

Application of Proper Asset Management Methodology and Technology in Defence Sector of Sri Lanka

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Abstract

Asset Management is seen as a simple business operation by most of the entities, however modern era demands for complex methodologies to cater the arising business need of optimization of Asset Management. More and more organizations around the globe are realizing the importance of proper Asset Management methodologies and use of technology. Studies done on Asset Management on Defence sector are a very new area of research which military organizations are slowly beginning to realize the importance.

The Sri Lankan defence entities which are one of the largest components of government of Sri Lanka with an annual budget around 200 billion Sri Lankan Rupees, and owning hundreds of assets at their disposal use very traditional methods to manage the assets and their operations and maintenance. Most of the methodologies date back to the Second World War era where the British colonial forces introduced most of the operational procedures and methodologies. It is time to rethink and modernize the Asset Management methodology of the Defence entities in Sri Lanka.

The modern world has seen Information Technology being used in most of the business areas. The Enterprise systems are typically the largest, most complex, and most challenging information systems implemented by firms, representing a significant departure from the individual and departmental information systems prevalent in the past by integrating the key functions and assisting better and timely decision making. The use of IT and Enterprise systems to manage Assets for defence entities in Sri Lanka is evaluated.

With the use of new methodologies Asset Management of defence sector of Sri Lanka can be optimized while supply chain and the operational processes getting more efficient and effective.

Keywords

Defence Sector, Enterprise Systems, Information Systems, Asset Management, Supply Chain Optimization

I. Introduction

Simple definition of a Military asset would be a military asset is a weapon or means of production of weapons or other defensive or offensive devices or capabilities. In extension it can be defined in acquisition and financial reporting purposes, military equipment assets are defined as weapon systems that can be used directly by the Armed Forces to carry out battlefield missions which is not intended for sale in the ordinary course of business or does not ordinarily lose its identity or become a component part of another article [1].

For Armed forces, maintaining asset readiness is a matter of life and death. Whole Fleet Management is set up to enhance the readiness of vehicle and equipment fleets, and improve the efficiency of their deployment [2]. When considering military assets it should not always be the war machines. For an example Australian Defence manages some \$51.5b in total assets of which the largest shares are \$31b in specialist military equipment, \$14b land, buildings,

plant, equipment and infrastructure and approximately \$4b in inventories. Other assets under Defence's management include intangibles and heritage and cultural assets [3].

When it comes to maintaining fleets – aircraft, ships, tanks or trucks – military organizations can learn a great deal from the private sector about warranty and fleet performance management. In most cases, manufacturers do not warranty military fleet equipment. Instead, the sustainment and repair cost is carried by the military maintenance organization that is responsible for the performance, reliability and safety of the equipment. Additionally, the coverage goes beyond a typical warranty period and encompasses the entire life cycle of each piece of equipment, which is often measured in decades. In other words managing assets of a defence entity can be considered different from the asset management of other sectors.

Military branches are challenged to become more expeditionary in nature, with a mandate to be operating in theater in a matter of weeks rather than months, and to be able to sustain operations. Defense operators must transform from fixed supply chains to flexible, on-demand supply networks. To conduct expeditionary and peacekeeping missions, combining joint and coalition capabilities, flexibility, agility and full deploy ability are key. Another key driver for defense operators is interoperability. Defense organizations require logistics capability across their entire operations. The ability to share information across service branches is critical to the effectiveness and efficiency of modern defense organizations, including their ability to cooperate and collaborate with allies and subcontractors.

In the military aviation maintenance sector, mission readiness remains paramount, and defense operators must achieve both reliable and affordable mission readiness. Aircraft and supporting equipment must be operational and ready to go, to respond to expected and unforeseen threats. Readiness management is particularly challenging in the defense environment due to the complexity of the weapons systems, large mixed military fleets, and the fact that weapons platforms are operated out of both permanent and deployed sites worldwide. Efficient fleet maintenance management requires the ability to manage the flow of information between these worldwide sites [4].

The 21st century defence organisations have strong bonds with suppliers, service agencies, government agencies and clients. So the defence entities need solutions to supporting defense agencies connect with each other for real time information. The Sri Lankan Defence Entities with traditional and out dated approaches find it extremely difficult to operate efficiently with the Assets it currently possess. Most of the methodologies date back to the Second World War era where the British colonial forces introduced most of the operational procedures and methodologies. It is essential that new thinking should be given and modern methodologies and technologies should be used to evaluate and transform Asset Management of Sri Lankan Defence Sector.

II. Post war Sri Lanka and the Defence Sector

History reveals that the consequences of war are so momentous that they often mark the division between historical eras. The devastation of war also creates a need for rebuilding and establishment of new political systems designed to restore social stability and to recover lost prosperity [5]. At the same time, war does not wipe everything away; social and political organizations are remade based on pre-war influences while adapting to a new social and political equilibrium [6].

After successfully defeating terrorism in 2009, Sri Lanka entered an era of peace after three decades. The huge cost that was pumped for the war effort was saved and finally it was available for development projects in the country. The post war Sri Lanka has become economically, socially and politically a different place with contrast of war times [7].

The United State of American War College has done studies and has identified the role of military in post war scenario. The main tasks include deterrent of potential threats to safeguard the country, use military force and defeat internal aggression in support of civil authorities, protecting humanitarian relief workers as those representing international agencies, directly engage in humanitarian actions such as delivering humanitarian relief supplies maintaining essential services and reconstruction of damaged structures, the military must routinely work and plan in concert with civilian organizations [8].

Sri Lankan defence forces have successfully performed the above tasks and in a very short time frame they have bring normalcy in war tone provinces of North and East. The government took a policy decision to deploy the defence forces for the development and reconstruction of the country. There are several large construction projects undertaken by the Army, Navy and the Air force. Even the civil defence force has embarked on commercial activities making the usage of Assets they possess. Several examples would be "Ranaviru Apparels" and several major construction projects undertaken by the military including the "Defence Services College".

The post war military with its intension of being a nation builder while engaging in largest development projects in Sri Lanka should consider revising traditional Asset Management and Supply Chain Management procedures. The end of war has given the breathing space for the Sri Lankan military to modernize its processes including Asset Management and Supply Chain Management.

III. Asset Management and Asset Management Systems

According to the PAS-551 standard on asset management from the British Standards Institute, asset management is defined as: "systematic and coordinated activities and practices through which an organization optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over their life cycles for the purpose of achieving its organizational strategic plan" [9].

Embodied in this definition, of course, are assets of various types (physical, financial, human, information and intangible), which all contribute to the organizational strategic plan. Best practices dictate that an Asset Management Plan, comprising of three main sub-plans (Operations, Maintenance and Risk) or its equivalent, be developed and implemented for physical assets [10].

Extracting the maximum value from an asset requires a broad range of expertise, whether that is business and financial know-how, or engineering and operations capabilities. These skills may be required at different stages of an asset's life, when acquiring,

utilising and maintaining the asset, for example. They are also needed to make decisions about how to best combine factors such as costs, risks, and performance. In 2014, the International Organization for Standardisation is due to publish the ISO55000/1/2 family of standards relating to Asset Management. The publication of these standards, currently under development through ISO Committee PC251, with 28 countries participating, will be a significant event for the Asset Management discipline [11].

The analysis by several researchers have concluded the following factors result in poor Asset Management.

A. Lack of a Proper Asset Registry

In common manufacturing industry parlance it is the common approach to asset management. While it might seem intuitively obvious, many organizations either don't appreciate the need to know with a high level of confidence, the assets that they have or they choose not to take the time to do so. Either way, this has to be the first major step taken towards ensuring that organization's asset management is effective. Any organization should commit the following to develop a proper Asset Registry.

- Develop a list of all the organization's assets and verify this list with what is in the field.
- Establish and configure a physical asset hierarchy. ISO 142242 from the International Organization for Standardization (ISO) can be used as reference.
- Develop the criticality evaluation criteria for the business and apply to the verified asset base. This is where the individual assets are linked to how they affect the organizational strategic plan.
- Develop and implement a management of change or configuration management process that will ensure that any future changes to the asset are properly evaluated and recorded.

B. Lack of a Proper Maintenance Plan and Information

During the operational phase of the asset life cycle, there can be a problem of overmaintaining as well as under-maintaining. The key issue regarding over-maintaining typically involves two issues that will make the asset management system ineffective. First, there is generally a significant cost associated with the execution of non-value-added maintenance. In this regard, cost can be loosely used as a guideline since there are well-documented industry benchmarks for maintenance spending that can be followed. Second, the typical organization that can be accused of overmaintaining its assets will most likely be performing intrusive maintenance tasks more frequently.

The issue of under-maintenance and how it prevents effective asset management is even more obvious. Maintenance is often viewed as a business expense open to maximize profits. With these pressures, maintenance departments are constantly struggling with how to balance cost with the performance requirements for the assets such as reliability and uptime. Cost-cutting often wins, however, in the form of delayed proactive maintenance as well as maintenance technicians lacking the necessary skills and tools to perform precise work. On the other hand most organizations suffer from lack of proper information to perform the proactive and reactive maintenance.

With respect to both types of maintenance issues, an organization must select the most critical assets, determine the optimum maintenance requirements of the assets through one of the more rigorous methodologies such as Reliability-Centered Maintenance (RCM). Then the required financial and human resources should be

allocated. Steps should be taken to upgrade the human resources by defining a training plan to close the skills gap of the persons required for the tasks.

C. Improper Operations

Many organizations suffer from a lack of understanding of the inherent design capabilities of their assets and, how best to operate within their ranges to optimize the asset life cycle. For some assets, either operating below or above the design range adversely affects the life of the asset.

D. Improper Risk Management

The basic tenet of best practices asset management dictates that a plan is implemented that not only manages the operation and maintenance of an organization's assets, but also manages the risks associated with the ownership and use of the assets. Risk, in its most elementary form, is a function of consequences and the likelihood of such an event taking place. Risk management takes place on two major fronts: 1) assessment or identification; and 2) management and controls. Each area, when not done well, is a continued contributor to ineffective asset management. The ISO recommends the following four step model for optimum risk management,

- Establish context
- Risk assessment: Risk identification, Risk analysis, Risk evaluation
- Risk treatment
- Monitor and review

E. Lack of Business fit of the existing Asset Management Systems

Recently enterprise asset management systems have become more popularly used within organizations to manage assets. Most systems have inherent deficiencies that prevent holistic management of all the required areas of the plan. As a result, additional secondary systems are often necessary. This generally stems from shortcuts taken during the system implementation. Apart from the systems and technical solutions, often fail to recognize the human resources and business processes are important parts of an organization's asset management system has a big impact. Change management professionals, ICT Professionals and asset infrastructure specialists should be hired for a proper Asset Management system development and implementation [12].

The Asset Management Systems as the last point derives have become the latest trend in managing assets. However improper business requirement analysis and lack of expertise knowledge for asset management has resulted in systems implemented where the desired targets are not achieved.

According to the technical definition an asset management system is defined as "Enterprise Asset Management (EAM) is the management of the assets of an enterprise across departments, facilities, business units and geographical locations. EAM integrates techniques for holistic control and optimization throughout asset life cycles, including design, commissioning, operations and replacement" [11].

In general organizations expect the investment on Enterprise Asset Management systems to provide a framework optimizes and extends asset life cycles and reduces Total Cost of Ownership (TCO) while maximizing Overall Asset Productivity (OAP) and Return on Assets (ROA), which is key for manufacturing and similar industries with high-value equipment. In summary an Enterprise Asset Management System provides,

- Improve return on assets.
- Decrease costs and risk.
- Increase productivity.
- Improve asset-related decision making.
- Increase asset service delivery responsiveness and revenue.
- Facilitate regulatory compliance efforts.
- Lower total cost of ownership [9].

Many leading ERP vendors such as SAP, Oracle, IFS and IBM have developed Enterprise Asset Management Solutions.

Oracle Enterprise Asset Management (Oracle eAM) supports sophisticated, condition-based maintenance strategies for property, plants, and public infrastructure. Oracle eAM's singleinstance design ensures best practices and quality compliance globally, eliminates excess and obsolete spare parts inventories, promotes environmental, health and safety policies, smooth coordination of production and maintenance schedules, and improves both the responsiveness and accuracy of contracted maintenance. Oracle eAM is part of the Oracle E-Business Suite, an integrated set of applications that automates business processes and delivers reliable information in one place while Oracle E-Business Suite helps to make more informed decisions and improve business operations while controlling costs [13].

The EAM solution from IBM "Maximo Enterprise Asset Management" takes the power, performance and possibilities of enterprise asset management to an entirely new level. Built on a single software platform, Maximo Asset Management delivers a comprehensive view of all asset types, production, facilities, transportation and IT across the enterprise. This holistic perspective allows the management to see all assets, as well as identify all of the untapped potential within them [14].

The leading ERP vendor SAP has developed an EAM product which is standards-based for managing physical assets that is production equipment, power grids, machinery, vehicles, or facilities. The SAP EAM solution is geared to increase operational efficiencies, improve asset usage, reduce costs, and better manage capital expenditures throughout the asset lifecycle. The solutions provides faster, more accurate asset reporting and analytics for savvy decision making, heightened visibility into asset performance, risk, and capital expenditures, improved asset utilization with centralized monitoring and control and superior asset performance, efficiency, and reliability with minimized disruptions [15].

IFS, the ERP vendor has a three tiered solution for Asset Management. Asset lifecycle management solution, EAM solution and fleet management solution. The fleet management solution is specialized for managing a fleet of vehicles with providing information depth for maintenance and maximized utilization [16].

In summary a properly implemented EAM solution can boost the performance and improve the return on assets.

IV. Methodological Analysis on Asset Management Inefficiencies in Sri Lankan Defence Sector

The methodology used in this study is by collecting data on assets and procedures in Sri Lankan defence entities.

The greatest point of leverage in future asset management will come from coordinating decisions at strategic, tactical, and operational levels across organizational boundaries. This coordination results from an integrated view of overarching mission requirements as opposed to a functional view of requirements. For example, optimizing the use of transportation assets may in fact diminish capabilities to achieve the overarching mission's objectives. Additionally, decisions at the strategic, tactical, and operational

levels are made by different organizations on different time scales [17].

In other words, the numeric of Assets and the procedures followed can resolve the outcome of proper Asset Management and optimized usage of military assets for operational use. So the methodology of this study is to collect the numerical values of critical assets of the selected Sri Lankan defence entity and analyse the simple process of management of those critical assets. If the process has no integrated information hence resulting in no information flow, the study continues to analyze the modern solutions of asset information integration for the defence sector.

The Sri Lankan military, after thirty years of war with the most ruthless terrorist organization ended up victorious. The victory was purely based on Military and Diplomatic tactics of the military and political leaders. The change of image inside the military personnel making them a winning force rather than a retreating army made the biggest difference while the Sri Lankan government provided the maximum in supply of equipment [18].

On the other hand it can be derived that neither better Asset Management nor Supply Chain Management caused the military success of the Sri Lankan defence forces in 2009. In reality the military was relying on the traditional and out dated procedures for Asset Management and Supply Chain Management while the fighting units were modernize with tactics and equipment and doubling the number of troops after 2007.

For the analysis the Sri Lanka Army Asset Management is considered since it is the largest branch of the Sri Lankan military

forces and consists of most number of assets.

The Asset Management tasks are conducted by the Sri Lanka Army Ordnance Corps (SLAOC). The Sri Lanka Army Ordnance Corps is responsible for the Provision, Receipt, Maintenance, Storage Issue and disposal of all Ordnance Stores required by the Sri Lanka Army. The Military equipment and ordnance are handled by the Sri Lanka Army Ordnance Corps. However the SLAOC is the evolution of The Ceylon Army Ordnance Corps (CAOC) was formed in 1949 on the pattern of Royal Army Ordnance Corps (RAOC). In contrary the Asset Management and Store Management procedures still practiced are based on RAOC procedures in 1949 [19].

The Asset Management of the Army became a complex task with the outbreak of the war and with the procurement of military machines from several countries. The operational life cycle support was so complex with the need to support spare parts and skilled personnel from several countries with the complex nature of global politics. This analysis is based on the military machine procurement that resulted in the complex fleet of military machines and vehicles where the traditional asset management resulted in waste of public funds where the optimum life cycle of these machines were lost.

The data set is comprised with the figures of the Sri Lankan Army fleet of Tanks, Armoured Fighting Vehicles, Armoured Personnel Careers, Artillery Guns and Rocket Launches, Trucks and Utility Vehicles which are currently operational. The author wishes not to disclose the source of the data obtained.

Tanks

Table 1: Tanks

Type and Model	Category	Country and Year Procured	Number Procured
T-55	Tank	Czechoslovakia - 1991	25
VT-55	Tank/ARV	Czechoslovakia - 1991	2
T-55AM-2	Tank	Czech Republic - 1997	18
MT-55A	Tank/BLT	Czech Republic - 2000	2
T-55AM-2	Tank	Czech Republic - 2001	36
VT-55	Tank/ARV	Czech Republic - 2002	6

Armoured Fighting Vehicles (AFV)/Armoured Personnel Careers (APC)

Table 2 : AFVs and APCs

Type and Model	Category	Country and Year Procured	Number Procured
YW-531/Type-63	APC	China - 1988	10
WZ-551/Type-90	APC	China - 1991	10
YW-309/Type-85	AFV	China - 1992	20
YW-531H/Type-85	APC	China - 1992	20
BMP-1	AFV	Ukraine - 1994	12
BMP-2	AFV	Ukraine - 1994	4
BTR-80	APC	Russia - 1997	12
BTR-80A	APC	Russia - 2001	16
BMP-2	AFV	Russia - 2001	36
WZ-551A/Type-92A	APC	China - 2006	120
WZ-551A/Type-92A	AFV	China - 2007	70
YW534/Type-89	APC	China - 2007	25

Artillery Guns and Multiple Rocket Launches (MRL)

Table 3: Guns and MRLs

Type and Model	Category	Country and Year Procured	Number Procured
Type-83 (122mm)	Towed Gun	China - 1991	20
Type-59-1 (130mm)	Towed Gun	China - 1991	12
Type-66 (152mm)	Towed Gun	China - 1996	36
Type-83 (122mm)	Towed Gun	China - 1997	35
Type-59-1 (130mm)	Towed Gun	China - 2005	22
KRL-122 (122mm)	MRL	Pakistan - 2000	6
RM-70 (122mm)	MRL	Czech Republic - 2000	16
RM-70 (122mm)	MRL	Slovakia - 2002	8
Type-81(122mm)	MRL	China - 2006	3

Trucks

Table 4: Trucks

Type and Model	Category	Country Procured	Number in Use
Tiema XC 2200	Heavy Truck (6x6)	China	45
Dongfeng EQ 2102	Heavy Truck (6x6)	China	7
Tatra 813	Heavy Truck (8x8)	Czech Republic	6
Ashok Leyland Comet	Medium Truck (4x4)	India	115
Ashok Leyland Ecomet	Light Truck (4x2)	India	35
TATA LPT 709	Light Truck (4x2)	India	290
TATA SA 1212	Medium Truck (4x4)	India	75
TATA SE 1210	Medium Truck (4x4)	India	190
TATA SE 1210	Medium Truck (4x2)	India	135
TATA SD 1015	Medium Truck (4x4)	India	80
TATA SE 1613	Medium Truck (4x2)	India	65
HOWO SINOTRUCK	Heavy Truck (4x6)	China	30

Utility Vehicles

Table 5 : Utility Vehicles

Type and Model	Category	Country Procured	Number in Use
Toyota Land Cruiser	4x4 Utility (70 Series)	Japan	90
Land Rover Defender	4x4 Utility (110)	United Kingdom	195
Land Rover Defender	4x4 Utility (90)	United Kingdom	55
Toyota Prado	Luxury SUV	Japan	25
TATA 207 (4x2)	Utility – Single Cabin	India	220
Mahindra Bolero (4x2)	Utility – Single Cabin	India	160
Mahindra Bolero (4x4)	Utility - SUV	India	60
Mahindra Invader (4x4)	Utility - SUV	India	15
TATA Sumo (4x4)	Utility - SUV	India	35
TATA Sumo (4x2)	Utility - SUV	India	45
TATA 207 (4x4)	Utility – Double Cabin	India	30
Maruti Gipsy (4x4)	Utility	India	25
Mitsubishi L200 (4x2)	Utility – Double Cabin	Japan	60
Mitsubishi L200 (4x4)	Utility – Double Cabin	Japan	130
Isuzu KB (4x4)	Utility – Double Cabin	Japan	70
Isuzu Rodeo (4x2)	Utility – Double Cabin	Japan	15
Toyota Hilux (4x4)	Utility – Double Cabin	Japan	40
Mitsubishi L300 (4x2)	Utility – Van	Japan	65

The Sri Lanka Army's light vehicle fleet was vastly extended by the capture of large number of LTTE used vehicles. It included Toyota Hilux, Mitsubishi L200, Nissan and Isuzu pickups, Toyota Hiace Vans, Mitsubishi Pajeros, Toyota Land cruisers and Prados and several types of light vehicles. Other than the above data set there are several sets of small number of other vehicles which were donated or procured for special purposes.

As the above data set illustrates the fleet of the Sri Lanka Army is so diverse. The manufactured and country and the maker varies making the maintenance cycles diverse and complex. To optimize this kind of a fleet, the information depth and the real time information is critical. The processes also should be optimized to cater the operational need to use the fleet to maximize the operational efficiency.

To analyze the processes of Asset Management and Maintenance the simplified process was captured in steps.

Step 1 – Procurement of the Vehicle through Ministry of Defence or Sri Lanka Army and handing over to Sri Lanka Army Ordnance Corps.

Step 2 – Registration of the Vehicle in Department of Motor Traffic. (For special vehicles such as tanks this step is not necessary)

Step 3 – Registration of the Vehicle in Sri Lanka Army Ordnance Corps' vehicle registry. Once the registration is done it is issued with a "UHA" number. (In Sinhalese "UHA" is the shortened form of saying Army. Every vehicle including tanks have a "UHA" number according to the category of the vehicle.)

Step 4 – Dispatching the vehicle to the relevant unit of the Army. Once the vehicle is dispatched in to a unit or an area command, the unit of Sri Lanka Electrical and Mechanical Engineers (SLEME) responsible for the relevant area takes over the maintenance of the vehicle. Periodical and non-periodical maintenance and repair work is carried out in a SLEME workshop under the responsible SLEME unit. The operational authority and decision making is done by the relevant commander of the unit, in contrary operational usage of the asset is decided by the relevant commander.

Step 5 – When it comes to disposing the vehicle, first the relevant unit owning the vehicle reports that the vehicle should be disposed. Then SLEME unit responsible for the vehicle prepares a report stating that it is ready for disposal. The next steps are once again taken over by the Sri Lanka Army Ordnance Corps and the vehicle is brought to a yard of a SLAOC unit. After preparing a list and approvals from the Ministry of Defence and the Treasury of Sri Lanka the vehicle is auctioned and removed from the list of Vehicles in SLAOC. This process usually takes three years.

This out dated procedure of Asset Management and fleet management has resulted in a big drawback which is the lack of coordination between the registration entity, maintaining entity and the operational entity of the Asset. The information flow from each entity to the next is almost zero and it gets worse when the Asset is transferred for a different operational unit during the life cycle. The life cycle management of the Asset is purely based on the decisions made by the operational entity and maintaining entity just follow the instructions given by the operational entity.

The critical information such as return on assets, optimized productivity levels and decision making and Total cost of ownership is never calculated because the silos of information in different entities and the information flow does not exist for optimum decision making.

V. Asset Management Innovations and the Importance of Supply Chain Management for the Defence Sector

The military supply chain always focus on the essentials such as

food, water and fuel, however effective management of the spare parts supply chain for vehicles, aircraft and other equipment can also be a matter of mission success or failure. The military and the defence industry that supports it have large, complex and volatile supply chains. A country's military needs supplies where its troops are deployed, regardless of how difficult the task of getting it there. The value to military organizations to identify performance, reliability and safety issues that affect mission-critical equipment from aircraft and helicopters to tanks and trucks is critical [20]. Since military budgets around the world, especially in Western Europe, have been on a downward spiral for years, many countries have been forced to take radical measures so that they can continue to carry out their missions. Logistics represents one of the largest monetary outlays for military forces that actively deploy and one of the main areas where even a small percentage in improvement can mean large savings. Fortunately, age-old logistics practices are beginning to change. The military is actively training up to run the military more like a business, with the term "efficiency" being used with increasing frequency. Encompassed in this is the procurement of information systems to provide global and near real-time visibility of asset and engineering data [21].

The British military has launched a project called Joint Asset Management and Engineering Solutions (JAMES) to stream line and to introduce Information Technology for Asset Management. These massive improvements in fleet wide performance and reliability management have been made possible by innovations in advanced emerging issue detection algorithms. In traditional fleet management, top-issue lists (in the commercial sector) and top-degrader lists (in the military sector) are used to identify and track those issues that affect the fleet's performance, reliability, maintenance costs and safety [22].

The Joint Asset Management and Engineering Solutions (JAMES) has addressed the British military's requirements of expeditionary warfare, invariably demands short planning times, so to plan for future operations Commanders need precise and timely information on units, formations and fleets, including:

- Location of the Asset
- State of operability of the Asset
- Configuration and readiness of the Asset [23]

The Australian defence forces in 2002-03, continued implementation of an improved asset management and reporting framework which began in February 2001. The framework seeks to better:

- Integrate asset planning, management and disposal decisions into corporate planning processes
- Ensure that asset planning decisions are based on evaluation of alternatives, including life-cycle costs, benefits and risks of ownership
- Assign responsibility and accountability for asset management policy development, accounting and reporting
- Increase the involvement of senior Defence committees in balance sheet management of key assets.

This framework is consistent with the Australian National Audit Office (ANAO) Asset Management Handbook, published in 1998. A key objective of the framework is to assist the department in complying with section 44 of the Financial Management and Accountability Act 1997 which specifies that the Chief Executive is responsible for promoting the efficient, effective and ethical use of resources.

As part of this new asset management responsibility, workshops were conducted during the year with all systems project offices in the Defence Materiel Organisation to explain the implications of this new role, particularly in terms of financial reporting and improved

understanding of the cost of asset ownership. The consolidation of specialist military equipment asset management into a single organization enables improved visibility of both financial management issues and cost of ownership performance.

The asset acquisition process, including whole-of-life costs, is being refined through a strengthening of the planning, estimation, risk assessment and approval process prior to acquisition. This will provide improved management of asset acquisition, including cost and delivery delay aspects. An improved capability costing model is being developed. The consolidation of registration of all assets into Defence's primary asset register, the Resource and Output Management Accounting Network and it has improved the accuracy of records and supported decision making in regard to asset acquisition and divestment programs [24].

The US Department of Defense systematically reducing large inventories, replenishment supplies, and safety stocks. However with the modern asymmetric warfare it necessitate faster, more automated capabilities to:

- Monitor the operational readiness of materiel and equipment
- Predict equipment failure using forecasting and simulation technologies
- Rapidly identify, order, acquire, source, pack, and transport required sustainment supplies and equipment
- Monitor and enhance retrograde movement and repair of failed components and return of items to inventory for reissue.

The overriding common goal of these programs is to enable the warfighter to project and sustain overwhelming combat power sooner through better control of the logistics pipeline. For this purpose US Department of Defense has come up with an Advanced Logistics solution called the Advanced Logistics Program (ALP) that will develop automated, multi-echelon, collaborative information systems/transportation technologies that will provide warfighters with an unprecedented capability to monitor, rapidly replan and re-execute logistical support [21].

VI. Conclusion

Proper asset management in the defence sector globally is a new area of research. Being a developing country, optimizing asset operations will save millions of Sri Lankan rupees since the number of Assets in the Sri Lankan defence sector is big. Usage of an integrated ICT solution can enhance the management of Assets and the following are some of the case studies which can be used as influential research and developments.

The four key areas that must be adopted or utilized more effectively to improve Asset Management practice are:

- Effective decision making. Improving decision making across the organization, through better use of longer term financial, and non-financial, metrics to deliver value for all involved in managing assets.
- Organizational changes. Organizations must evolve to enable better decision making and share knowledge and skills, breaking down silos and boundaries resulting from functional specialism and multiple cost centers.
- Data capture, sharing and standards. Improving the quality and availability of the information available for decision making.
- Predictive analytics. New information technologies are available to improve Asset Management, but several barriers prevent their effective use [11].

The Asset Managers of the military should be able to redistribute

assets in motion when an operational need arises. Evolving military logistics information systems will enhance the availability and the visibility of military assets across the globe which the tacticians can be used for their operational tasks [22].

The up-to-date information on Assets are critical for a modern day battle field where the military assets play a key role in the dynamic theatres of war in the 21st century [23].

The use of information technology for proper Asset Management or Fleet Management can be illustrated by a UK Government commissioned study in 2001 identified that the MOD had:

- Poor visibility of: Land equipment configuration, locations, ownership, usage, maintenance, reliability and availability
- Inefficient maintenance techniques and procedures, which did not implement Reliabilitycentered Maintenance (RCM) well and involved little data analysis
- Few effective logistic support partnerships with Industry.

Further the report recommended: "Fleet Management (FM) and Engineering & Asset Management (E&AM) as key areas for improvement and rationalization across the Defence Logistics organizations and into the Front-Line Commands". The application of commercial Information Technology (IT) systems that allowed the rapid sharing of data and resulted in better logistical decision making allowing commanders to calculate the military risks accurately.

In addition, three critical processes are needed to support a typical requirement for a Commander to deploy:

- Planning of vehicle requirements against operational and training plans and cascade of plans down the chain of command
- Allocation of vehicles to meet plans, tasking and recording of usage information on task completion
- Forward planning at the highest level of operational command for operations and training, founded on directed training plans and any other ad hoc plans;
- Enable units to be able to identify vehicles by variant, model and quantity;
- Enable the Unit Fleet Manager to compare planned requirements against vehicle holdings and assess spares needs;
- When the equipment demands are satisfied, units and sub-units can allocate crews to vehicles
- Details of vehicle usage and manage consequent programming of inspection and/or maintenance [26].
- Fleet Management is the first step towards delivering the benefits of engineering and effective asset management for the military. Once all equipment is identified and is being managed coherently, true maintenance, repair and overhaul management capability can be introduced delivering real savings by the efficient management of spares, consumables and the more effective use of assets through life. Co-ordination of engineering specifications from conceptual design, through as-built and as-maintained provides maintenance crews with up-to-date specifications and the confidence to know that each asset is being maintained according to the original equipment manufacturers latest standards and revisions.
- Overall, the benefits to the Commander are through the visibility and, hence, control a Fleet Management ICT Solution. A well suited Asset Management solution for the military should take control of the following tasks granting the edge for battlefield commanders. The following ICT solution is a good case sample to illustrate the capability of ICT for battle winning Asset Management tactics.

- SMART Asset Management is the compatible mobile app that scans passive and active RFID tags and barcodes for enhanced tracking and location. Users can select an asset or group of assets to determine their current locations or they can view assets located in a specific room, floor, building or other location. Assets scanned
- via Wi-Fi are immediately synced to Asset Management system. This simple ICT solution enables battle field commanders to,
- Automate asset assignment and categorization
- Track the full chain of custody of an asset, including detailed information about who the asset is currently assigned to, and all
- previous user assignments of the asset
- Manage warranties and service agreements
- Facilitate maintenance, repair and operations tracking and scheduling
- Enable real-time exceptions and/or incident notification
- Enable condition-based maintenance, testing, scheduling and reading
- Automate maintenance work order processing
- Provide visibility into operational, financial and life cycle performance of assets
- Provide information regarding cost of asset ownership
- Automates and streamlines business processes for asset transfers, reclassifications, disposals and other standard asset accounting tasks
- Facilitates automated data acquisition through radio frequency identification, global positioning system and barcode scanning [27].

The Military Strategy and the Asset Management Strategy has to be aligned to get the maximum military advantage during an operation. In other words proper Asset Management and up-to-date Asset Information are critical for a success of a military operation [28].

With a successful implementation of proper Asset Management methodology [29,30] and operational procedures, Sri Lankan military branches may be able to optimize the usage of military assets during peace time or in a war scenario. The operational cost saving may be in millions of Sri Lankan rupees which may have to be a separate research area to calculate the benefits. So when considering the status of current operations of Sri Lankan military branches it can be said that a sustainable and suitable ICT solution for Asset Management with proper methodologies is possible and the benefits will be in millions of Sri Lankan rupees.

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