refilling, cartridges, procurement, technology, manpower.

1. INTRODUCTION

The vibrant export sector, high level of education, an absence of extreme poverty and inequality, relatively well-developed physical infrastructure, and an effective administration have contributed to the development of the country. Currently, the country is dependent on the import of goods produced by other countries, while substances are determined by vital materials. Hence, as a response, policies to minimize excessive import expenses are needed, and priority should be given to areas where local industries would be generated to save unnecessary expenditures.

Moreover, every organization has several ways to save costs and help the government in this challenging situation through innovative ideas. The Sri

Lanka Army (SL Army) can reduce its annual ammunition demand without importing everything required. As a result, it would have a significant impact on the government's overall defense spending. According to details of the Directorate of Operations (Dte of ops), the Army has projected approximately 60 million 7.62 x 39mm and 1.6 million of 9 x 19mm annual average ammunition for the training directives, annual firing, and competitions in the year 2021.



9 x 19mm ammo



7.62 x 39mm ammo

Figure 1: 9 x 19mm and 7.62 x 39mm ammunition

Source: www.nammo.com

Moreover, the Sri Lanka Army has an ammunition refilling process at the Central Armament & Ammunition Depot (CAAD) at Veyangoda. By considering the annual ammunition requirement of the Army for the last five years (9 x 19mm), it can be observed that year by year, the quantity and price have increased gradually. The quantity has increased by 32% and expenditure by 36% from 2017 to 2021. CAAD has two refilling machines for 9 x 19mm ammunition refilling processes at present. The average cost of refilling ammunition was 132,012 rounds, and the average cost was Rs 1,254,114 for the last five years. A proper refilling system would fulfill our annual ammunition requirement by using empty cartridges without wasting them.

2. LITERATURE REVIEW

2.1 Small Arms Ammunition (SAA)

According to Beuan&Pezard (2006), Black powder is a combination of charcoal, sulfur, and potassium nitrate used for making ammunition for

firearms. It was first developed as a propellant for use in cannons in Europe in the 14th century. In the early part of the 17th century, the first cartridge was invented for the first time in history. Small Arms Ammunition (SAA) refers to the entire round/cartridge or its components, including bullets or projectiles, cartridge cases, primers/caps, and propellants (United Nations report, 1999). It is used for small arms and light weapons, consisting of low explosives. Cartridges are the most common type of ammunition used in small weapons.

Refilling is the process of assembling the individual components (case, primer, propellant, and projectile) to produce a new type of usable ammunition. The refilling procedure entails putting all of these pieces together to make a serviceable round. Compared to factory ammunition, the cost per round is significantly lower due to the material used and other relevant variables. According to Bevaux, J. & Pezard, S. (2006) a cartridge is a self-contained unit that includes the case, primer, propellant (powder), and projectile (bullet). A barrel is an integral part of the process of transferring energy, velocity, and direction to the weapon's firing chamber. Small caliber cartridge-based ammunition is available in various sizes, from the smallest to that which is slightly under 12.7 mm caliber. According to the Small Arms Survey. (2005), cartridges for pistols and rifles, as well as shotgun shells, make up small arms ammunition. The primer, propellant, projectile, and case are the four major components of cartridges and shells.

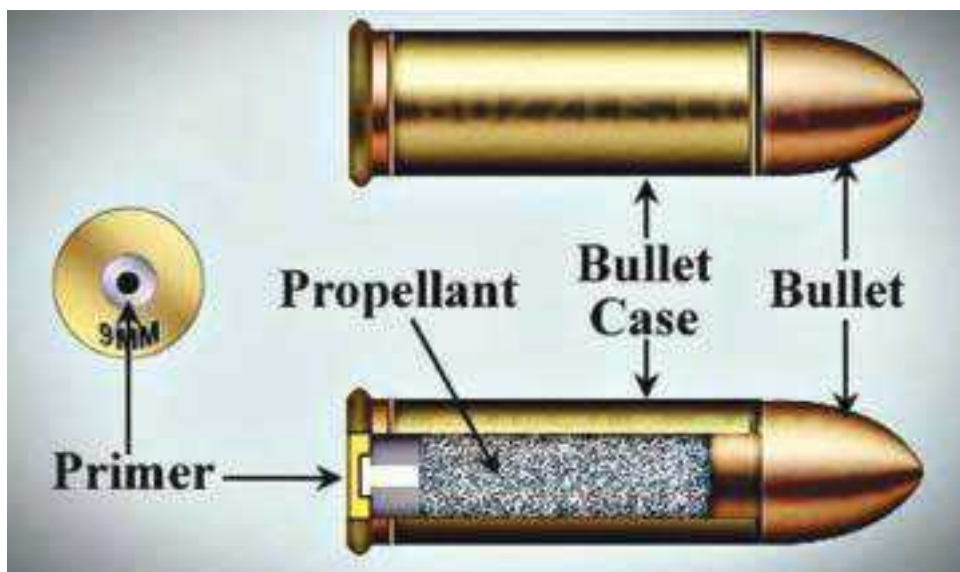


Figure 2: The main component of the SAA

Source: buckeyefirearms.org

Primer - Primers are high-explosive initiating explosives (like dynamite and TNT). They are susceptible to shock and heat and can detonate if exposed to either.

Propellant (powder) - Black powder (a combination of nitrate, charcoal, and sulfur) was superseded by smokeless powder initiated at the end of the 19th century, and it is still in use today. The smokeless powder can be single-base (when nitrocellulose is the solitary explosive) or double-base (when nitrocellulose is the main explosive) if it also contains nitro-glycerine in addition to nitrocellulose (Saferstein, 1995).

Projectile - Different types of bullets can be made depending on the intended use of the ball, armour-piercing, tracer, incendiary, and ranging or spotter. The nose of the bullet can be spherical, half-flattened, or flattened, and the bullet can be cylindrical. A bullet can be fully jacketed, or it can be unjacketed.

Case - The primer, propellant, and projectile are all contained in the cartridge case, the only component that can be reused. The heat-absorbing quality of the cases protects the gun's barrel while shooting. It can be used several times after firing by reproducing as appropriate.

2.2 Refilling and Factory Production Ammunition

According to the Snyder (2014) refilling is a very accurate process that needs the use of specialist equipment. Refilling is not a dangerous and harmful technique; it does need some basic safety precautions and meticulous attention. Refilling has several advantages, including cost savings, enhanced accuracy, and more versatility. Instead of purchasing commercially made ammunition, Refilling is constructing ready-to-fire ammunition from individual cartridge components. The cartridge case may be refilled several times after its first firing, and the process is usually referred to as reloading. The prime motive for people to choose to refill is to save money. Refilling ammunition tends to be less expensive than similarly loaded factory ammunition. The case is the most expensive component of a cartridge, contributing to 60-65 percent of the total cost. Reloading fired cases is a helpful technique to recoup the money spent on ammunition or components since cases may be reworked and loaded several times. Refilling can be saved 50-60% instead of buying factory ammunition. The money saved by utilizing hand-loaded ammunition instead of manufactured ammunition

will vary depending on the components utilized and the kind of cartridge loaded.

In essence, the factory has produced massive amounts of ammunition at the same time. As a result, due to numerous considerations, the cost will be high, and the accuracy will be limited. The cases used for manufacturing ammunition are only used once, and the explosive composition may differ from time to time. Furthermore, the factories are governed by the United Nations norms and regulations, which apply exclusively to larger nations. When it comes to a small country like ours, if it is necessary, it should be imported. Similarly, raw materials and technology employed by the more extensive production are quite challenging to procure (Snyder, J. 2014).

2.3 Annual Small Arms Ammunition Requirement and Expenditure in Sri Lanka Army

According to the Small Arms Survey (2010), the three industries which are key markets for SAA are the military, law enforcement, and civilian sports shooters. Military and law enforcement procurement in non-war nations is primarily for training to replenish or replace outdated stocks. In 2007, the total value of verified imports of SAA and parts was USD 960 million. The United States is the world's largest importer of SAA, accounting for 29% of total imports. No other country's imports accounted for more than 5% of worldwide totals.

In Sri Lanka, ammunition is mainly utilized for training base courses, stockpile updates, and competitions during times of peace. According to authorities, the Army currently lacks SAA in all of the mentioned areas. The reason is that SAA does not import and only uses what is on hand. However, a country's security force must be constantly updated and developed to guarantee human security first. Individual military activities are usually based on two primary SAAs: 7.62 x 39 mm and 9 x 19 mm, used for pistols and personal rifles, respectively. According to the Directorate of Operations and Directorate of Plans (2021), the Army's annual estimated ammunition requirement and expenditures of the last five years are as follows:

Table 1: Annual SAA requirement and expenditure in the SL army

Ser No	Year	Total Annual Quantity of Requirement (Round)	The estimated Unit price for import (Rs)	Total Expenditure (Rs)
(a)	(b)	(c)	(d)	(e)
1.	2021	1,631,890	79.18	129,213,050
2.	2020	1,440,485	72.28	104,118,255
3.	2019	1,182,220	72.28	85,450,861
4.	2018	1,260,300	68.23	85,990,269
5.	2017	1,234,565	66.25	81,789,931

Source: Directorate of Operation and Directorate of Plans (2021)

Table 2: The annual requirement and the expenditure of 7.62 x 39 mm ammunition

Ser No	Year	Total Annual Quantity of Requirement (Round)	Unit price of purchase (Rs)	Total Expenditure (Rs)
(a)	(b)	(c)	(d)	(e)
1.	2021	60,165,538	62.30	3,748,313,017
2.	2020	60,165,538	62.30	3,748,313,017
3.	2019	60,165,538	62.30	3,748,313,017
4.	2018	40,220,235	56.65	2,278,476,312
5.	2017	40,220,235	56.65	2,278,476,312

Source: Directorate of Operation and Directorate of Plans (2021).

2.4 Determinants of Import Substitution

The main idea driving import substitution is that effectively replacing imports in specific categories of the economy with domestic production will modify the economy to make it more resilient, independent, diversified, and effective at generating increased welfare. Initially, when import substitution was first introduced in the 1950s and 1960s, it was as a policy for national economic development to reduce poverty in post-colonial developing countries.

Interest in import substitution as a national economic development strategy was renewed in the late 1970s and early 1980s. A key factor for the renewed interest in importing less was environmental degradation caused by the exploitation of local resources for export purposes. In addition to economic degradation, several global crises such as the OPEC oil embargo

led to an exponential increase in global oil prices and widespread economic disruptions.

Interest in import substitution as a national economic development strategy is primarily driven by two factors, i.e., self-reliance and delocalization. Increased focus of local, regional, and federal governments in reducing wealth and job leakage from local economies. Herman Daly argued that focus on import substitution was necessary because export-driven strategies were unsustainable.

3. PRACTICAL AND THEORETICAL IMPLICATIONS OF THE STUDY

The Army's refilling of ammunition with SAA is critical as it will address two critical issues that the organization currently faces, namely lack of ammunition and high costs associated with purchasing SAA. Poor decision-making has failed to effectively utilize the existing SAA refilling factory of the Army. Given the dilapidated state of the SAA refilling factory, any decision to procure 100% or even a large quantity of SAA through refilling would necessitate the construction of a new factory with new machinery, technology, and raw materials. This decision would also necessitate large-scale recruitment of personnel. The viability of this significant investment in the current economic context of the country is questionable.

A study has shown that purchasing SAA from foreign suppliers has resulted in a massive outflow of foreign exchange from the country. The study suggests that local refilling of SAA will contribute to the development and expansion of subsidiary industries such as the explosives industry. It is consistent with the central premise of Burton (1998) relating to import substitution. The Army's refilling of its tanks with SAA will generate significant financial and other benefits for the Army and the country. This finding of economic benefits from SAA refilling contradicts findings from several empirical studies. For example, import substitution fails to encourage learning and innovation in local companies. This, in turn, resulted in domestic companies becoming high inefficient companies producing sub-standard goods.

4. RECOMMENDATIONS

Sri Lanka Army should implement the following to address the current issues in the SAA refilling process.

New factory

The Army should invest in the construction of a new SAA refilling factory as the current factory is old and rundown, and its capacity is not enough to meet the annual SAA requirements of the organization. In constructing a new factory, the Army should ensure that the factory comprises a section for research and development and for training the workforce.

Equipment and technology

The Army should invest in new SAA refilling equipment and technology as the existing equipment and technology is old, prone to breaking down, and cannot produce the refilling volumes required to meet the annual SAA needs of the army. Investment in new equipment and technology will increase quality, efficiency, and reliability levels at the refilling plant. For example, the high energy efficiency of modern equipment will significantly reduce energy costs whilst increasing productivity levels. The researcher has found the following machines are most appropriate to invest in.



Figure 3: Modern refilling machines

Source: www.dilonprecision.com

Recruitment of new employees

The Army must recruit new employees for the refilling factory as the current workforce cannot produce the volume of SAA refills required by the organization on an annual basis.

Training of new employees

Immediate arrangements should be made to provide existing personnel with professional training in ammunition refilling, and other aspects of arms and ammunition as only 33% of the current workforce have professional qualifications in this regard. Training employees is essential to enhance the current productivity, quality, and reliability standards at the SAA refilling factory.

Raw materials and other supplies

Old explosives and other raw materials should be immediately disposed of, and new explosives and materials should be purchased. Purchasing new raw materials is essential to ensure the high quality and reliability of refilled SAA.

Environment

The Army should ensure that increasing refilling capacity does not adversely impact the environment. Adverse impact on the environment in this regard should be analyzed in terms of environmental pollution caused by the refilling process and the extent to which natural resources are depleted through this process.

Identifying refilling as an essential activity of the Army

The Army should upgrade SAA refilling to a critical activity of the organization given the significant importance of this activity in terms of reducing SL Army cost, reducing reliance on foreign companies for the supply of SAA, and reducing high foreign exchange outflows from the country.

Implementation of the suggested recommendations will address the current issues in the Army refilling process. This should enable the Army to address its current SAA ammunition requirements more effectively whilst reducing high cost and high foreign exchange outflows associated with importing SAA.

5. CONCLUSION

This study has successfully achieved its stated objectives. A key objective of this study was to find the present and future ammunition requirements of the Army. The Army's refilling factory and the process is not sufficient to produce sufficient volumes of refilled SAA to meet the annual requirements of the organization. Low workforce and inadequate professional training of

the manpower, lack of technology, tools, and equipment, poor funding for SAA refilling, and general negligence of the existing refilling process were among the issues identified in this regard.

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JOINTNESS, BOON OR BANE? PERCEPTION VERSUS REALITY

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ABSTRACT

The military's capacity to work together has long been a hot topic. In order to benefit from strengths in the military sphere, the notion of jointness is taught in many professional military colleges. There is literature that claims jointness has certain drawbacks. While some research praises the synergistic effects of joint warfare, other material contends that synergy will not exist and that joint warfare will instead be less effective. Consequently, a study was conducted on the question "Jointness, Boon or Bane?: Perception vs. Reality". Although armed forces have a positive perception of jointness, the researcher hypothesized that it is not always feasible. Twenty respondents were interviewed in semi-structured interviews to gather the data. They comprised tri-service officers with a minimum of ten years' experience. There were 10% European, 15% African, 15% Arab, 20% South East Asian, and 40% South Asian countries in the mix. The purpose of the interview was to find out about two key topics: how they felt about jointness and how much they had experienced it in practice. The results showed that most people have a favorable opinion of jointness. However, the majority lacks real-world experience in a joint military setting. The outcome supports the validity of the theory. Consequently, a number of recommendations were made to enhance the jointness among military organizations.

Key Words: Jointness, Military, Perception, Reality.

1. INTRODUCTION

The notion of 'jointness' in military operations is not new, and its importance has increased significantly over time. To address anticipated threats to national security, the Army, Navy, Air Force, Police, and civil defense forces have previously worked together to enhance total military capabilities. The main goal of jointness today is to reduce the need for numerous, occasionally redundant military procurement programs by utilizing each service's unique assets and skills. Increased total war fighting capabilities are still needed to counter new threats, but doing it with less financial resources is still necessary.

Biemer and O'Brien (2000) states that the term 'joint warfare' gained popularity amongst military practitioners after congressional approval of Goldwater-Nichols Act of 1986 in the late 1980s. However, examples of joint work are not scarce in history beyond the 1980s. Joint warfare brings up metaphors of inter-service, multi-national or even inter-regional force

operating under the command of a designated Joint Force Commander, as in Operation Desert Storm in 1991 or the 1999 conflict in Kosovo, Yugoslavia. Many military organization favour jointness and therefore they execute a variety of activities to improve and train personnel in joint operations. These activities encompass short term plans such as scheduled military exercises to long term plans such as training in a joint environment. Nevertheless, except for a few countries, those military organizations have had very few opportunities to evaluate the effectiveness of their jointness. Military service can be regarded as a long-endured profession. Thus, most military organizations have developed environment-based existence where the Army specializes in land warfare, the Navy in maritime and the Air Force in aerospace. The concept of jointness seems forcefully absorbed despite the traditional existence of being an environment-based forces. Therefore, the culture of jointness or the practical understanding of jointness seems to be lacking in most militaries. Thus, this paper intends to verify the practical understanding of the concept of jointness among military officers.

2. LITERATURE REVIEW

In the West, the word 'joint operations' has a special meaning. Its widespread use in military terminology, formations, and teaching since the 1980s shows that it underpins most military actions. It appears uncontroversial and sensible on the surface. To achieve military success, the three conventional armed services, land, sea, and air (and now space and cyberspace) must operate together. Nevertheless, the expression of 'jointness' would give different meanings to individual readers. Thus, it is necessary to compare and contrast them with other similar words in military terminology for better comprehension of this paper.

The Jointness has been defined as "the quality or state of being common to two or more persons" (Jointness, 2022). The word joint in the military is defined as that which "connotes activities, operations, organizations, etc., in which elements of two or more Military Departments participate". The phrase Joint-concept is defined as that which "Links strategic guidance to the development and employment of future joint force capabilities and serves as "engines for transformation" that may ultimately lead to doctrine, organization, training, materiel, leadership and education, personnel and facilities (DOTMLPF) and policy changes". The word coalition is being defined as "An arrangement between two or more nations for common action". The word combined in military is defined as "A term identifying

two or more forces or agencies of two or more allies operating together” (Gortney, 2016).

The military literature which speaks positively on the concept of jointness are not scarce. Along with the jointness, the prospective concepts such as synergy, inter-operability, optimal resource utilization, unity of effort, augmented cooperation etc were introduced. Further, operations such as Desert Storm are stated as proof for the effectiveness of military action in a joint environment. In addition, various joint doctrines were introduced to enhance the jointness within constituent forces which deliberate precepts for adaptation. NATO’s joint doctrine is one such example.

Nevertheless, jointness has a long history of tensions and failures; yet the literature which speak against the jointness is scarce. While, examples are quoted for the success in joint operations, whether failures have been overlooked is a question to be addressed.

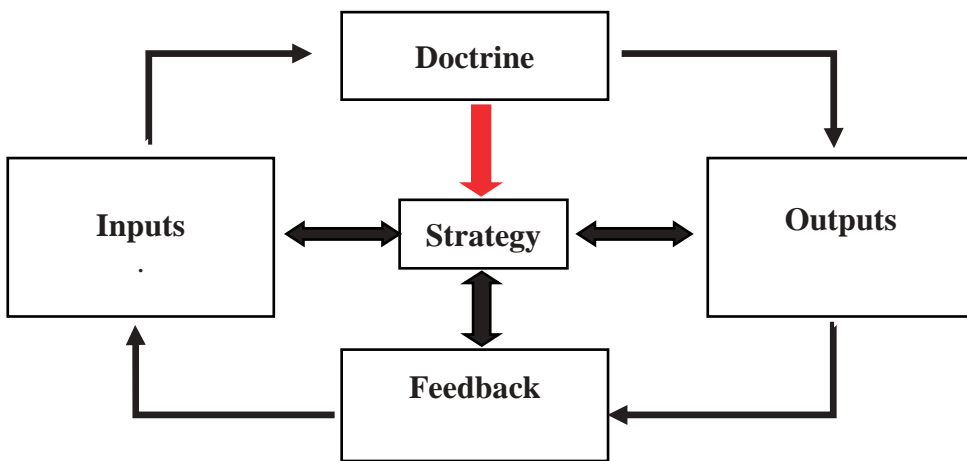
2.1 Developing Jointness

Jointness cannot be achieved overnight. It is a complex design which requires development in various aspects through politico-military level to tactical employment. The following table depicts necessities for joint warfare analysis by time frame as described by Biemer and O’Brien (2000).

Past	Present	Near Future	Far Future
Historical analysis	Doctrine development	System requirements	Technology requirements
Benchmarking	TTP ¹ development	Force structure	Advanced concepts
	Operations planning	Concepts of operation	
	Exercise support	System acquisition	
	Training	PPBS ² support	
	Education	System development	
	Test and evaluation	Experiments	
	Contingency planning	Technology development	

The above table proposes a logical sequence of goals to be achieved to develop jointness. It may not address all the requirements, but gives a forethought on the complexity in achieving a substantial level of jointness. In light of such theory, it is wise to assess the level of present military jointness. In

the contemporary scenario, it is not unfair to state that certain constituents have been addressed. Joint doctrines, joint exercises, joint planning and even joint procurements are not uncommon. However, of all, how many militaries have established a sequential process for jointness development is a question that needs to be answered. This doubt would lead to another problem when developing a joint strategy as flawed doctrines, outputs, inputs and feedbacks will lead to flawed strategy. The following diagram depicts the relationship of strategy to above



Source: NATO, AJP-3.3: Joint Air & Space Operations Doctrine (Change 1).

2.2 Synergy in Jointness

The expression synergy entails the interaction or cooperation of two or more organizations, substances, or other agents to produce a combined effect greater than the sum of their separate effects. The synergy is expected in jointness. A joint planning with complimenting parallel or sequential operations would generate decisive results. The Gulf War 1991 gives a good example of airpower complimenting land forces to conduct ground operations. On the other hand, arguments exist that jointness might not be as synergistic as expected. A fine example can be quoted from the Battle of France, 1940. The French Air elements were extensively decentralized and kept under command of the Land forces. In such an arrangement a greater jointness of air and land elements should be existed as the tactics, techniques and procedures (TTP) are similar as well as unity of command exists within individual combined Land-Air elements. However, post analysis indicated

¹ Tactics, Techniques, and Procedures.

² Planning, Programming, and Budgeting Systems

that France was unable to produce satisfactory results during the battle. There was a lag of four to five hours from sighting as target to dispatching and attacking. In addition, the synergy as a combined force was lacking between Royal Air Force (RAF) and French Air Force. Akin to the above, Overay (1989), referring to the doctrinal differences, explains that “..by the end of the month the two Allies were effectively fighting separate air wars”. While, many other factors have contributed to failures in jointness during the Battle of France, possible negative effects of flawed jointness should not be ignored.

One possible factor which reduces the expected synergy in joint forces would be that one force is dependent on another's actions, and this affects the results generated. Further, during the planning stage, the true potential of military elements might be overlooked for the sake of jointness. Therefore, it is vital to assess the level of jointness existing between services prior to devising a strategy.

2.3 Interoperability in Jointness

Another aspect associated with the jointness is the interoperability. It entails the ability of military equipment or groups to operate in conjunction with each other. The interoperability would reduce the budgetary burden of a nation while improving the effectiveness through acceptance, and delivering services between military elements. This concept would require compatibility between equipment as well as procedures and processes. In the present context, the Army, Navy and Air Force use highly specialized equipment and platforms for their operations. Differences in domains inevitably necessitate equipment to be domain-specific. In such a scenario, achieving interoperability is a challenge. Still there is certain equipment and procedures which would allow the achievement of interoperability, such as communication equipment and training procedures. Yet, the extent of compatibility for complete cross-domain operations needs to be tested prior to integration.

Confirming the statement above, Finlan et al (2021) states that “Interoperability offers more potential from the three services, but requires the development of compatibility through shared training, outlook and technologies. Integration is perhaps the most difficult state to achieve, but offers the most potential through the seamless configuration of the armed forces”. Designing joint operations with ill-estimating of the present capabilities would be

catastrophic. In 1980, Operation Eagle Claw, an ambitious plan to rescue hostages from Iran's capital stands proof for such failure. The mission relied on eight long-range helicopters, which encountered multiple sandstorms enroute to a rendezvous point in Iran to meet the Special Forces, who came via C-130 transport planes. Several of the helicopters (not suited for sandstorms) were predicted to be mechanically damaged at the rendezvous point, and catastrophe struck when one of the cargo planes crashed with a helicopter at the time. Complications in different operational environments are obvious as seen through this accident. Therefore, interoperability is a capability that should be a given serious consideration before it is adopted.

2.4 Inter-Force Rivalry in Jointness

Inter-force rivalry is a popular word as a challenge to jointness. As long as services remain apart, inter-force rivalry, inter-services rivalry or inter-force friction would exist. Inter-force rivalry does not exist only because of mere human nature. Many other factors such as lack of resources, budgetary constraints, differences in doctrines and ill-understanding of capabilities would give rise to friction among services. During WWII, in the campaigns of USA against Germany and Japan, the different services had their own take on the conflict. The Army pursued a 'Europe first' policy, fighting the German Troops on the ground; the Navy's mission was to carry and assist the Army. The Navy, on the other hand, pursued a 'Pacific first' approach. The Navy would be the main military, with the Army playing a supporting function of capturing islands, a position that the Marines, 'the Navy's Army' might fill. The United States Army Air Corps exploited World War II as a chance to gain independence from the Army. It became an independent third military service in 1947.

As such, having only one service comprising of multi-domain capabilities is the most obvious and ideal solution. The upcoming concept of 'oneness' instead of 'jointness' would also entail the fact that service-frictions are detrimental for military effectiveness. Nevertheless, at present, the majority of the armed forces have been configured to have different services. Further, even a single force is configured to exist in regional/ theater commands. In addition, the support systems have also been developed to address this decentralization. Therefore, reconfiguration of these organizations into a single entity would be a mammoth task and would contradict the other accepted military concepts like flexibility through decentralization. Thus, it is fair to argue that true jointness is difficult to achieve within the present

organizational frameworks.

The study utilized semi-structured interviews with randomly selected officers having military service of more than 10 years. The interview was conducted impromptu in order to ascertain the level of understanding in jointness. The questions were designed to obtain data on six aspects of individual officers and their military organization. Those were; theoretical understanding on joint concept, experience in joint operations, experience in joint training, availability of doctrines/ SOP/ orders for joint warfare, perception on jointness and existence of culture of jointness within their military organization.

4. FINDINGS

During the analysis the following results were found:

Theoretical Understanding of Joint Concept

Out of the sample, a majority could not identify the correct definitions of joint warfare given in internationally published joint doctrines. However, the majority of respondents managed to formulate a satisfactory definition with key words of their own within a given time. Majority of the officers failed to distinguish the difference between combined and joint operations.

Experience in Joint Operations

Out of the sample, a majority have not taken part in any joint operation. Further, responders who have experience in joint operation is as low as 5% of the sample. The majority of responders stated that they are not aware of any joint operation conducted by their military organization during their military career.

Experience in Joint Training

The majority of respondents have taken at least one joint training during their service career. However, the majority of respondents' joint training was for less than six months. Only 20% of the respondents had the experience in joint cadet training.

Availability of Doctrines/ SOP/ Orders for Joint Warfare

The majority of responders stated that they do not have Doctrine/ SOPs/ Orders for joint operations within their working environment. However,

the majority stated that their organizations are working on a joint doctrine which is yet to be published.

Perception on Jointness

The majority believes that jointness is a force multiplier and should be adopted in the military. They were able to bring out at least three benefits of jointness but were unable to state at least three disadvantages of jointness. The majority were however able to bring out at least one challenge to jointness.

Existence of Culture of Jointness

The majority of responders stated that they are not aware of the phrase 'Culture of Jointness'. They stated that except for joint functions which are passed down by directives and orders, nothing of a joint nature is taking place. The majority believes that inter-services marriages are available but insignificant, and stated that there are dedicated welfare shops available which serve for all military personnel. They also stated that their military hospitals treat personnel irrespective of their service (i.e Army, Navy and Air Force). While there are dedicated combined schools for their children, they also stated that their camps/ bases do not offer services to sister services unless special directives are issued. The majority also stated that they do not have many close friends in sister services, and added that many welfare facilities available to them are not extended to the sister services.

5. CONCLUSION

During the course of this paper, the expression 'jointness' has been analyzed for its practicality. The objective was to develop an argument based on several overlooked aspects in military concepts. Throughout the literature survey, it was evident that jointness has been positively emphasized while its practicality is under-emphasized.

The complexity of developing jointness has been discussed at early stage to enlighten the reader on the gravity of jointness. Further, a question was introduced to self-assess the present jointness in militaries. In addition, a discussion was held on the fact that flaws in understanding jointness would give rise to a chain reaction for flawed strategy.

The popular term, 'synergy through jointness' has also been discussed and a counter-argument was brought; flawed jointness would lower the military

effectiveness. In addition, the interoperability and its practical difficulties in contemporary scenario were discussed emphasizing the domain-specific military operations. Further inter-services rivalries which had been inherited through decentralization were discussed. Those counter arguments were supplemented with examples from various time lines.

During the thematic analysis of the semi-structured interviews, it was evident that the majority of the respondents have been exposed to joint concepts theoretically. However, they lacked practical understanding of jointness. It was further evident that the majority of military organizations strive to adopt jointness. They lack the culture of jointness within them, and it seems that although jointness is integrated, the organizations still think along traditional lines of environmental based segregation. In addition, the level of practical exposure to the jointness of the majority of the officers was at a very low level.

Thus, from the above it is noteworthy that achieving substantial jointness is a complex process and would require tremendous effort. Further, flawed jointness would generate detrimental effects rather than what is expected.

6. RECOMMENDATIONS

Following recommendations are made from the results of the study.

- To have a time bound plan to integrate jointness in the Armed Forces with short term and long term objectives.
- To develop prerequisites such as joint doctrines as a matter of priority.
- To implement a plan to generate practical exposure to jointness among officers.
- To develop culture of jointness within services.

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