

INVENTORY MANAGEMENT OF EQUIPMENT & SPARES PARTS

IN INDIAN NAVY- ISSUES AND SUGGESTIONS

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CERTIFICATE

I have the pleasure to certify that Captain Hari Krishnan Nair, has pursued his research work and prepared the present dissertation titled 'INVENTORY MANAGEMENT OF EQUIPMENT & SPARES PARTS IN INDIAN NAVY- ISSUES AND SUGGESTIONS' under my guidance and supervision. The same is result of research done by him and to best of my knowledge; no part of the same has been part of any monograph, dissertation or book earlier. This is being submitted to the Indian Institute of Public Administration, New Delhi for the purpose of Master's Diploma in Public Administration in partial fulfillment of the requirement for the Advanced Professional Programme in Public Administration (APPPA) of Indian Institute of Public Administration (IIPA), New Delhi.

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GLOSSARY OF TERMS

3PL	:	Third Party Logistics
ACL	:	Annual Consumption Limit
ACPOP:		Alternate Commercial Product Ordering Program
AGV	:	Automatic Guided Vehicles
AI	:	Artificial Intelligence
AIDC	:	Automatic Identification and Data Capture
AMC	:	Annual Maintenance Contract
AMR	:	Autonomous Mobile Robots
AoN	:	Acceptance of Necessity
ASRS	:	Automated Storage and Retrieval Systems
BEL	:	Bharat Electronics Limited
B&D	:	Base and Depot Spares
BPA	:	Blanket Purchase Agreement
CAG	:	Comptroller and Auditor General
CAMC:		Comprehensive Annual Maintenance Contract
CDS	:	Chief of Defence Staff

CfA	:	Contracting for Availability
CFA	:	Competent Financial Authority
COLD	:	Consumer Operated Lube Depot
CMP	:	Controller Material Planning
COTS	:	Commercial Off the Shelf
CPRO	:	Controller Procurement
CPIL	:	Comprehensive Part Identification List
CST	:	Comparative Statement of Tenders
CTS	:	Controller Technical Services
CWH	:	Controller Warehousing
DAPA	:	Distribution and Pricing Agreements
DART	:	Defect and Repair Transaction
DFPDS	:	Delegation of Financial Powers to Defence Services
DPM	:	Defence Procurement Manual
DoD	:	Department of Defence
DVA	:	Department of Veteran Affairs
DQAN	:	Directorate of Quality Assurance (Navy)

DBT	:	Direct Bank Transfer
DP	:	Delivery Period
DSE	:	Defence Services Estimates
DLA	:	Defence Logistics Agency
DMSMS:		Diminishing Manufacturing Sources and Material Shortages
EDS	:	Estimated Date of Supply
ERP	:	Enterprise Resource Planning
FSS	:	Federal Supply Schedule
FCL	:	Forecast List
FMS	:	Federal Military Sales
FOAL	:	First Outfit Allowance List
FSMTC:		Federal Service for Military Technical Cooperation
GeM	:	Government e-Marketplace
GFR	:	General Financial Rules
GPS	:	Global Positioning System
GTP	:	Goods-to-Person
HADR:		Humanitarian Assistance and Disaster Relief

IFA : Integrated Financial Advisor

ILMS : Integrated Logistics Management System

INBR : Indian Naval Book of Reference

IDT : Inter Depot Transfer

INCAT: Indian Naval Catalogue of Stores

INSMA: Indian Naval Ship Maintenance Authority

IoT : Internet of Things

JIT : Just In Time

JLN : Joint Logistics Node

JRI : Joint Receipt Inspection

LC : Letter of Credit

LCL : Life Cycle Logistics

LTB : Life Time Buy

LL&MC: Long Logistics and Management Course

LTMS : Life Time Maintenance Support

MCPP : Maritime Capability Perspective Plan

MILSBILLS: Military Standard Billing System

MILSTRIP: Military Standard Requisitioning and Issue Procedures

MIPR : Military Interdepartmental Purchase Requests

MMM : Material Management Manual

MRLS : Manufacturers Recommended List of Spares

MRO : Maintenance Repair and Overhaul

MO : Material Organisation

MS : Material Superintendent

MTBF : Mean Time Between Failure

ML : Machine Learning

MRLS : Manufacturers Recommended List of Spares

MTC : Maritime Theater Command

MSTC : Metal Scrap Trading Corporation

MSL : Minimum Stock Level

NAVSUP: Naval Supply Systems Command

NSB : Not Stocked Before

NPO : Naval Petroleum Office

NMS : New Management Strategy

OBS	:	On Board Spares
OEM	:	Original Equipment Manufacturer
PAC	:	Proprietary Article Certificate
PBL	:	Performance Based Logistics
PDD	:	Post Defectation Demand
PIL	:	Parts Identification List
RFID	:	Radio Frequency Identification Device
RIN	:	Royal Indian Navy
RC	:	Rate Contract
SHQ	:	Service Headquarters
SOP	:	Standard Operating Procedure
SPTA	:	Spare Parts Tools and Accessories
S&S	:	Supply and Secretariat Branch
SSA	:	Strategic Supplier Alliances
SOP	:	Standard Operating Procedure
SQL	:	Structured Query Language
SSS	:	Serviceable Surplus Stores

TAV	:	Total Asset Visibility
TLS	:	Tailored Logistics Support
TLCSM:		Total Life Cycle Systems Management
TOD	:	Tender Opening Date
USL	:	Upper Stock Level
USNDS:		United States National Defence Stockpile
VED	:	Vital Essential Desirable
VMI	:	Vendor Managed Inventory
WMS	:	Warehouse Management System

ABSTRACT

"Amateurs talk about tactics, but professionals study logistics."

Gen. Robert H. Barrow, Commandant,

USMC

The Indian Navy, the world's seventh largest Navy, is growing as a well balanced three dimensional force consisting of sophisticated missile-capable warships, aircraft carrier, advanced submarines and aircrafts. Many advanced platforms like Shivalik class stealth frigates, modified Talwar class, Scorpene Submarines, Kolkata class destroyers have been inducted in accordance with Maritime Capability Perspective Plan (MCP). With the Navy's growth in the size and induction of new state of the art technologies there has been considerable increase in the reach of Indian Navy to a Blue Water Navy. To sustain the reach of the Indian Navy from Persian Gulf to the South China Sea, there is a requirement to augment the logistics supply chain and a complete re-vamp of the Logistic support philosophy.

According to the Handbook of Materials Management, Inventory Management has assumed much greater significance in the recent years owing to its potential in reducing cost (Gopalakrishnan, 1997). Integrating the supply partners, collaborative planning and strategic alliances has proved to be one of the most successful strategies of cost optimization. In the traditional system that the Navy follows, the anticipated requirement is procured, stocked and issued as and when the user requires (*IN Material Management Manual*, 1995). The existing system continues to manage its inventory by using methods

that create unnecessary inventory levels, provide poor customer service, generate excess and obsolete inventory and huge costs to manage and distribute. This process invariably results in high investment cost, inventory carrying cost and obsolescence cost. In order to achieve the desired service levels and optimize the cost, there is a need to explore modern methods and arrive at a new strategy. There are also significant opportunities to improve the existing management of naval inventory with respect to rationalization, cost effectiveness, efficient storage and distribution system. It is necessary to emphasize upon the total cost analysis to make informed trade-offs between different functions to improve overall performance.

The *raison d'être* of logistics is three R's (right spare at the right time in the right place) to support operations in a cost effective manner. The existing logistics support system is a fragmented approach and leads to sub-optimal utilization of resources and duplication of effort. In order to utilize the logistics resources in a more rational and optimum manner, it is desirable to integrate all logistics elements on a functional basis. Major world military powers have gone in for total integration of their logistics support systems. An analysis of the Gulf War will indicate that an operation of such magnitude would not have been successful without an integrated logistics system being in place (Pagonis & Cruikshank, 1992).

Activities connected to inventory provisioning and management must be streamlined by using effective inventory classification in terms of consumption and criticality to achieve selective inventory controls, as outlined in the Material Planning Manual. To avoid over procurement of stores and inflated inventory, replenishment provisioning must be properly streamlined.

In the past two decades, Indian Navy has transformed itself into blue water Navy and its presence has been increasingly visible in the Indian Ocean region as a first responder in Humanitarian Assistance and Disaster Relief (HADR). The challenge therefore, is to develop a robust and efficient logistics system synchronized with the operational commitments. Some of the best practices that are followed by other Navies which can be emulated for material management functions in the Indian Navy are listed in chapter III.

A sizeable chunk of the Equipment and Spare parts inventory fitted onboard our ships are sourced from foreign OEMs, as the indigenous sources are not well developed. As per the Indian Naval Indigenisation Plan (2015-30) 70% of equipment/systems in the fight category and 40% in the move category are imported. An overview of our procurement system would reveal that it is not technologically advanced in scope and function. Although, it has been modified from time to time, it is compartmentalized and disjointed growth has been able to meet, at best, the short term requirements. One of major factor contributing to procurement lead time in inspection related delays. Self certification, with much longer guarantee period (say 03 yrs) to cut down on inspection delays is recommended.

Primary data was generated through a survey questionnaire administered to 100 officers working in the field of inventory management in the Indian Navy. The questionnaire was targeted at specific officers to obviate biased views. Responses were received from 53 officers and analysis of profile indicated that majority of responses were received from officers with adequate seniority and experience in the field of inventory management.

Majority of the respondents disagree that Equipment & Spare Parts inventory management in Indian Navy fully meets its Operational & Equipment Maintenance requirements and that critical spares for Refits & Running Hour based routines are always available within required timelines. This clearly brings out that there are challenges in existing inventory management system which affects refit logistics management. A large percentage of respondents agree that the present Integrated Logistics Management System has outlived its utility and needs upgrade.

Current annual review process does not optimally leverage the time available to Planning officers. Annual review policy leads to few months of high number of Indents per officer, while a low level of activity for other months for same officer. The recommended changes in review policy should provide significant efficiency improvement. Each officer will have his own review calendar so that he reviews nearly equal number of items each month and reviews each item at least four times a year. In addition, each officer will review items whose stocks fall below MSL every month.

The major reason for the non-availability of timely spares is the non-integration between Material Organisations, IN Ship Maintenance Authority, repair yards and Ship. Navy requires a common ERP integrating all these inputs. Having ERP linked to all stakeholders and catering for each event affecting allowance and urgent upgrade of ILMS is to be done. Asset visibility onboard and with repair yards and utilisation/consumption of spares is the weakest link. Pan-navy integrated system for all stakeholders for material and inventory management using a good contemporary ERP, coupled with strong VMI are the basic requirements to proceed ahead. Visibility of spares held at repair yards too needs to be catered and utilization of spares by

Dockyards in refits/ ops ships should be linked to ILMS. Obtaining a new customised system with logistics supply chain practices of the commercial world are need of the hour. All SCM stakeholders should be in one ERP system.

Chapterisation Scheme

The chapterisation scheme will be as follows:-

Chapter I - Introduces the subject and establishes the need for an efficient logistics management system.

Chapter II - This chapter gives a detailed review of the existing literature on the subject. The existing literature shows studies on the subject of Logistics in defence forces, however, they deal with outsourcing of logistics, joint logistics and performance based logistics. Study of latest trends in inventory management and warehouse automation will be carried out as also best practices in other Navies that can be imbibed.

Chapter III – In this chapter Global Best Practices that can be imbibed based on review of literature and responses to survey questionnaire will be discussed in detail.

Chapter IV – Review of the existing procurement system will be carried out to highlight the drawbacks.

Chapter V – Primary data generated through survey questionnaire administered to officers working in the field of inventory management will be analysed in this chapter.

Chapter VI – Recommendations for enhancing responsiveness of logistics chain and conclusion.

References/Bibliography

Appendix “A” – Survey Questionnaire

CHAPTER - I

EXISTING SYSTEM OF LOGISTICS MANAGEMENT IN THE NAVY

1.0 Introduction

At several Material Organizations, the Indian Navy stores a variety of materials. The Indian Navy's fleet has grown significantly during the last decade, with numerous new platforms being deployed. As the fleet grew, the responsibility for meeting store demand grew exponentially, and the size of the inventory grew in synch. To offer stores at the right location, at the right time, and at the right cost, the Indian Navy needed to ramp up its capability and equip Material Organizations with the necessary resources. Currently, the Indian Navy manages inventory with the help of a fully automated Integrated Logistics Management System (ILMS). In 2002, the Comptroller and Auditor General (CAG) conducted an audit of the Indian Navy's inventory management. The report largely remarked on deficiencies observed in the areas of replenishment provisioning, procurement, demand fulfilment, inventory holding and disposal, and inventory automation, as well as making appropriate recommendations for improvement. In the 2006 Action Taken Report (ATN), it was promised that the replenishment provisioning system would be revamped to make procurement procedures more effective, that demand satisfaction would be improved, that surplus/non-moving inventory would be quickly disposed of, that ILMS deficiencies would be addressed, and that ILMS would be connected to all stakeholders.

CAG conducted a Performance Audit (PA) of four Material Organizations (MOs) in 2016 on the inventory management of Naval Stores and Equipment and Spare Parts (E&SP) for

the years 2011 to 2016. The audit consisted of a review of documents and records at the Naval Headquarters and Material Organizations in Mumbai, Visakhapatnam, Kochi, and Karwar. The data obtained from the ILMS was also studied in relation to several areas of material management (CAG Report 2017 Para 2.1).

1.1 Inventory Management in Indian Navy

One facet of successful military logistics around the world is accurate inventory and its effective management. Whether it's routine or breakdown repair, the inventory management system should be able to pool in essential parts in a fair amount of time to keep platform downtime to a minimum. This necessitates a well-organized inventory management as well as a forecasting, review and provisioning system. The Indian Navy's inventory management and logistics planning begin with a review of its inventory, which is based on demands from ships and establishments, forecasts from repair yards, and requirements raised by Directorates at IHQ MoD. (Navy). This is used to arrange for and raise indents for the purchase of Naval stocks, equipment, and replacement parts. Ship downtime has a significant impact on the Indian Navy's force levels. As a result, material support is responsible for maintaining force levels through a well-maintained inventory management system that reduces downtime during peace operations and results in efficient repair cycles. Demand satisfaction is an important criterion because "stock outs" have a significant impact on capability and the unavailability of any store might result in months of downtime, with serious consequences (CAG report 2017 Para 2.2).

1.2 Key Audit Findings

At the data input stage, there was a lack of effective control mechanisms for guaranteeing data accuracy and validity. The presence of several vendor codes in the system hampered inventory rationalisation in the Navy. The ILMS's resources were not efficiently utilised, which led to unnecessary store procurement. The integration of ILMS with all stakeholders, including MOs, Naval Dockyards, Technical Directorates at IHQ MoD (Navy), Indian Naval Ship Maintenance Authority, Warship Overseeing Teams, and user units, has not yet been completed, resulting in a lack of continuous information flow and Total Asset Visibility (TAV) at all levels (CAG Report Paragraphs 2.7.2, 2.7.4 and 2.7.5).

1.3 Material Organisations – Challenges/Concerns

Provisioning action is taken once a year for Equipment and Spare Parts, twice a year for Naval Stores and once a year for Russian Spares. This calendar year based provisioning leads to few months of intense activity soon after each review is fired. If an item has breached Minimum Stock Level (MSL) or is stocked out after the last review it will be indented only in the next review cycle. No information on the actual consumption pattern at repair yards or ships is available. A spare once issued is considered to be consumed, whereas, it may actually be in stock somewhere in the logistics chain unconsumed and available for use in an eventuality. The replenishment process in material Organisations is not effectively based on MSL triggered system of replenishment and instead an Annual Review method is followed. Vital, Essential and Desirable (VED) categorization carried out on system is also not used for meaningful inventory control purposes as the co-

efficient of Minimum Stock Level (MSL) and Upper Stock Level (USL) are fixed for the entire range of inventory. The provisioning formula used in the past generated upto four times the Annual Consumption Level (ACL) which leads to overstocking, yet results in poor customer satisfaction. Significant instance of “Not Stocked Before” demands exists, items are missing from system or with insufficient technical specifications making indenting, acquisition and quality certification difficult (CAG Report 2017 Para 2.3.1).

1.4 Incorrect Ranging and Scaling

On Board Spares (OBS) and Base & Depot (B&D) spares ranging and scaling process is not fact based. The process does not appear to rely on historical data and has no linkages with ILMS or actual consumption data. This leads to promulgation of incomplete spares list and critical items not being procured. In addition, during acquisition of equipment no life cycle cost analysis is done for evaluation and recommendation of equipment. Most of the time OBS and B&D spares are not fully indicated and stocking levels are not specified. There is currently no systems based approach for formulation of OBS and B&D spares, even for equipment that already exist in service. Being buyers Navy in the past, equipments purchased are almost invariably at obsolescence. The Base & Depot and On Board spares supplied by Original Equipment Manufacturers (OEM), by and large are a tool to pass on surplus spares through Manufacturers Recommended List of Spares (MRLS). If critical data like Comprehensive Part Identification List (CPIL) and Part Identification List (PIL) linkage with cost is not available Material Organisations cannot take many items on charge. Thereafter, when items are demanded they cannot be identified, sourced and supplied.

Budget considerations at times result in incomplete ranging and scaling. The responsibility and timeline for full material definition is unclear and this leads to unnecessary delays in spares codification as well as incomplete codification. At the time of contracting for equipment, Professional Directorates along with vendor should define the expected life of the equipment which needs to be tracked. In addition vendor commitment for spare parts supply for life of the equipment, lead times for spares supply and where possible broad pricing parameters or indexes for price escalation should be obtained. For equipment already in service, the spares usage pattern from Ship and Integrated Logistics Manage System (ILMS) should form the basis of ranging and scaling exercise. The ranging and scaling list should be purely based on technical considerations. The list should be also fully specified in the system, including stocking level like MSL etc. In case the list needs to be pruned down due to budgetary considerations, then for the remainder of the items on the ranged and scaled lists, demands must be raised by Professional Directorates prior to ships commissioning (CAG Report 2017 Para 2.6.2.1).

1.5 Demand Management

Quality of demands raised by users at times is poor. Ships and Repair yards at times tend to over demand for hoarding and even demand spares that are unlikely to be used for ships under refit. Case in point is the ever present shortage of refrigerant gases due to hoarding by ships staff resulting in vicious cycle's of stock outs due to non-availability of empty cylinders for re-filling. In many cases demands raised are outside OBS and B&D spares range, requiring inclusion of spare in Indian Naval Catalogue of

Spares (INCAT) before spare can be procured and invariably spares in not available to customer on time.

1.6 Lack of Integration in System.

Since implementation of Single Server concept in 2010 there is Total Asset Visibility (TAV) among Material Organisations and Inter Depot Transfers (IDT) is frequently resorted to for meeting critical operational and refit requirements. TAV is however missing between MOs, ships and repair yards. All major navies have migrated towards TAV between ships, repair yards and distribution centers. It is a common practice in all organizations to have a common IT platform between customers and supply chain functions.

The US Naval Supply Systems Command (NAVSUP) is a perfect example of integrated logistics management system which performs a wide range for functions. Headquartered in Mechanicsburg, Pennsylvania NAVSUP has a diverse global workforce of more than 22,500 military and civilian personnel. NAVSUP and the Navy Supply Corps share one mission: to conduct and enable supply chain, acquisition, operational logistics, and Sailor & family care with their mission partners to generate readiness and sustain naval forces worldwide. The NAVSUP/Navy Supply Corps team is responsible for a wide range of responsibilities, including supply chain management for material support supply operations, conventional ordnance, contracting, resale, fuel, transportation, security assistance, Sailor and family care, including food service, postal services, retail facilities, and household goods movement. NAVSUP will be covered in details in the chapter on Global Best Practices.

1.7 Ideal System

The utopian Logistics management system as it is designed to operate will work on the principle of “right spare” at the “right time” in the “right place”. In reality, spares management for refits and other related activities does not work in this manner and often fails at time critical junctures due to a combination of systemic deficiencies brought out above. What is desirable in a logistics management system are listed below:-

1.7.1 OBS and B&D spares are identified and catalogued on time, based on historical data on system and reviewed every year.

1.7.2 Repair yards to enhance material procurement capability and plan and procure items with low value, off the shelf, non-strategic and limited aggregation potential or price elasticity.

1.7.3 Material provisioning process fully based on replenishment model, with significant customer focus. Provisioning should be triggered at system defined re-order point to avoid breaching of MSL instead of annual review calendar.

1.7.4 Full visibility of spares consumption on ships, repair yards and Material Organisations for all stakeholders.

1.7.5 Spares consumption data to be prepared at repair yards by ship refit schedule. Running hour routines based spares list should be generated through system, instead of based on inputs from vendors.

1.7.6 Forecast lists prepared based on historical consumption data available on system. Presently lists are often prepared by the vendors for offloaded repairs.

1.7.7 Integration of systems at INSMA, ILMS and repair yards to provide a common platform at the earliest for seamless data flow.

1.7.8 Long term vendor development programme and quality certification process to be refined for domestic vendors, including significant use of self-certification for quality vendors.

1.8 Effects on Quality of Refits

The combined effects of the various systemic deficiencies brought out above result in non-availability of spares in time for the most crucial activity supported by the Material Organisations (CAG Report 2017 Para 2.5.3). The non-availability of spares in time for refit manifests itself in the following ways:-

1.8.1 Increased use of refurbished spares whose life and reliability at times is not the same as new spares. Refurbishing leads to decrease of efficiency of equipments, which causes defects during operational phase of ship. There is no accounting of hidden cost of refurbished spares.

1.8.2 In-house manufacture of item which leads to changes in specifications and modifications to end fittings leading to delays in refit completion.

1.8.3 Deferment of routines leading to non-adherence to Planned Preventive Maintenance (PPM) schedules with consequent increase in breakdowns at unanticipated intervals. Systematic deferment of routines is prevalent due to non-availability or partial availability of spares with ships and repair yards.

1.8.4 Delays in refit completion which in turn affects operational availability of ships.

1.8.5 Local purchase of “questionable quality” spares, which further increases the potential of equipment breakdown.

1.8.6 Offloading refits with spares, which is a costly proposition as the shipyards add their overheads also to cost of spares.

1.9 Conclusion

The issues and challenges involved in inventory management of Equipment and Spare Parts have been covered in this chapter. The Indian Navy's provisioning methodology has to be tweaked to guarantee more accurate procurement quantity projections and less manual involvement. Activities connected to inventory provisioning and management must be streamlined by using effective inventory classification in terms of consumption and criticality to achieve selective inventory controls, as outlined in the Material Planning Manual. To avoid over procurement of stores and inflated inventory, replenishment provisioning must be properly streamlined. To avoid stock outs of 'Vital' and 'Essential' items, minimum stock levels must be maintained. To achieve a shorter internal lead time and robust competition, procurement activities must be streamlined. To ensure the availability of proper data for better decision making, ILMS must include appropriate controls/validations at all levels. Budget constraints can also lead to insufficient ranging and scaling. The responsibilities and timeline for comprehensive material definition are unclear, resulting in unnecessary delays and partial codification of spares. Ships and repair yards often have an excessive demand for stockpiling, even for spares that are

unlikely to be utilised on refit ships. The compounded impact of the aforementioned systemic flaws result in the non-availability of spares in time for the most critical activity supported by Material Organizations i.e refit of ships.

CHAPTER - II

LITERATURE REVIEW

2.0 Literature Related to Logistics in Defence Forces

2.0.1 Singh (2018) discussed in his book titled “Blue Waters Ahoy!” the history of Logistics cadre of Indian Navy. The word 'logistics' comes from the Greek adjective logistikos, which means 'skilled in calculating,' and its first military application, administratively, dates from the Roman and Byzantine periods for a military administrative official with the title Logista. Military strategists have emphasised the critical need of protecting one's own logistics supply lines while undermining the enemy's in order to win battles since the dawn of time. This is a tenet that has been upheld to this day and will undoubtedly be upheld in all future wars. The military logistics framework encompasses a vast array of supplies, spares and support systems, ranging from rations to ammunition supplies and fuel to run the war-waging machinery, all of which are no small task, regardless of a nation's size or might. The Indian Navy's Logistics Cadre has grown in its ambitions during the last seventy-five years, in concert with the Navy's own expanding presence. The history of logistics in the Indian Navy has seen phases of expansion, as well as (nearly) oblivion at one point with the phase-out of the previous Supply & Secretariat (S&S) Branch, and a later rise in its current avatar when the Navy's Logistics arm was reorganised as an Executive Branch Cadre. The former S&S Branch, as its name suggests, was in charge of the Indian Navy's supplies and secretarial duties when it was rebuilt in 1950 from the Royal Indian

Navy (RIN). The branch was created as part of the RIN's World War II effort, which saw tremendous growth during that time. Secretarial tasks, pay and allowances, pensions, victualing, inventory management, travel, civil works, quartering, non-public money management, information technology, and even law were among the services provided.

The S&S Branch demonstrated its mettle during the difficult periods of 1962, 1965 and 1971, but the manner the Branch conducted and carried out functions in the steadily expanding Indian Navy was in desperate need of a significant overhaul. In 1978, the Branch was officially absorbed into the Executive Branch, and in 1989, the Logistics Cadre was established. Since then, the terminology has remained the same. The Indian Navy's logistics have come a long way since its inception. The days when demand for each item from a ship was physically registered at the depot and issued only after a series of manual processes that caused delays are long gone. Labor-intensive procedures for recovering supplies and spares kept on physical ledgers, as well as a time-consuming clothing and victualing delivery system, are no longer in vogue. Logistics in the Navy has become an unavoidable cornerstone, keeping up with ever-changing technology by developing systems, procedures, and infrastructure that are commensurate with the induction of front-end labour and material. Innovative software technologies have dramatically improved the quality and service of victualing stores, pay and allowances, and clothing stores. Furthermore, the desire to improve adds to the organization's efficacy. Various expert committees and teams have conducted numerous studies, and suggestions based on those studies have been implemented.

The logisticians' development from a small band of Royal Indian Navy's Paymasters to the current cadre has been amazing.

The Indian Navy was one of the first of the three armed forces to jump on the IT bandwagon, with an in-house implementation of the Integrated Logistics Management System (ILMS), a material-management software. This software was to prove to be a beneficial management tool that connected Material Organizations and Naval Head Quarters, allowing for more efficient material management. The project was launched on 17 May 1993, at INS Hamla, and system analysis began on 01 September 1993, at four locations. The ILMS team was established in February 1993, and the project was completed on 30 June 1997, with the appointment of System Administrators and Maintenance Teams. The modules were fine-tuned as well as data collecting and refining during the months of July to December 1997. On 29 December 1997, the then-CNS formally launched the system. In both software adaption and inventory management, the ILMS, which was first launched in 1997, underwent significant revisions. With over a thousand individuals registering into the ILMS, the active naval inventory had expanded from around 3.70 lakh in 1997 to almost double that figure by 2010. With the introduction of a single server at MO (Mbi) in 2010, the system's architecture was altered, making it a true real-time online inventory management system.

The five Material Organizations are responsible for meeting the needs of their respective Naval Commands/Areas. Each MO is led by a Material Superintendent (MS), who is assisted by a Controller of Material Planning (CMP), who is

responsible for provisioning and planning, a Controller of Procurement (CPRO), who is responsible for procurement, a Controller of Warehousing (CWH) and a Controller of Technical Services (CTS).

2.0.2 CAG Report (2017) for the year ending March 2016 has been prepared for submission to the President of India under Article 151 of the Constitution of India. The Report contains significant results of the Audit of the Union Government (Defence Services) - Indian Navy and Indian Coast Guard. Chapter II of the report specifically deals with performance audit of the inventory management of Naval Stores and Equipment & Spare Parts in the Indian Navy. The report brings out that for effective inventory management and to minimise downtime due to stock out situations, a well designed inventory management system supported by forecasting, provisioning and review tools is essential. The Indian Navy's existing provisioning formula resulted in excess provisioning quantity due to an inbuilt flaw, demanding full manual intervention. In accordance with the established regulations, the Indian Navy did not use selective inventory control procedures. At several points of the procurement process, there were significant delays compared to the lead time specified. There were no time constraints set for assessing demand compliance and other demand-related activities. Across all Material Organisations, massive amounts of non-moving inventory were maintained in stock, increasing inventory carrying costs. Data integrity concerns and master data cleansing requirements have plagued the ILMS since implementation in 1993.

2.0.3 Indian Navy Book of Reference – 622 (2005) contains the guidelines on Ranging and Scaling of Base and Depot (B&D) spares. This document lays down the procedure for ranging and scaling of spares at initial induction stage of platforms and equipment. The Indian Navy follows a concept of On Board Spares (OBS), Base and Depot (B&D) spares. The OBS supplied along with the platform, equipment wise, in Spare Parts Tools and Accessories (SPTA) boxes are for the first year of operation. B&D spares supplied by the shipyard to Material Organisations are for supporting the first five years of operation. Both OBS and B&D spares lists are based on Manufacturers Recommended List of Spares (MRLS) vetted by Professional Directorates at Integrated Headquarters of MoD (Navy).

2.0.4 General Financial Rule (2017) is a compilation of rules and orders of Government of India to be followed by all while dealing with matters involving public finances. These rules and orders are treated as executive instructions to be observed by all Departments and Organisations under the Government and specified Bodies. Chapter 6 of GFR-17 deals with procurement of goods and services. As per Rule 142 of GFR-17, this chapter contains the general rules applicable to all Ministries or Departments, regarding procurement of goods required for use in the public service. Detailed instructions relating to procurement of goods may be issued by the procuring departments broadly in conformity with the general rules contained in this Chapter. Any recommendations or suggestions coming out of the study should be in consonance with the provisions of GFR-17, to be implementable. To illustrate, Ministry of

Finance, Department of Expenditure, to promote Aatma Nirbhar Bharat, has issued an Office Memorandum No F.1211712019-PPD dated 15 May 2020 regarding amendment in Rule 161(iv) of GFR-17 stipulating that no Global Tender Enquiry (GTE) shall be invited for tenders upto Rs 200 Crore.

2.0.5 Defence Procurement Manual (2009) contains the principles and procedures to be followed by all wings of the Ministry of Defence and the Defence Services, as well as all subordinate organizations and units/establishments, for procurement of goods and services, expenditure on account of which is met from the revenue heads of the Defence Services Estimates (DSE) and any other type of purchases to which the provisions are made specifically applicable. DPM-09 was issued in accordance with Rule 135 of the earlier version of GFR issued in 2005. DPM is presently under revision in accordance with Rule 142 of GFR-17. Any recommendations or suggestions coming out of the study should be in consonance with the provisions of revised DPM, to be implementable.

2.0.6 Material Management Manual (1995) is the standard reference and text book for logisticians in the Navy. The Integrated Logistics Management System (ILMS) was the first on-line inventory management application in the Defence Services, pioneered by the Navy. On 17 May 1993, the Navy launched the ILMS project at Material Organisation (Mumbai). The entire system study, analysis, design, and software development were completed in-house, and ILMS was deployed in December 1997. Coinciding with the launch of ILMS, manuals on Material Management, Planning, Procurement, Warehousing and ILMS were

published by Integrated Headquarters of MoD (Navy) to facilitate the transition to online system. Over the period many processes have changed including changes in the ILMS functionalities, however, the manual has not been revised.

2.0.7 Pagonis and Cruikshank (1992) offers a firsthand account of the supply effort that led to the dramatic allied victory in the Gulf. The Gulf War was the largest military logistics operation in history, involving large scale deployment of troops and supplies halfway around the world. Under his leadership, between August 1990 and August 1991, the 22nd Support Command facilitated mobilization of 5.5 lakh troops and 70 lakh tons of supplies. The other staggering statistics involve pumping 1.3 billion gallons of fuel to support 52 million miles of driving in the war theatre, handling 32 thousand tons of mail and since no army can march on an empty stomach 122 million meals were served. The war only lasted 43 days including a ground offensive of 100 hours, effectively supported by the 22nd Support Command. The book co-authored by Lt Gen William G Pagonis (Retd) gives an insight into various leadership and logistics lessons from the operation.

It's difficult to comprehend the extent of logisticians' achievement during the Gulf War. On the eve of the Gulf War, logisticians had the foundation of a good logistics plan thanks to Army logistics doctrine developed over the previous decades (particularly those tailored to support AirLand Battle). It is crucial to emphasise, however, that in its original form, this theory would not have been able to equal the effectiveness of the Gulf logistics operation. The theory was useful in situations where logisticians and their equipment could arrive early in an

operation, but it was useless in situations where tens of thousands of combat forces entered the theatre before logisticians. The circumstances necessitated flexibility and creativity. During the Gulf war General Schwarzkopf permitted the establishment of an ad-hoc logistics system devoid of layers of bureaucracy by designating Lt Gen Pagonis as a single logistics manager. This infrastructure was tailor-made for the demands of desert combat. Lt Gen Pagonis, for one, used a leadership style that was admirably adapted to the circumstances of the Gulf War. He was at ease delegating a great deal of power and responsibility to his subordinates. When the situation called for it, he wasn't hesitant to deviate from doctrine. His new-style logbases, which he strategically positioned ahead of allied forces, are a prime example of his visionary leadership.

Despite the logisticians' undeniable success in the Gulf War, historians should be wary of rushing to conclusions about whether or not all components of the Gulf War logistical operation should be incorporated into current doctrine. It's important to note that the war's actual combat activities were incredibly brief. There's no way of knowing whether Pagonis' logbase theory could have kept combat forces supported for an extended period of time. Fuel shortages in the field early in combat operations could have been an anomaly, or they could have signalled a flaw in the system itself. So, while incorporating the new logbase concept into doctrine appears to be a good idea, it has to be more fully tested and polished.

Based on a review of Gulf War logistics, it appears that the selection of a single logistics manager was the single most critical determinant in the success of

logistics operations. There is no doubt that having a single "boss" streamlines the decision-making process in any complex, time-critical circumstance. For the past two decades, civilian firms have been re-discovering this reality and responding by drastically reducing their management bureaucracy. The military departments, as well as other government entities, have been following suit. During the Gulf war the logistics operation of Lt Gen Pagonis reflected this new corporate management approach. Given the complexities of the circumstance, it's hardly surprise that his operation went off without a hitch. Current management philosophy should be included into military logistics doctrine by military strategists.

Finally, logisticians went into the Gulf War with a solid logistics philosophy that had been established and tested over a two-decade period. The concept stressed responsiveness and flexibility while retaining the trappings of traditional management bureaucracy. During the Gulf war Both General Schwarzkopf and Lieutenant General Pagonis have shown a readiness to break from this doctrine in order to improve logistics operations. As a result, a single logistics manager was appointed for the first time in a combat theatre, a unique ad-hoc logistics management infrastructure was established, and a new-style logbase was created, allowing logisticians to operate as actual force multipliers for combat soldiers.

2.0.8 Khanna (2019) has concluded that Performance Based Logistics is a well-articulated technique for ensuring not just a good product but also its intended performance throughout the equipment's life cycle. The essence of PBL is buying performance instead of spares for supporting equipment. PBL contracting has

evolved through the years to guarantee that both the supplier/OEM and the consumer are satisfied with the end outcome, according to a study of western Navies. This process of PBL evolution will be ongoing in nature, as both technology and demand will evolve over time.

The concept has evolved over time, resulting in improved performance of platforms, systems, sub-systems, and components, as well as cost reductions over time. It has assured that cost savings match legislative standards, and long-term contracts incentivize the industry to expand profit margins by ensuring greater product quality through progressive R&D and applying methods to significantly raise Mean Time Between Failures (MTBF).

In most nations, the early stages of PBL contracting implementation were fraught with difficulties and extensive examination from all parties interested in order to assess the accompanying advantages. There have been instances where contracts did not produce what was expected, which was attributed to a variety of systemic flaws. The countries that implemented the methodology, on the other hand, overcame the flaws through an iterative process of improving the contracts through a continuous process of analysis and study, eventually arriving at a model that is both successful and flexible enough to meet the nations' overall needs.

The Indian Navy is at a critical point in the development of PBL contracts. A tailor-made model for the Indian context can be constructed by making appropriate changes to the models used in Western countries. This model should meet legal criteria and take into account the country's infrastructure. Long-term

PBL contracting would incentivize the defence industry, ensuring organic growth. The model's start with a submarine project would increase the country's competence in this area, where we are still reliant on foreign countries for material and maintenance support. Annual reviews of the model can aid in improving the structure, and if properly constructed, the model can be extrapolated for Navy ships and other vessels in stages.

2.0.9 Katoch (2014) focused on one of the primary areas of jointmanship among the three services as logistics. The logistical system in our military services has remained unchanged since we gained independence from the British. Many developed and emerging countries, including our neighbours, have begun to integrate their defence forces. We continue to use a single-service approach to logistics management in India, which has resulted in unnecessary redundancy, lack of standardisation, and codification. The three services have developed their logistical systems and networks independently, with no compatibility or interoperability. There are a lot of commonalities that can be utilised together and in a coordinated manner. The emphasis on equipment management as an integrated system is likewise insufficient. The proliferation of procurement organizations makes it difficult to get the best "value for money." In the sphere of defence logistics, the benefits of information technology have also not been fully utilised to encourage collaborative interfaces. Though certain adjustments have been contemplated in the recent past, they are purely cosmetic in nature. As a result, not only within the three services, but also throughout numerous government organisations, changes in concepts, philosophy, decision-making

processes, organisational structures, infrastructure, and research and development are required for sustenance and jointness. This will make it easier to incorporate new technology and streamline operations. The current piecemeal strategy of simplifying particular processes and the isolated usage of technology in for a single service or department must be abandoned. However, both the rules of war and the concepts of logistics suggest that a coordinated and integrated logistical effort at both the national and service levels would aid in the creation of synergies and efficient output. The appointment of a Chief of Defence Staff (CDS) and the consolidation of logistics under one command will also aid in the timely procurement of military equipment, which, as we all know, is having a significant impact on our military readiness. For effective integrated operations, organisational reforms at multiple levels are required, as well as rapid advances in automation, communication, resource mobilisation, and transportation. Changes to the current organisation, or, in other words, resistance to any change, are expected to be strongly challenged by the civil bureaucracy as well as some military personnel who may have vested interests in maintaining the current structure. However, if change management is adequately specified and managed, the intrinsic character of the organisation might promote a faster rate of change. Even with sophisticated military like the United States and the United Kingdom, political will and essential legislation were required to bring about changes. Though change will be difficult, it must be implemented because it will save money, enhance accountability and efficiency, increase transparency, and aid in the development and modernization of the military.

2.0.10 Manchanda (2012) opined that logistics has always been a resource-intensive aspect of the defence services around the world, and it has commanded undivided attention. No country, no matter how wealthy or developed, can afford to waste its finite and non-renewable natural resources. As a result, every nation attempts to develop new ways and means of increasing the military's productivity by examining, analysing, and revamping the logistics system in place. The current logistical system in our armed forces is largely the same as it was at the time of independence. Only a few alterations were made, and they were mostly cosmetic in nature. As a result, the armed forces' logistical setup is now archaic, necessitating a comprehensive evaluation of the whole gamut of current logistics systems in order to improve the operational readiness of combat formations/units. The armed services must use the system of combined operational logistics as soon as possible because to changing field force requirements, developing technical explosions, and changing warfare scenarios. Delays in implementing the same would jeopardise operational efficiency and possibly jeopardising national security.

2.0.11 SOP for JLN, Mumbai (2021) lays down the operating procedure for Joint Logistics Node. Maritime Theatre Command (MTC), formerly Peninsular Command, is a planned integrated tri-services command of the Indian Armed Forces, with responsibilities that might encompass command and control of the entire Indian navy fleet as well as coastal defence operations. It is planned to contain assets from all of India's armed branches. The MTC will be led by an Indian Navy officer who would report to the Joint Chiefs of Staff Committee,

which will be chaired by the Chief of Defence Staff (CDS). The 'Joint Forces Doctrine,' a 2017 Indian military doctrine, advocated for integrated commands like the MTC. Following the appointment of the CDS, the process of putting this doctrine into practice began. The Indian Navy conducted a detailed study to introduce the MTC in 2020. With the advent of theaterisation and raising of MTC, tri-services joint logistics will be the way forward. Accordingly, the first Joint Logistics Node is functioning at Headquarters, Western Naval Command since 01 April 2021. The contours of the Joint Logistics Node will be covered in succeeding paragraphs.

Joint Logistics Node (JLN) Mumbai was implemented from 01 Apr 2021 with Indian Navy as the lead service. As per the Government Sanction Letter (GSL), provisioning and procurement of common items will be undertaken only by the lead service. No other service shall undertake similar/ duplicating action. The issue, accounting and budgeting of transactions made, will be accounted for by the lead service (Indian Navy) from its own Budget Heads. Office of JLN Mumbai has been set up within the premises of Base Victualling Yard (Mumbai) and Material Organisation (Mumbai). The offices are manned by service components of all the three services. The type of stores and services under the ambit of JLN Mumbai will be covered under detail in succeeding paragraphs.

2.0.11.1 Rations

Apart from the Naval units, a total of 24 Army and Air Force units with a feeding strength of approx 5300 personnel are dependent on JLN,

Mumbai. Out of this 10 units located in Colaba region designated as “Co-located units” and balance 14 units located in sub-urban, Mumbai and as far as Daman are designated as “Outlying units”. Any changes in the movement/ relocation of dependent units, has to be intimated by the respective service to JLN Mumbai, at least one month in advance.

Individual units will be responsible for drawing rations as per the authorised scales of their respective service only. Accounting and audit for individual units will continue as hitherto. The dependent units are to forecast their annual requirement for the ensuing year by the month of September of the preceding year to JLN. The forecasted requirement is to be based on feeding strength, scale, emergency ration, etc.

2.0.11.2 Dry Provisions. Dry Provisions are categorised into two types viz. Basic Group & Necessary Group items. All dependent units, co-located as well as outlying, collect Dry provisions from JLN Mumbai, once in a month. Monthly Issue Programme is promulgated by JLN for all the dependent units by the 25th of preceding month. Units forward their demands to JLN Mumbai at least one week prior to the issue date as per the promulgated issue programme. Units depute their authorised personnel with requisite manpower for collection of dry rations as per the promulgated issue programme. In the rare event of any item not being issued on the promulgated issue date, units may forward supplementary demands between 10th to 15th of the month.

Supplementary Issue Date will be promulgated by BVY(Mbi) for collection by the units.

2.0.11.3 Fresh Provisions. The procedure for issue of fresh provisions is different for co-located units and out-lying units. The co-located units collect fresh provisions from JLN twice a week, whereas each feeding point for outlying units has been assigned as Direct Demanding Officers (DDOs). Weekly demand from co-located units is to reach BVY(Mbi) latest by Friday of the preceding week. The DDO will be responsible for demanding, inspecting, accounting and issuing the items to all sub-units at that particular feeding point. In case of poor performance by the supplier, the DDOs, after suitably warning the suppliers, only as a last resort, may undertake Risk & Expense Purchase under intimation to HQWNC and JLN Mumbai.

2.0.11.4 Cooking Gas (LPG). The contract for supply of Cooking Gas (LPG) is concluded by the Indian Navy and all Air Force units except Air Force Station Mumbai are assigned as DDOs. The requirement of Indian Army and Air Force Station, Mumbai are included in the contract concluded by JLN Mumbai.

2.0.11.5 Main Grade Fuels. Main Grade Fuels (Petrol, Diesel, and Kerosene) is provisioned by the Navy and issued to the Army and Air Force units. However, service specific fuels will continue to be contracted by the respective services.

2.0.11.6 **General Stores and Consumables.** As per the GSL, common items as identified by the Army, Navy and Air Force, will be supplied by Material Organisation (Mumbai). These items will be issued to units once every 04 months as Auto Replenishment System (ARS) on 01 Apr, 01 Aug and 01 Dec. Consumables and Hygiene chemicals are stocked at MO(Mumbai), Ghatkopar and Lubes & Oils are stocked at Naval Store Depot, Sewri. Accordingly, the units have to arrange collection from respective depots.

2.0.11.7 **Civil Hired Transport.** As per GSL, a consolidated contract for Civil Hired Transport will be concluded by the JLN Mumbai, including the requirements of all Army, Navy and Air Force units. The responsibility of forecasting and projecting demands for the following year will be of the respective service. The bills after utilisation will be forwarded to the Navy for payment action only. The contract for hired vehicles will be concluded by the HQWNC with HQ Maharashtra Gujarat & Goa, Area designated as DDO for all Army units and all Air Force units will be designated as DDOs. The payment will be processed by Naval Transport Pool as is being done for the naval requirements.

2.0.11.8 **Salvage Disposal.** As per GSL, in-situ Salvage Disposal will be carried out under the delegated financial powers of CFA of the Navy. The responsibility of fixing Reserve Price and forwarding lot details for e-auction will be that of the respective units of the Army, Navy and Air

Force. The accruals from salvage disposals will be credited to the Navy's account.

2.0.11.8.1 Air Force Units. IAF units will continue to comply with the current procedure in vogue in IAF for Salvage Deposits in their Salvage Stores. The accumulated Salvage in the respective Salvage Stores shall be converted to Lots as per the policies of Salvage segregation. There are a total of 19 groups in which the salvage is to be segregated. For items covered under the Rate Contract (RC), Air Force units will forward the details to MO(Mbi) as and when sufficient quantity of Scrap is accumulated. MO(Mbi) will issue MRO to the Vendor for the quantity indicated by the unit. Vendor will make payment to MSTC and will obtain Delivery Order which is a proof that the full amount has been deposited with Navy. The Lots will be allowed to be lifted from the Air Force premises in the presence of Board of Officers constituted for Disposal of Salvage. For items not covered under RC the fixation of Minimum Reserve Price (MRP) for the designated Lots will be done by the units and details forwarded to MO(Mbi) for e-auction. The Lots which are auctioned by MSTC as per the MRP rates are to be handed over to the bidder from the location of the Lots. The CWH Disposal Section of MO(Mbi) will intimate the respective Air Force unit along with Delivery Order issued by MSTC, which is a proof that the full amount has been

deposited with Navy, for delivery of the auctioned Lot. Only after receipt of MSTC Delivery Order, will the Lots be allowed to be lifted from the Air Force premises in the presence of Board of Officers constituted for Disposal of Salvage.

2.0.11.8.2 Army Units. For items covered under RC, the Army units will deposit scrap to MO(Mbi) once every quarter. The date for depositing the scrap is to be finalised by the unit in liaison with CTS section at MO(Mbi). Further action towards e-auction will be carried out by MO(Mbi). For items not covered under the RC, Army units will follow the disposal procedure, as hitherto.

2.1 Literature on Case Studies

2.1.1 Gopalakrishnan (1997) provides the best coverage of the materials management discipline. The book deals with inventory management, warehousing, logistics and supply chain. It covers basic principles and practices concerning these areas as well as to its application in Indian conditions. The book brings out that material costs vary from 35 to 75 percent in various industry groups. The sale price of a product consists of material costs, fixed overhead costs and profit. Considering the same fixed overhead costs, reducing the material cost can significantly increase the profit margin. This emphasises the significance of cost-cutting in warehousing and the linked fields of purchasing and inventory control. The primary steps in achieving economy include proper identification of how materials have been consumed and accurate updating of warehouse records

on receipt, issue, price, balance, waste and rejection losses. The book is largely theoretical and only covers one case study of a hypothetical firm.

2.1.2 ICMR (2004) covers fifteen case studies in supply chain management of major logistics service providers from around the world. All the case studies are covered in detail and give an insight into the inventory management of industry leaders like Pepsico and Walmart. The book is dated and covers only one Indian firm i.e. M/s Ashok Leyland, therefore, its relevance to Indian context and applicability in present times due to large strides made in the field of Inventory and Supply Chain Management need detailed study.

2.1.3 Mark and Johnson (2018) is a case study on Supply Chain Management of amazon.com. It meticulously records the journey of transformation of Amazon from a bookstore in 1994 to present day retail giant. Inventory Management and Supply Chain Management functions at Amazon are covered in great detail in lucid fashion with supporting facts and figures accurate upto 2018. The case study also provides a link to the website of MWPVL International a logistics and Supply Chain Management consultant firm where the updated figures can be obtained. Amazon's skilled warehousing strategy, which guarantees that products are easily accessible from almost anywhere on the planet, is a key component of the company's success. All of the company's warehouses are strategically located near major cities and population centres, and inventory is distributed among them to guarantee that supply can keep up with demand. There are even modest warehouses in smaller towns to ensure that purchases are transported and delivered quickly, regardless of what is purchased. Internally, warehouses are also

optimised. The organising plan, which includes five distinct storage locations, allows team members and pick-and-pack robots to pull things nearly instantaneously and move them toward delivery. Amazon owns a lot of land, and a lot of that property is used for warehouses. Amazon doesn't take a typical approach to warehouse management. Amazon's decision to organise its distribution network into five types of facilities was a game-changer. The most common are:-

2.1.3.1 Cross-dock centres, where items from overseas vendors are held until the fulfilment centres require more stock.

2.1.3.2 Amazon stores its goods in fulfilment centres, which are similar to traditional warehouses and staff pick and pack products for customers. The company has over 175 locations throughout the world.

2.1.3.3 Sortation centres are designed to help with "last mile delivery." At these locations, no product is kept. Instead, ready-to-deliver customer items travel down conveyor lines, where Amazon associates and robots sort and route them by zip code before sending them to a carrier for final delivery.

2.1.3.4 The corporation discovered a means to own "last mile delivery" in its distribution chain by establishing delivery stations. These stations allow Amazon to be more flexible in places where there is a high volume of orders.

2.1.3.5 Prime Now hubs are used by Amazon for time-sensitive commodities like groceries. These hubs are responsible for items that are usually delivered within two hours of purchase.

When buyers in COVID-19 lockdown rushed Amazon with more orders than it could manage, the firm was unable to keep its two-day delivery promise. Amazon.com Inc. aims to create 1,000 local delivery centres around the United States. The facilities, which will eventually number over 1,500, will bring products closer to customers, making online shopping as quick as running to the store. It will also assist the world's largest e-commerce company in competing with a revitalised Walmart Inc. Amazon's response to this existential dilemma is exemplified by a recently opened warehouse in Holyoke, Massachusetts. It's just a short drive from more than 600,000 people and it's not far from a once-bustling mall. The goal is to get closer to nearly everyone in the United States.

2.1.4 MWPVL International (2021 on their website <https://www.mwpvl.com>) bring out that from a modest distribution network of two Fulfillment Centers started at Seattle and Delaware in 1997, Amazon today has 1801 distribution facilities in 24 countries as of Sep 2021. Amazon's future expansion plans include creation of additional 573 distribution facilities with a cumulative total warehousing space of 6.09 Billion Square Feet making it the second largest retail chain in the world. Amazon has 72 Fulfillment Centers and 49 inbound / outbound Sortation Centers, Delivery Stations, Air Hubs and Prime Now Network Hubs in 15 states of India.

2.1.5 Vitasek, Bayliss, Owen, Srivastava (2022) in an article in Harvard Business Review have discussed that Walmart has long been regarded as a supply chain management pioneer. However, its prowess did not protect it from an issue that has plagued the transportation sector for decades: massive data discrepancies in freight carriers' invoice and payment processes, which necessitated costly reconciliation operations and caused protracted payment delays. Then Walmart Canada came up with a solution: it used blockchain, a distributed-ledger technology, to automate the management of invoices from and payments to its 70 third-party freight providers. The idea began when John Bayliss and his team at Walmart Canada began brainstorming innovative solutions to the problem. The amount of information was enormous. Walmart Canada uses its own transportation fleet as well as third-party carriers to deliver over 500,000 cargo to distribution centres and stores across the country each year. The vital function of transporting a large volume of commodities (many of which are perishable) across borders, time zones, and climates is a huge operational issue. Each load sent, for example, necessitates tracking data points such as stop locations, gallons of gasoline, and temperature updates, all of which must be calculated separately and incorporated into each invoice. It's simple to see how the invoicing and payment process may be riddled with data conflicts with over 200 data points that required to be considered into invoices. There were also higher transaction costs and dissatisfied carriers waiting for payments because 70% of invoices required reconciliation procedures. The fundamental cause of the problem was discovered to be the usage of several information systems by Walmart Canada and its

carriers, which were unable to communicate with one another. As a result, reconciliation had to be done manually, which was a time-consuming, labor-intensive procedure fraught with inconsistencies. One of Walmart Canada's tech leaders proposed automating the process by establishing a blockchain network, which would solve the problem of incompatible business systems and provide all parties with a shared single source of truth. However, there were critics because blockchain technology had yet to be employed in a significant, business-critical capacity. Furthermore, blockchain came in a variety of flavours. Is a public blockchain network, such as those used for cryptocurrency, preferable to a private blockchain network? DLT Labs, a leader in designing and executing innovative enterprise solutions leveraging distributed ledger technology, was brought in to assist Walmart Canada. Bison Transport, one of Walmart Canada's carriers, joined the team responsible with creating a network a short time afterwards. After extensive testing, a prototype version, which initially only involved Walmart Canada and Bison Transport, became live in January 2019. It was a success, and the network, known as DL Freight, was rolled out to the remaining 69 carriers in March 2021. Every step of the process, from the carrier's tender offer through evidence of delivery and payment approval, the system collects data in real time. This data is automatically gathered and synchronised in real-time, and only the parties involved in the transaction have access to it. According to all reports, the system has been a huge success. Over 70% of invoices were disputed prior to DL Freight. Today, invoice discrepancies account for less than 1% of all invoices, and

these issues are easily identified and remedied. Payments are no longer delayed for weeks or months; carriers are now paid on time.

2.1.6 Gilmore (2021) in an editorial in Supply Chain Digest has mentioned that on the retail and supply chain front, we're witnessing the war of the century between Walmart and Amazon. It's been going on for far longer than a single night, but it's now nearing a crucial phase that could determine who wins the war. Walmart is still much bigger than Amazon, with \$559 billion in revenue last year vs \$386 billion for Jeff Bezos' company. However, just a few years ago, the margin was much wider: in calendar 2016, Walmart had \$485 billion in sales, while Amazon had only \$126 billion. Right now, both stores are focusing on the main business of the other.

It established its first Amazon Fresh supermarket in Los Angeles last September, on the site of a closed Toys R Us store. This Amazon store was distinct from what is effectively a speciality food store that Amazon acquired in 2018 when it purchased the Whole Foods network. This was a more traditional grocery store, but one with some cutting-edge technology. This includes carts with computer vision that capture the things customers choose, allowing for quick checkout, as well as Alexa voice assistants placed throughout the stores to answer customers' questions. According to the Financial Times, Amazon has opened at least a dozen more of similar storefronts around the United States, with several more in the works. Amazon is vying for a large portion of the \$1.3 trillion US food market, which strikes me as unusual given the industry's history of low margins. And it appears that Amazon believes that achieving that goal necessitates a huge brick-

and-mortar shop network. Walmart (along with Kroger and others) is unlikely to face an existential threat, but it doesn't mean it isn't a severe threat. Walmart's grocery products account for more than half of its income in the United States.

Meanwhile, Walmart is doing everything it can to chip away at Amazon's massive ecommerce dominance. Walmart has a 7% share of the US online market, compared to Amazon's 40%, according to analytics firm eMarketer, however this is only an estimate because Walmart does not reveal its ecommerce revenues. Walmart announced a 37 percent increase in online sales in the United States in the quarter ending in April - great, but not as stunning as Amazon's enormous 44 percent gain in the first quarter ending in March. And Walmart, which has a reputation for being frugal, is spending billions of dollars to catch up. According to the Financial Times, Walmart CEO Doug McMillon said at a recent investor day, "It's time for us to ramp up our aggression even more".

As a result, Amazon is directly attacking Walmart and other US groceries, while Walmart is investing heavily on ecommerce revenue growth to keep up with Amazon. However, the two battlegrounds are becoming increasingly intertwined. Slow to catch on, online grocery's portion of the US industry has tripled to 10% in the last year, with forecasts that it could more than double by 2025. Walmart has long considered its 5300 US stores to be a crucial edge in the ecommerce struggle with Amazon.

A Walmart is predicted to be within 10 miles of 90% of consumers. Despite its hundreds of fulfilment centres and local delivery stations, Amazon can't match

Walmart's retail network, which may allow it to deliver cheaper and faster than Amazon or make picking up at a store more convenient. As a result, Amazon is launching brick-and-mortar grocery stores.

2.1.7 Rodrigues et al. (2015) in an article in ScienceDirect have discussed that there has been a considerable trend toward servitization in the defence context. With rising competition, commercial tactics are increasingly focusing on offering long-term solutions for complicated engineering items like submarines. In this situation, value for money is a critical factor in deciding which bid to accept. This shift in the business climate has had a significant impact on the defence industry. The Industrial Product Service System (IPSS) is a paradigm for providing services to industrial clients that intends to reduce product and service life cycle impacts through product servicing, remanufacturing, and recycling. This strategy has proven to be a successful way to improve service support in military projects. IPSS adds value to clients by responding more quickly to their needs at lower costs. This is accomplished through a contracting method between the MoD and industry, which might differ in numerous elements such as risk sharing, application level, ownership policy, and supportability criteria.

The United Kingdom Ministry of Defense, as well as other defence authorities such as the US Department of Defense, have found that Contracting for Availability (CfA) is the most common contracting technique. As a result, the Ministry of Defense and industry are becoming increasingly interested in optimising these contracting arrangements. Understanding how to assess the cost of military services is a barrier when designing a good CfA support plan. The

existing understanding of important contract performance drivers, such as contract duration, project hazards, and Defense Line of Development (DLoD), by CfA design teams must be improved. They must devote the appropriate amount of attention to these factors in order to ensure that projects meet contractual requirements and are profitable. Furthermore, no methods exist to accurately assess and develop CfA, taking into account all of the risks and uncertainties. DLoDs are further hampered by a widespread lack of comprehension. Most contemporary CfA design teams focus their efforts on training and equipment DLoDs, and their estimations are largely reliant on expert opinion and historically unreliable data. Furthermore, the lack of or incomprehensibility of historical data is a key source of difficulty, leading to an increased reliance on expert opinion. The literature is encouraging in terms of identifying new ways to better understand how to model the DLoDs. This model could be a suitable way to use in the in-service phase of CfA, and it could be expanded, adapted and improved to be used in the development of CfA support strategies.

2.1.8 KPMG (2021) in this study report titled “Future of Procurement” has brought out that unprecedented change and disruptions are threatening organisations' long-term sustainability. Consumerization, rising regulatory requirements, pricing challenges, an ever-changing business landscape due to Merger & Acquisition activity, and transitions to outcome-based pricing are all driving procurement professionals to rethink their tactics. Customers and employees alike are no longer prepared to accept a lengthy procedure and lengthy delays in a world when most purchasing experiences are available at the press of a

button. Procurement organisations of the future will almost certainly need to shift from purchasing and sourcing to providing a seamless digital experience. The emergence of big data and analytics in the procurement organisation of the future should provide category managers with previously unavailable information. To know how to increase value, the company needs have the correct systems, processes, and people in place. Only then can intelligent automation assist with forecasting, demand planning, and should-cost modelling by providing on-demand data. Customer expectations have shifted dramatically in recent years, and this trend is now spreading from the home to the workplace. Customer centricity will likely be an emphasis in the procurement function of the future in all aspects of procurement, including systems, procedures, and people. Procurement will strive to become a true business partner rather than a spend gatekeeper, and business leaders will recognise procurement's value and desire to collaborate with them. Companies that use digitised procurement can obtain a competitive advantage by focusing more on their customers and having the necessary agility to meet ever-changing client requirements. Meanwhile, in order to develop transparent and effective end-to-end supply chain management, out-of-date procurement organisations may find it difficult to identify innovative suppliers early on and integrate them into their value chain. As the corporation is compelled to cling to veteran suppliers who have likewise missed the boat on innovation, the gap between it and its competitors is likely to widen. As a result, the market is projected to split into two supply chains: new and outmoded. Companies who wish to be among the innovators must embark on the digital

transformation journey as soon as possible. Data and analytics are one of the foundations for enabling supplier-centricity, customer-centricity, and category innovation in the future of procurement. Previously separate and fragmented data sources are expected to be smoothly connected in the procurement organisation of the future to produce simply accessible and accurate data points. Procurement professionals will most likely be the in-house data scientists, providing strong, real-time, and accurate data.

2.1.9 Disney and Towill (2003) has compared the projected performance of a Vendor Managed Inventory (VMI) supply chain to that of a standard "serially-linked" supply chain in this article. The focus of this inquiry is on the impact that these two alternate topologies have on the supply chain's "Bullwhip Effect." As a result, VMI has been demonstrated to be far better at responding to volatile fluctuations in demand, such as those caused by reduced ordering or pricing variations. In the context of the bullwhip, vendor managed inventory (VMI) is of special interest. VMI is a well-known supply strategy that has gained traction in a variety of industries. In many cases, this has occurred as a result of the retailer's belief that delegating more duty to the vendor will be beneficial. It should go without saying that increased visibility and, as a result, comprehension of both information and material flow should lead to improved company performance.

2.2 **Literature on Latest Trends in Inventory Management**

2.2.1 Jenkins (2021) titled “Top Inventory Management Trends to Know in 2021” has elucidated the latest trends in inventory management prevalent in industry. No matter what industry you're in, staying on top of the latest inventory management trends is critical. Many of these trends are aimed at assisting businesses in determining where to allocate resources, while others will help you gain stakeholder buy-in, improve data usage, and develop a growth strategy.

2.2.1.1 **Artificial Intelligence and Machine Learning.** Systems with artificial intelligence (AI) and machine learning (ML) capabilities work hand-in-hand with IoT activities in warehouses and inventory management. The issue is that a lot of the data that manufacturers and retailers collect presently isn't formatted in such a way that it can be easily manipulated in a spreadsheet: Consider product photos, films shot as AMRs travel through warehouses, different SKU forms, and data generated by various sensors and scanners. Machine learning could be used to identify damaged products or packaging, ensuring that buyers receive only high-quality products. Furthermore, due to the nature of inventory, data collection is constantly increasing and changing. All of this makes analysis difficult.

2.2.1.2 **Cloud Based Solutions.** For any organisation, the ability to track inventory in real time can be a game-changer. Decision-makers can respond to and resolve inventory concerns more rapidly with cloud-based solutions because all of company's data is stored securely and

centrally and can be accessible from anywhere. In addition, cloud applications, like software as a service, offer a number of advantages over on-premises applications. Because there is no hardware to acquire, there are lower upfront costs, faster installation, continually up-to-date software, and higher security and resilience than most enterprises can achieve on their own. In terms of inventory management, storing data in a single location makes it easier to add new warehouse sites and even set up pop-up fulfilment centres in stores. Centralization permits a GPS location project, in which you track moving pallets, containers, or delivery vehicles in real time to estimate when they will arrive at their destinations. The data can then be analysed to discover the causes of frequent delays. Any cloud-based inventory management software you choose, whether SaaS/cloud or on-premises, should interact with your finance and accounting and order management systems and enable for granular inventory tracking down to the SKU or barcode level, whether inventory is in a warehouse or in transit.

2.2.1.3 Distributed Inventory Management. If you can put the correct products in the right places and reliably dispatch items from the warehouse nearest to the consumer, you can cut transportation costs and shorten delivery times by distributing inventory over many warehouses. Data analysis to understand where orders are coming from vs. where stock is situated, flexibility to establish up distribution centres in the right locations depending on data, and technology to guide suppliers to properly

break up shipments are all required for success. In most circumstances, a corporation can better manage inventory when it manages multiple, smaller warehouses rather than a few large ones.

2.2.1.4 Predictive Picking. This trend too is based on data analysis, in this case, finding interdependencies and patterns in unstructured data to forecast behaviour. Predictive picking software can tell businesses when to start fulfilling orders before they've even been placed. To estimate consumer orders with a high degree of accuracy, data such as planned marketing activities, weather, and seasonality must be compiled. That sounds difficult, and it is. At scale, you'll need a lot of data and sophisticated analytics tools. However, most manufacturers and merchants can begin the prediction process by studying past data to identify demand spikes for specific products, such as sweets in late October or pool chemicals in May. Then, using human intelligence, they can determine out why there was a surge and whether it's likely to happen again. If this is the case, the company will be able to keep enough inventory on hand and build a fulfilment procedure that reduces shipping times and touches. And that information can eventually be fed into a predictive picking algorithm.

2.2.1.5 Third Party Logistics (3PL). Distribution, warehousing, and other activities are outsourced to a third party under third-party logistics, or 3PL. These services could let firms reach out to more customers or run more efficiently without incurring the costs of

infrastructure expansion. Businesses might outsource the complete logistics process or just a few functions. The key to 3PL success is to link all manufacturing sites, including the manufacturer and 3PL provider, so that they work together as a single supply chain. With more ecommerce, refunds, often known as the reverse supply chain, are becoming a bigger drain on earnings. Contracting with a 3PL for returns handling could save money since these companies typically offer economies of scale, such as better carrier rates and systems that are tailored to execute returns as cheaply and efficiently as feasible.

2.2.1.6 Hybrid Warehousing and Shipping. A hybrid warehouse incorporates many activities, some of which are conventional — storage, picking, and shipping — and others which are not, such as when the line between a retail outlet and a warehouse blurs. Some big box businesses, for example, have transformed spare space into drop-shipping facilities. While this makes optimal use of space, it is possible that shop staff may need to be retrained. Retailers have also partnered with 3PLs to store goods and dispatch orders directly to end customers, creating a hybrid layer on top of traditional warehousing and shipping. When a shop chooses to store a small number of popular drop-shipped items so it can provide premium shipping choices, drop shipping, in which the retailer never takes custody of stock but pays a manufacturer to send items directly to customers, can take on a hybrid taste. Businesses can offer

those extra SKUs while lowering expenses if they take an innovative approach to warehouse management.

2.2.1.7 Omni-channel Inventory Control. Align your channels so that a client may check online to see if a specific item is available in a local physical location, then make a purchase and pick up the item and double-check that the price of the item on the shelf matches the price paid by the consumer. In actuality, to reconcile physical and online inventory and assure price and discount or sale parity, omni-channel inventory control necessitates cooperation among store, distribution centre and ecommerce operations. Nonetheless, an omni-channel strategy is required to remain competitive. Businesses must have a connected supply chain, a near-real-time inventory reconciliation process to offer insight, enhanced demand planning, extremely accurate order fulfilment, data analytics and tracking, and distribution facilities close to where customers are in order to succeed.

2.2.1.8 Blockchain. The majority of people consider blockchain to be the foundation for digital currencies like Bitcoin but that's only the start. A blockchain is nothing more than a transactional database. Transactions can't be changed once they've been created, and a distributed ledger allows for transparency, whether to the general public or to members of a private consortium. Companies are utilising blockchain for inventory management and control in a variety of ways. Deloitte claims that the blockchain decade began in 2020, citing some novel use cases to

demonstrate the possibilities, such as companies using blockchain to secure AP loans. The leading industry utilising blockchain right now is life sciences and healthcare, which is frequently used for clinical trials and the digitization of health information. Walmart and Nestle are among the food merchants who use the IBM Food Trust blockchain in the supply chain to eliminate ambiguity about food safety and freshness while also increasing efficiencies and reducing waste. Companies that want to use blockchain to give certainty and visibility into their supply chains will almost certainly need to join a consortium that is focused on their industry. Deloitte recommends choosing a consortium that is open about governance, treats players fairly and has widespread adoption in your market.

2.2.1.9 Reporting and Analytics. The use of real-time data analytics to make decisions, build a more customer-centric business model, and reduce costs while increasing efficiency is a common thread in many of these themes. In terms of inventory, becoming more data-driven enables companies to better estimate demand, move toward just-in-time inventory replenishment, and receive and offer near-real-time updates on where supplies or shipments are and when they'll arrive at their destinations. However, having access to enormous amounts of data isn't enough. Businesses must see it as a resource and utilise it in order to remain competitive.

2.2.2 Jenkins (2020) titled “Warehouse Automation Explained: Types, Benefits & Best Practices” has elucidated the best practices in warehouse automation. The process of automating the transportation of inventory into, within, and out of warehouses to consumers with little human intervention is known as warehouse automation. A firm can reduce labor-intensive tasks such as repetitive physical labour and manual data entry and analysis as part of an automation initiative. A warehouse worker, for example, might put large products onto an autonomous mobility robot. The robot transports inventory from one end of the warehouse to the shipment zone, while software tracks its progress and keeps all records up to date. These robots increase the task's efficiency, speed, reliability, and precision. Warehouse automation, on the other hand, does not always entail physical or robotic automation; in many cases, it simply refers to the use of software to replace manual operations. This example, on the other hand, shows how humans and robots collaborate to complete repetitive jobs while avoiding tiredness and harm. A Warehouse Management System (WMS), data collecting, and inventory control are all good places to start with automation. While warehouse automation entails a high initial investment, it has numerous advantages, including improved operations and less human error. Robotics and the integration of Artificial Intelligence (AI) into the warehouse floor are the future of warehouse automation. Data and software are used in digital automation to decrease manual procedures. In the warehouse, digital automation might take the form of Automatic Identification and Data Capture (AIDC) technologies, such as mobile barcoding. The ability to integrate with Enterprise Resource Planning (ERP) systems,

enhanced security, greater data management efficiency, reduced operational and legal risks, and improved safety are all advantages of digital process automation, but it reduces manual processes and eliminates human errors in the warehouse. Radio Frequency Identification (RFID) and mobile barcode scanning are examples of AIDC technology that can improve worker experience, increase customer service, and save operational expenses associated with human error. Digital automation technology necessitates a considerable initial investment. Hardware, software, and maintenance contracts, as well as the time and resources required to implement the systems and train staff, are included in these expenditures. Furthermore, digital automation raises the danger of data loss or corruption, as well as cybersecurity concerns.

Physical automation is a technique for reducing staff movement and creating more efficient processes through the use of technology. In the warehouse, robots are one example of how things work. Physical automation has several advantages, including increased warehouse capacity and efficiency, improved service reliability and scalability, and improved performance. Significant upfront costs, a scarcity of competent personnel to operate and maintain the system, high maintenance costs, and equipment designed for highly-specific duties are all disadvantages. Businesses must plan ahead of time and organise themselves in order to benefit from automated warehouse systems. These systems are better suited to high-volume warehouses and distribution facilities with enough space for specialist equipment.

Warehouse automation automates processes using software and technology such as robotics and sensors. These goods can be used in conjunction with other tools, such as inventory management software. Warehouse automation ensures that your facilities' business-critical processes match client demand. It all starts with a warehouse management system (WMS), which automates manual procedures and data collection, as well as inventory control and data analysis. These systems work in tandem with other solutions to manage and automate processes across a variety of business and supply chain functions. The complexity of warehouse automation ranges from simple to sophisticated. To eliminate repetitive operations, basic automation employs planning, machinery, and vehicles. Artificial intelligence and robotics are used in advanced systems.

2.2.2.1 **Basic Warehouse Automation.** Simple technology that assists individuals with chores that would otherwise require more manual effort is referred to as this sort of automation. A conveyor or carousel, for example, transports inventory from point A to point B.

2.2.2.2 **Warehouse System Automation.** To automate processes and procedures, this sort of system employs software, machine learning, robots, and data analytics. A warehouse management system, for example, evaluates all of the orders that need to be filled in a day and instructs users to pick similar items to satisfy all of those orders at once, avoiding repeated trips to the warehouse.

2.2.2.3 Mechanised Warehouse Automation. Robotic equipment and systems are used in this type of warehouse automation to aid humans with warehouse activities and procedures. One example is autonomous mobile shelf loader robots that lift product racks and bring them to human pickers for retrieval and sorting.

2.2.2.4 Advanced Warehouse Automation. Advanced warehouse automation integrates warehouse robotics and automation technology to automate labor-intensive human activities. Consider a robotic forklift fleet that navigates a warehouse using powerful AI, cameras, and sensors and communicates each forklift's whereabouts to an online tracking portal.

Because of the large range of warehouse technologies and systems available, there are many different forms of warehouse automation. From receiving to shipping, warehouse automation strives to reduce human duties and speed up procedures.

2.2.2.5 Goods-to-Person (GTP). One of the most prominent strategies for enhancing efficiency and minimising congestion is goods-to-person fulfilment. Conveyors, carousels, and vertical lift systems are all included in this category. GTP systems can double or triple the speed of warehouse picking when used correctly.

2.2.2.6 Automated Storage and Retrieval Systems (AS/RS). AS/RS is a type of GTP fulfilment technology that incorporates automated systems and equipment for storing and retrieving materials or products,

including as material-carrying vehicles, tote shuttles, and mini-loaders. AS/RS systems are commonly used in high-volume warehouse applications with limited space.

2.2.2.7 Automatic Guided Vehicles (AGVs). This type of mechanised automation has a little amount of processing capacity onboard. To navigate a defined path across the warehouse, these vehicles use magnetic strips, wires, or sensors. AGVs can only be used in big, straightforward warehouse locations with this navigation scheme. AGVs are not a good fit for complex warehouses with a lot of human traffic and limited space.

2.2.2.8 Autonomous Mobile Robots (AMRs). AMRs, which are more adaptable than AGVs, employ GPS systems to plan efficient paths within a warehouse. AMRs can safely navigate dynamic situations with a lot of human traffic because they employ modern laser guiding systems to detect impediments. They're simple to programme with routes and quick to implement.

2.2.2.9 Pick-to-Light and Put-to-Light Systems. Warehouse pickers are directed where to position or pick up selected items using mobile barcode scanning equipment linked to digital LED displays. In high-volume settings, they can significantly minimise walking and searching time, as well as human error.

2.2.2.10 Voice Picking and Tasking. Speech recognition software and mobile headsets are used in voice-directed warehouse procedures, commonly known as pick-by-voice. To tell warehouse workers where to pick or put away a product, the system produces efficient pick pathways. This technology eliminates the need for handheld instruments such as RF scanners, allowing pickers to focus on their work in a safer and more efficient manner.

2.2.2.11 Automated Sortation Systems. Sortation is the process of using RFID, barcode scanners, and sensors to detect things on a conveyor system and route them to a warehouse location. In order fulfilment, companies employ automated sortation systems for receiving, picking, packaging, and shipping.

The role of the warehouse in the supply chain has changed dramatically. Modern warehouses perform mission-critical, cost-cutting operations while also adding value to client interactions. The best practices in warehouse automation are listed below:-

2.2.2.12 Integrate with Warehouse Management System (WMS).

Make sure the warehouse automation solutions you choose are compatible with a WMS. Look for a system that can control inventory, track inventory, monitor and report on labour expenses, integrate dashboards, and automate these functions. Learn about the features of WMS and the distinction between inventory and warehouse management.

2.2.2.13 **Scalability.** Technology should grow together with the company. Future warehouses, workers, equipment, and new supply chain partnerships, such as 3PLs or drop shippers, should all be factored into the system.

2.2.2.14 **Automatic Data Collection.** Start with a solution that automates data collection, transfer, and storage, regardless of the type and level of warehouse automation you're considering in the long run. Cloud-based technologies in combination with mobile barcode scanners offer a low-cost, low-risk path to automation. This ecosystem will aid in the elimination of human error, the capture of crucial warehouse performance and inventory data, and the storage of that data in a centralised cloud database for subsequent analysis.

2.2.2.15 **Cycle Counts.** Cycle counts are a critical element of WMS that monitor inventory levels versus the inventory data record. Once you have automated data gathering systems in place, you can use mobile barcode scanning or RFID sensors to automate continuous cycle counts. Then you may check for inventory inconsistencies using dashboards.

2.2.2.16 **Optimise Receiving.** Receiving data is the first step in collecting warehouse data, therefore you'll want a system that can collect as much data as possible to help direct warehouse activities. Set rules in your WMS to determine how to handle the incoming goods

(dimensions, categories, packaging), where to store it, and how to direct available resources to put it away.

2.2.2.17 Warehouse Design. To be successful, many physical automation technologies, such as GTP and AS/RS systems, AGVs, and sortation systems, necessitate specific warehouse layouts and adequate space. Consider redesigning existing warehouses and distribution hubs to make them more automation-friendly. Work with solution providers, architects, and contractors who are familiar with your specific needs. This evaluation should be included in your implementation budget.

Many warehouse procedures, such as bin tracking, cycle counting, and order picking, can be automated. Automation of warehouse processes results in more cost-effective operations and lowers product handling costs. Order fulfilment and inventory control processes can be automated with the correct warehouse automation technologies, including:-

2.2.2.18 On Receipt Accounting. Mobile devices can be used to swiftly take data in the receiving area of your warehouse. Data is captured, processed, and stored by integrated software, which has an impact on downstream and upstream automated activities.

2.2.2.19 Returns Accounting. Return processing methods can be automated using automated sorting systems and equipment such as conveyors. Use them to sort products and place them on return-to-stock shelves or in specified storage areas.

2.2.2.20 **Putaway.** The act of shifting things from receiving to storage is referred to as putaway. Putaway can be made more efficient and accurate by automating physical and digital warehouse processes. Cross-docking, in which items are quickly sorted, processed, and loaded onto trucks going for multiple destinations rather than being held at the warehouse, can be facilitated by automating this process.

2.2.2.21 **Picking.** Manual order picking is the most expensive warehouse task, with warehouse travel time accounting for up to 50% of working hours. Using GTP systems and autonomous mobile robots, the speed and efficiency of moving inventory from stock locations to meet client requests may be dramatically increased.

2.2.2.22 **Sorting.** Sorting and consolidating warehouse inventory is a time-consuming and frequently perplexing process. By detecting and handling small or fragile goods individually, automated sortation and AS/RS systems increase inventory accuracy and quality control.

2.2.2.23 **Replenishment.** Automated reorders are made possible by inventory tracking and cycle counting. The system automatically triggers an order request and flags it for approval when an inventory item hits a pre-determined par level. Overstocking costs and inventory losses due to rotting and theft can be avoided with automated replenishment.

2.2.2.24 Packaging. Due to the high cost and environmental impact of packing materials, the packaging stage of order fulfilment is crucial. Based on product qualities (such as durability), size, and material costs, automated packing and cartonization systems employ algorithms to select the optimal form of shipment packaging.

2.2.2.25 Shipping. Conveyors, scales, dimension sensors, printers, and software applications are used in automated shipping systems to find available carriers, estimate shipping prices, and affix labels to goods for shipment.

Ecommerce's popularity and expansion has boosted the demand for warehouse automation. Here are a few instances of how it's done in different industries:-

2.2.2.26 Barcode Scanning. To dominate online retail and enhance warehouse operations, Amazon employs automated barcode scanning and labelling. Amazon's renowned revolutionary storage system is the result of this automation. On incoming products and the shelves where they are stored, unique barcodes are put. When it's time to transport a product, personnel use the most recent picking list to locate the item using automated routes that are designed for efficiency and flow.

2.2.2.27 Picking Automation using GTP Systems. In their new distribution hub in Japan, Nike installed a GTP picking system. The automated GTP picking system employs self-driving robots to transport products and packages stocked on shelves or pallets to warehouse

personnel for order fulfilment. Nike is now able to give same-day delivery to customers in Japan thanks to the new warehouse automation.

2.2.2.28 Inventory Automation with AS/RS Systems. IKEA

has warehouses all over the world that are highly automated. AS/RS inventory automation systems and equipment, such as 100-foot-tall trilateral stacker cranes and conveyor rack systems capable of autonomously transferring 600 pallets per hour to dispatch zones, are used at its distribution centres.

2.2.2.29 Back-office Automation. Back-office operations can be

improved by using WMS platforms with digital process automation technologies. Staff at iAutomation, a distributor of machine control solutions and services to OEM machine makers, had to manually import and export data across different platforms to support sales and customer service teams, which impeded productivity. With automated barcoding, case management, and issue tracking solutions, the company integrated NetSuite's Inventory Management, CRM, and Manufacturing Execution System to improve back-office sales and customer support services.

Modern warehouses have a greater emphasis on value-added services, order customisation, and rapid flow-through operations that stage products according to just-in-time inventory rules, rather than on traditional storage duties. The following is a rundown of the digital and physical warehouse automation and robotics trends that are transforming the modern warehouse:-

2.2.2.30 Robotics. In the first quarter of 2020, investment in warehouse robotics startups surged by 57 percent to more than \$380 million. In a post-pandemic economy and places with labour shortages, such as Japan, the movement will continue to gain traction.

2.2.2.31 Cobotics. The term "cobotics" refers to human-robot collaboration (cooperation and robotics forms cobotics). Human tasks are not replaced by cobots, which are designed to work alongside people. AMRs, which can scan their surroundings, are included in warehouse automation cobots. By identifying changes in its 360-degree range of view, this cobot AMR can avoid collisions with humans and human-operated machines, and can safely drive backward when necessary.

2.2.2.32 Supply Chain as a Service. The desire for flexible warehouse operations and automated technology such as autonomous robots is driving the growth of warehouse service-based sectors. Manufacturers and service providers that sell automated equipment and systems are attempting to be replaced by companies that offer subscription-based, full-service automated warehouse solutions.

2.2.2.33 Blockchain Technology. Blockchain technology is a secure automated network that uses cryptography to establish data transfers in blocks on a shared digital ledger, while it is still in its infancy. Because of its improved data authentication, validity, and transparency, blockchain technology has ramifications for warehouse operations and

inventory management. Every player in a complex supply chain may use blockchain databases to link and exchange permanent, automatic records for every transaction, with shared data storage accessible to everyone on the secure network.

2.2.2.34 Warehouse Drones. Intelligent drone fleets, powered by advanced algorithms and linked to cloud-based warehouse management systems, can assist with inventory management inside warehouses. To manage inventory and automate activities like cycle counting, certain warehouse drones are fitted with vision sensors or barcode scanners.

2.2.2.35 Fast Shipping. Regardless of who sells the product, the "Amazon effect" of one- or two-day shipping has created a huge demand for quick online deliveries. Same-day shipping will continue to promote warehouse automation, which increases the accuracy and cost-effectiveness of automated packaging and shipping procedures while speeding up order fulfillment chores like selecting.

2.2.2.36 Warehouse Sanitation. Automated industrial-sized robotic floor cleaners that negotiate complex warehouse layouts already have a market. With UV lamps and sanitization chemicals, a new generation of autonomous mobile cleaning robots is emerging to safely cleanse and disinfect high-touch indoor workplaces including warehouses and distribution facilities.

2.2.2.37 Mobile Shelving. Amazon is the most well-known company to use GTP systems based on AGVs and AGRs. The self-driving robot fleets can load and transfer mobile shelving units containing stored inventory to specific destinations. This allows staff to choose orders with the least amount of movement and walking time possible.

2.2.2.38 Autonomous Vehicles. In automated warehouses and distribution hubs, autonomous robotic forklifts are already in operation. Automated delivery trucks that transport inventory between warehouses, manufacturers, and retail outlets are projected to be among the first autonomous vehicles to advance farther up the supply chain.

2.2.2.39 ERP Integration. Automation systems that interact with ERP suites to provide an end-to-end automated business platform are being empowered by API technology and machine learning (ML). Back-office workers will be able to conduct more value-added, creative, and customer-focused tasks as automation and ERP technologies improve.

2.2.2.40 Big Data. The shift to cloud-based applications and databases capable of collecting, analysing, and storing huge datasets in a user-friendly format will accelerate data analytics in warehouse operations.

2.2.2.41 Internet of Things (IoT). RFID sensors, while not strictly a new technology, continue to be a driving force behind new IoT applications that improve supply chains and warehouse operations. The

Internet of Things improves warehouse visibility by giving real-time location data on equipment and goods. RFID sensors enable better data collecting capabilities across systems due to its mobility, cost, and real-time inventory monitoring capacity.

2.2.2.42 Wireless Fleet Management. The ability to control automated fleet vehicles wirelessly has been made possible by advances in IoT applications, cloud databases, and sensor technology. Onboard computers send extensive information about equipment location, maintenance schedules, and accident alarms to your system via telemetry.

2.3 Conclusion

During the course of literature review, lack of previous studies on the specific theme of Inventory Management in the Indian Navy became apparent. The existing literature shows studies on the subject of Logistics in defence forces, however, they deal with outsourcing of logistics, joint logistics and performance based logistics. Study of best practices of industry leaders in the field of inventory management like Amazon and Walmart have given meaningful insights. These latest trends in inventory management and warehouse automation will greatly improve the responsiveness of the logistics supply chain.

CHAPTER – III

GLOBAL BEST PRACTICES

3.0 Introduction

In the past two decades, Indian Navy has transformed itself into blue water Navy and its presence has been increasingly visible in the Indian Ocean region as a first responder in Humanitarian Assistance and Disaster Relief (HADR). The logistics support required for sustaining such operational tempo has grown more complex and assumed greater significance than ever before. The challenge therefore, is to develop a robust and efficient logistics system synchronized with the operational commitments. It is therefore imperative that the best practices across other Navies and industry be studied, analysed and suitably incorporated to meet the challenges of the future. Some of the best practices that are followed by other Navies which can be emulated for material management functions in the Indian Navy are listed in succeeding paragraphs. These practices will help in bridging the gap between expectations and reality in the existing system of material management.

3.1 Material Codification

Indian Navy codification of using Original Equipment Manufacturer (OEM) code and Part Number was a pragmatic decision for conversion from manual to computerized process. This different from practices of private organizations as well as other Navies. Indian Navy needs to move towards a parallel codification scheme, which is in tune with global best practices. A solution would be to allow the firms to manage the database of their inventory. This would be prudent system as the

codification system used is primarily the vendor's part number to which we suffix the vendor code. This feature is available in almost all material management applications, wherein module for obsolescence is inbuilt. This feature is commonly used in the Automobile industry where spare parts supercession and obsolescence is a regular feature due to product re-engineering. The vendor can be authorized to update part number changes by a web based application for items pertaining to his vendor code. This change can be communicated to all users and can be effected in all ongoing processes like Indent, Tender Enquiries and Orders for that particular item.

3.2 Material Provisioning and Review Cycle

Most organizations follow replenishment model and start provisioning for an item as soon as it falls below re-order point to avoid breaching of MSL. In fact, number of items below MSL and number of items that are stock out are key performance metrics. Once a year material review cycle for indenting is typically not practiced globally.

3.3 Low Value Purchases

Organisations like US Navy have migrated to authorizing purchases on Credit Cards for low value purchases. A federal credit card is issued to the Logistics Officer of the ship for making purchases of common nature items. The card has a limit equal to the budgetary allocation for the ship and general nature items susceptible to local purchase in the open market are purchased using it. If this system were to come into practice then the complete focus of Material Organizations can be on provisioning of Equipment and Spare parts and not on cleaning material for ships.

3.4 Department of Defense Online Marketplace

FedMall was formerly known as US Department of Defense (DoD) eMall is an eCommerce ordering system for DoD, federal, state and authorized local agencies to acquire products from commercial suppliers. This web based service is managed by M/s Atlantic Diving Supply Inc. FedMall, an easy-to-use point, click and ship system from ADS, includes over 5,000 products from 140+ vendors. Shipping notifications, tracking information, and the ability to send to various destinations are all components of order management. Uses requisitions from the Government Purchase Card or Military Standard Requisitioning and Issue Procedures (MILSTRIP) to conveniently fund purchases up to a maximum of \$35,000. FedMall conducts business using following “preferred vendors” concepts explained in subsequent paragraphs as per Atlantic Diving Supply Inc (www.adsinc.com).

3.4.1 Blanket Purchase Agreements

BPA contracts create a communication channel for future use between the customer, the contracting office, and the possible vendor. You can expect a quick turnaround on delivery once you've setup your account, and there's no minimum purchase requirement. The Federal Acquisition Regulatory creates BPAs as a streamlined method of filling expected repeated needs for supplies or services, with no need to know exact items, quantities, or delivery requirements in advance. ADS has more than a decade of experience assessing RFPs and developing Blanket Purchase Agreements.

3.4.2 Commercial Off the Shelf Modernisation

For the US Department of Defense and the Department of Homeland Security, this contract handles complex, continuing program-level or multi-unit/agency requirements that fall under the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense (JPEO-CBRND) mission. The CBRNE Indefinite Delivery Indefinite Quantity (IDIQ) contract is a vast, on-going effort to provide commercial off-the-shelf (COTS) goods that are technologically advanced and capable of keeping up with the quickly changing defence environment.

3.4.3 Tailored Logistics Support Programme

The Special Operational Equipment (SOE) TLS programme includes M/s ADS as a participating vendor. This dynamic Defense Logistics Agency (DLA) contract programme provides access to the most up-to-date commercial technology, services, and training to all military services and federal agencies. It's a simple, streamlined purchasing process with on-time deliveries and responsive customer service. Government monitoring is maintained through an audit-ready approach that includes collaboration between the financial office and the DLA. MILSTRIP requisitions or Military Interdepartmental Purchase Requests are used to process all orders (MIPRs).

3.4.4 Electronic Medical Catalogue

ECAT is an online ordering, distribution, and payment system that gives all medical DoD, Veteran Affairs medical centres and government consumers

subsidised access to commercial catalogues from many medical manufacturers and distributors. This extremely efficient system allows deploying military units, Military Treatment Facilities, Veterans Affairs Medical Centers, Health & Human Services, and Indian Health Services to quickly obtain the entire range of supplies required to meet their needs. Customers can explore, compare, and order a variety of laboratory supplies and equipment, dental supplies and equipment, optical supplies, orthopaedic implants, cardiovascular products, medical/surgical supplies, and medical equipment through the programme. ECAT automates the complete client procurement cycle, from product discovery to reorder lists, order submission, approval, and receipt and payment. Within 24 hours, ECAT will notify you of the status of your vendor acceptance. Within the United States, purchases are typically delivered within 72 hours of receipt, and international orders are typically delivered within 7-10 days. Military Standard Billing System (MILSBILLS) is a payment mechanism accepted by ECAT. These capabilities provide Medical consumers with the best of both worlds: the simplicity of buying from local vendors while yet taking advantage of the volume discounts offered by central procurement systems. Furthermore, ECAT integrates with the Services' Material Management Systems, allowing clients to purchase materials through a business-to-business paradigm. To optimise the range and depth of its product offerings and promote vendor competition, ECAT offers products from both manufacturers and distributors. There are no fees for vendors to participate in the ECAT programme. The contracting professionals at DLA Troop Support Medical Supply Chain negotiate a discount off the vendor's commercial catalogue price.

ECAT clients will see this decreased pricing as the product's "Total Delivered Price." All transportation/distribution and administrative fees are included in this price.

3.4.5 General Services Administration Contract

GSA Advantage is the federal government's primary online shopping marketplace, with millions of pre-negotiated items and services available to federal organisations. It offers over 10,000 items and professional services from over 100 vendors. Competitive, market-based pricing combines the federal government's purchasing power with the opportunity to negotiate further discounts at the order level. Customize terms and conditions to obtain exactly what you're looking for. E-tools provide clients with quick and easy access to industry partners while also assisting them in maximising competition and fulfilling their socioeconomic objectives.

3.4.6 Distribution and Pricing Agreements

These schedules allow Commands to acquire Owens & Minor and Cardinal Health products under the Prime Vendor Program. ADS can give exceptionally competitive pricing and provide preparedness at a reduced cost for medical equipment and supply requirements, with 124 manufacturers and 3,827 products on schedule. A Prime Vendor (PV) is a single distributor of brand-specific medical goods that they can supply the same day. PVs are industry leaders in their respective fields. Pharmaceuticals, medical/surgical supplies and equipment have contracts encompassing the entire United States, Europe and the Pacific. The

program's pricing is determined by Distribution and Pricing Agreements (DAPAs). Federal Supply Schedule (FSS) contracts for medical items are contracted by the Department of Veteran Affairs (DVA), while DAPAs are agreements that Defense Supply Center Philadelphia-Medical Directorate has entered into with the producer or, in some situations, a distributor of the product. One gets the best overall cost in the business because of legislation that regulates suppliers to federal clients. If one chooses to participate in the programme, one must purchase all of their recurring products from the Prime Vendor for that commodities line. The programme includes a wide range of options. If the precise item one requires is not covered, it is possible to order supplies not covered by a DAPA or FSS through the Alternate Commercial Product Ordering Program (ACPOP).

3.4.7 Maintenance Repair and Operations Contract

MRO contracts allow businesses to get the operational equipment and services they need to keep a building, facility, or factory running. Organizations can get MRO service contracts and order the supplies they need to maintain and operate their facilities through ADS and the Defense Logistics Agency (DLA).

3.4.8 Tactical Communications Equipment and Services

Tactical Communications Equipment can now be purchased in a simple and convenient manner. M/s ADS Inc. is a vendor on the TacCom II contract, which is aimed to give agencies access to the most up-to-date tactical communications equipment, including radios, infrastructure and satellite solutions. There is no

administration cost imposed to ordering agencies. As new tactical communications technology becomes available, one will have access to it. Interoperability of communication between government agencies is improved. Price reductions are available through volume purchasing and economies of scale. Reduces procurement expenses by making ordering simple and quick. Duplication of contracts is eliminated across the federal government.

3.4.9 Preferred Vendors

Organisations world wide are migrating to “preferred vendor” concept. Such vendors supply a large number of items under contracted rates. The guarantee low lead times and material availability. They can be regional or national. This allows organizations to deal with less number of vendors and make vendors more responsive to quality and delivery reliability needs. A preferred supplier list ensures that suppliers provide the highest value in terms of pricing, quality, financial stability and contract performance. Ones purchasing power will increase as one buys more from recommended suppliers, allowing one to negotiate better pricing and save money. Purchasing goods and services takes time, especially when one has to go through a bidding process, gather offers from potential vendors and negotiate contract terms. Because these stages have already been completed centrally, purchasing goods and services is significantly faster and easier. Instead of focusing on administrative procurement responsibilities, personnel may concentrate on their principal mission. When managing ones supply chain, there are numerous risks associated with suppliers that can be addressed by employing a preferred supplier list. One can then keep a close eye

on their performance to ensure that they are meeting their contractual commitments. Because they are more committed to your business and have a better understanding of it, your important suppliers should give higher service levels. Having a preferred vendor list gives you more control over procurement. Building relationships with these vendors makes them more accountable, and you're more likely to get better service. Communication will also be improved, lowering the likelihood of misunderstandings.

3.4.10 Preferred Purchase Modes of US Navy

US Department of Defense defines primary vendors for a material after a round of competitive bidding. Any unit can order from primary vendors with minimal paper work and have the material delivered to the unit. Primary vendor will only add freight charges to the delivery location to the earlier agreed upon rate. Primary vendors are typically aggregators, such as primary vendors for construction material, electrical material etc. Ordering from primary vendors does not require re-tendering or price negotiation. Primary vendors contracts are valid for finite time period.

3.5 United States National Defense Stockpile

The Defense Logistics Agency Strategic Materials is in charge of safeguarding strategic and vital materials in the US National Defense Stockpile (NDS) in a safe, secure, and ecologically sound manner. A pre-World War II version of the NDS was established with the goal of acquiring and storing metals, minerals, and agricultural commodities. During a national emergency, the materials stockpile was meant to

reduce reliance on foreign sources of supplies. The United States Congress has given DLA Strategic Materials permission to sell surplus commodities to the Department of Defense. DLA Strategic Materials has made nearly \$6.6 billion in sales since 1993. The Treasury General Fund and a variety of defence programmes profit from the sale of excess NDS materials, including the Foreign Military Sales programme, military personnel perks, and the buy-back of broadband frequencies for military use. The proceeds from the sale also support DLA Strategic Materials' activities, allowing it to become self-sustaining. DLA Strategic Materials has 42 commodities worth more than \$1.1 billion in six sites across the United States. Base metals like zinc, cobalt, and chromium are traded alongside more precious metals like platinum, palladium, and iridium. No other private corporation in the world sells such a diverse range of commodities and resources. The aim of the program is that in times of national emergency, to reduce and eliminate reliance on foreign sources or single points of failure for strategic commodities. The details of US National Defense Stockpile are available on website of US Defense Logistics Agency (<https://www.dla.mil>).

3.6 Strategic Supplier Alliances (SSA)

Defense Logistics Agency (DLA) and its major suppliers—mostly OEMs—have long-term cooperation agreements that allow DLA to leverage its purchasing power across a large number of items. They improve customer service by agreeing to place a vendor's sole-source items under long-term contracts with performance metrics. During the period of the contract, a competing long-term contract may be deemed part of the alliance. Competitive contracts, like SSA sole source contracts, must

include performance criteria and items controlled across the agency. To be termed a "corporate" contract, they must include things maintained by more than one DLA inventory control point. The overall parameters of the cooperation are outlined in a written charter, which is endorsed by senior level officials from both parties. Some of these words are presented as strategic qualitative goals, such as cost control, resource sharing, acquisition process streamlining, stakeholder communication, and business process improvement. The corporate contracts include clauses and terms and conditions that detail the specific performance metrics that must be met in order to meet the qualitative objectives (for example, achieving 99 percent on-time delivery for all orders, shipping all high priority (Issue Priority Group One) requisitions within 24 hours, and reducing production lead-times by 25%). DLA and the supplier are among the SSA relationships; others include the Services and the Defense Contract Management Agency. SSAs are agreements that DLA makes with vendors with whom it has a sole-source business worth more than \$100 million. To facilitate customer service, DLA and these vendors have a high level of day-to-day engagement. Because suppliers can create strategic partnerships with their own suppliers, long-term relationships result in price stabilisation. By placing big volumes of things on long-term contracts rather than granting individual contracts as demand arises, economies of scale can be realised. DLA can keep lower quantities of stock in storage depots because of shorter lead periods. DLA is also able to procure equipment on a more just-in-time basis rather than relying on depot stockpiles. This involves partnering initiatives with 36 top suppliers that are the sole source of material critical to US defense posture. Compared to this we have approximately

3000 vendors for the same quantum of inventory. Details of SSA are available on US Defense Logistics Agency website (<https://www.dla.mil/>). The strategy pursued to make this programme a success are as follows:-

3.6.1 Negotiated , signed agreements between DLA and suppliers to collaborate to pursue common objectives.

3.6.2 Specific, quantifiable objectives have been set, some of which are number of items managed under SSA, administrative lead time, procurement lead time, quality issues, backorders, price control, delivery performance and sales volume.

3.6.3 Performance of these preferred vendors is measured and monitored. In other words the aim is not to buy spares and increase the inventory levels but to buy assured performance.

3.7 US Naval Supply Systems Command

NAVSUP and the Navy Supply Corps share one mission: to conduct and enable supply chain, acquisition, operational logistics, and Sailor & family care with their mission partners to generate readiness and sustain naval forces worldwide to prevent and decisively win wars. With headquarters in Mechanicsburg, Pennsylvania and a diverse global workforce of more than 22,500 military and civilian personnel, NAVSUP and the Navy Supply Corps share one mission: to conduct and enable supply chain, acquisition, operational logistics and Sailor & family care with their mission partners. The NAVSUP/Navy Supply Corps team is responsible for a wide range of responsibilities, including supply chain management for material support to the Navy, Marine Corps, joint and coalition partners, supply operations, conventional

ordnance, contracting, resale, fuel, transportation, security assistance, Sailor and family care, including food service, postal services, retail facilities and household goods movement. The NAVSUP Enterprise is made up of eleven commands around the world, in addition to its headquarters. NAVSUP is completely integrated and handles a wide range of inventory and services and the details are available on their website (<https://www.navsup.navy.mil/>).

3.7.1 NAVSUP Weapon Systems Support. By exerting centralized control over more than 430,000 different line items of repair parts, components & assemblies and providing global logistical support to US Navy's ships, aircraft, submarines and weapon systems, NAVSUP WSS ensures that US naval forces are mission ready. Through the Foreign Military Sales programme, NAVSUP WSS also provides logistical and supply support to coalition and partner nations.

3.7.2 Navy Exchange Service Command. NEXCOM is in charge of 100 Navy Exchange facilities and nearly 300 stores around the world, 39 Navy Lodges, the Ships Store Program, the Uniform Program Management Office, the Navy Clothing and Textile Research Facility, and the Telecommunications Program Office, as well as the Ships Store Program, the Uniform Program Management Office, the Uniform Program Management Office, the Navy Clothing and Textile Research Facility, and the Telecommunications Program Office. The purpose of NEXCOM is to offer authorised consumers with high-quality goods and services at a reduced price while also supporting Navy quality-of-life initiatives for active duty soldiers, retirees, reservists and their families.

3.7.3 NAVSUP Fleet Logistics Centers. NAVSUP has eight NAVSUP FLCs around the world. They are globally poised to supply integrated logistics, contracting services, ordnance and facilitate transportation to Navy and Joint operating units throughout all warfare businesses and military activities and they are aligned to the Navy's numbered fleets.

3.7.3.1 Fleet Logistics Center Bahrain. The NAVSUP Fleet Logistics Center Bahrain is located onboard Naval Support Activity Bahrain, which is home to the United States Naval Forces Central Command (NAVCENT) and the United States Fifth Fleet. In the NAVCENT area of responsibility, the NAVSUP Fleet Logistical Center Bahrain offers full spectrum operational logistics support and quality-of-life services to Navy, joint and coalition warfighters, DoD civilians and their families.

3.7.3.2 Fleet Logistics Center Jacksonville. NAVSUP Fleet Logistics Center Jacksonville provides supply assistance to Fleet units as needed and performs additional duties as instructed by the Naval Supply Systems Command (NAVSUP). NAVSUP FLC Jacksonville has evolved from a local storefront operation with several remote regional sites to a unified and decentralised single point provider of supply chain and logistics products and services for all Naval activities throughout the Naval Region Southeast, from Texas to Cuba.

3.7.3.3 Fleet Logistics Center Norfolk. For nearly a century, this is the US Navy's oldest and largest Fleet Logistics Center, providing high-quality supply and logistics support on the Norfolk waterfront. Over the years, their Command footprint has grown to include 37 naval stations in 13 states and the District of Columbia. Their reach, on the other hand, is significantly greater, with worldwide backing. Their staff of over 1,800 committed military, civil service and contractor specialists provides support for twelve different products and services, all of which are tailored to the specific needs of each customer.

3.7.3.4 Fleet Logistics Center Pearl Harbor. The goal of NAVSUP Fleet Logistical Center Pearl Harbor is to provide logistics solutions to the INDO-PACIFIC region in order to generate and maintain readiness. The command's mission is to be the most trusted and relevant readiness generator in the Indo-Pacific. Supply chain management, contracts, transportation, defence fuel products and global personal property movement are all services provided by the command.

3.7.3.5 **Fleet Logistics Center Puget Sound.** The NAVSUP Fleet Logistical Center (FLC) in Puget Sound, onboard Naval Base Kitsap - Bremerton, provides a variety of logistics support services and products to the US Navy's fleet and shore commands, as well as other military commands and governmental organisations throughout the Pacific Rim. NAVSUP FLC Puget Sound is the Navy's regional broker for Commander, Navy Region Northwest, with 68 Navy personnel and 322 civilian employees. Supply chain management, procurement, contracting and transportation services, technical and customer support, defence fuel products and worldwide movement of personal property are all provided by NAVSUP FLC in collaboration with regional partners and clients.

3.7.3.6 **Fleet Logistics Center San Diego.** NAVSUP Fleet Logistical Center San Diego (NAVSUP FLC San Diego) offers logistics, business and support services to the Navy, Coast Guard, Military Sealift Command and other joint and allied forces' fleet, shore and industrial commands. Supply chain management, procurement, contracting and transportation services, technical and customer support, defence fuel products and worldwide movement of personal property are all provided by NAVSUP FLC San Diego in collaboration with regional partners and clients.

3.7.3.7 Fleet Logistics Center Sigonella. Naval Supply Systems Command Fleet Logistics Center (NAVSUP FLC) Sigonella was established in March 2005 on Naval Air Station Sigonella (NASSIG) in Sicily, Italy. It's the seventh of NAVSUP's eight global logistics centres and it supports the fleet's whole range of military activities.

3.7.3.8 Fleet Logistics Center Yokosuka. The main US Navy logistics command in the Western Pacific is NAVSUP Fleet Logistics Center Yokosuka (NAVSUP FLC Yokosuka). The NAVSUP FLC Yokosuka operation connects more than 20 detachments, installations and fuel terminals from Misawa, Japan, to Sydney, Australia; Diego Garcia in the Indian Ocean, to Guam, from its headquarters off Truman Bay, roughly 26 miles (41 kilometres) due south of Tokyo. Within the 7th Fleet Area of Responsibility, these detachments and locations offer logistics support to the Navy, Marine Corps and other DoD and federal activities.

3.7.4 NAVSUP Business Systems Center. NAVSUP BSC is responsible for designing, developing and maintaining information systems that support many activities for the Navy, Department of Defense and international partners in the functional areas of logistics, supply chain management, transportation, finance and accounting.

3.7.5 NAVSUP Ammunition Logistics Center. As the Navy's munitions support agent, NALC assists the fleet. Within the Navy Ordnance Enterprise Office, they coordinate fleet requirements, handle issues, manage distribution, conduct inspections and do other technical responsibilities.

3.7.6 Naval Petroleum Office. NPO is the Joint Petroleum Enterprise's (JPE) face-to-fleet representative and the Department of Navy Service Control Point for the JPE's requirements and infrastructure. NPO assists DoD and non-DoD customers worldwide by coordinating petroleum and supply chain policy and practices.

3.8 Total Life Cycle Systems Management (TLCSM)

TLCSM is the implementation, management, and oversight of all activities connected with the acquisition, development, manufacture, fielding, sustainment, and disposal of a DoD weapon system throughout its life cycle by the designated Program Manager (PM). It gives the PM full accountability and duty for system acquisition and follow-on maintenance as the life cycle management. PBL is the recommended weapon system product support sustainment method, which leverages the acquisition of support as an integrated, cost-effective performance package designed to maximise system readiness. PBL achieves a weapon system's performance goals through a support framework built on long-term performance agreements with clear authority and responsibility lines. The TLCSM and PBL principles have now become policy, and they have been implemented to deliver more effective, cheap, and operationally ready systems by increasing system dependability, supportability, and maintainability.

Implementation of the TLCSM business approach means that all major materiel alternative considerations and all major acquisition functional decisions demonstrate an understanding of their effects on operations and affordability. In addition, TLCSM

assigns the program manager responsibility for effective and timely acquisition, product support, availability and sustainment of system throughout its life cycle. TLCSM applies to all systems in all life cycle phases. Consistent application of TLCSM metrics enables effective management by providing visibility across all major programs throughout the life cycle. Details of TLCSM are available on the website of AcqNotes LLC (<https://acqnotes.com>).

3.9 Life Cycle Logistics

The planning, development, implementation, and management of a comprehensive, affordable, and effective systems support strategy that encompasses the entire system's life cycle: acquisition (design, develop, test, produce, and deploy), sustainment (operations and support), and disposal is referred to as Life Cycle Logistics (LCL). A fundamental element of LCL policy is the designation of a Program Manager as the life cycle manager or as part of Total Life Cycle Systems Management (TLCSM), responsible for effective and timely acquisition and sustainment of the system throughout its life cycle. The PM is responsible for providing the needed product support capability to maintain the material readiness, sustainment and operational capability of a system. Emphasis is placed on increasing reliability and reducing logistics footprints in the systems engineering process and providing for effective product support using Performance Based Logistics (PBL) strategies. In support of the total system level responsibilities of the PM, PBL strategies may be applied at the system, sub-system or major assembly level depending upon the programs unique circumstances and appropriate

economic/business case analysis. TLCSM, employing PBL, is the framework for implementing the requirement to provide sustained material readiness to war fighter.

LCL is the planning, development, implementation and management of a comprehensive, affordable and effective systems support strategy. Under TLCSM, LCL has a principal role during the acquisition and operational phases of the weapon or material system life cycle. LCL should be carried out by a cross-functional team of subject matter experts to ensure that sustainability requirements are addressed comprehensively and consistently with cost, performance and schedule during the life cycle. Affordable, effective support strategies must meet goals for operational effectiveness, optimum readiness and the facilitation of iterative technology enhancements during the systems life cycle.

The Programme Managers responsibility under TLCSM is to provide the war fighter with sustainable systems that meet their requirements while at the same time being fiscally responsible and accountable. PM's should use the best possible analysis at all stages of program existence to assess performance, schedule, supportability and cost outcomes. These outcomes should be documented to ensure there is credible foundation based on the analysis that has been conducted. These efforts are critical both for establishing budgetary requirements and also for tracking execution success over time for both new and legacy programs.

LCL supports the achievement of sustained material readiness by establishing material readiness standards (metrics), developing optimized life cycle investment strategies to achieve the material readiness standards, implementing and executing

material readiness plans and continually assessing performance against the standards. LCL also includes the planning, development and implementation of PBL/Performance-based Life Cycle Product Support initiatives as the preferred approach to systems support. Examples of these initiatives include following strategies:-

3.9.1 Managing Performance Agreements. Objective outcomes, metrics, resource commitments and stakeholder obligations are all specified in performance agreements. The Program Manager, in collaboration with users, execute ongoing evaluations of sustainability initiatives, comparing performance expectations as established in performance agreements to actual performance metrics.

3.9.2 Integrating Support Strategies. Under Life Cycle Logistics the various support strategies like Supply Chain Management, PBL and TLCSM are integrated to ensure that the desired operational level of equipment as laid down in the performance agreement is maintained.

3.9.3 Proactive DMSMS Management. The loss, or probable loss, of makers or suppliers of commodities or raw materials is a Diminishing Manufacturing Sources and Material Shortages (DMSMS) concern. When a manufacturer or supplier stops producing or supporting critical items, raw materials or software, or when raw material is no longer available DMSMS management is required. The US National Defense Stockpile, covered earlier is a prime example of DMSMS management.

3.9.4 System Affordability and Reduced Logistics Footprint.

The

logistics footprint refers to the amount of logistical support that a company needs to get a product to a client. All of the tasks required to keep these logistic operations running are included in the footprint for example workforce, transportation, fuel and equipment. Life Cycle logisticians have two basic goals: to ensure that weapon systems are built, maintained and modified in such a way that the demand for logistics and consequently logistics footprint is reduced and that product support is effective and efficient.

LCL should be an integral part of the systems engineering process to ensure that sustainment considerations are implemented during the design, development and production of a system. This process is critical to providing more effective, affordable and operationally systems by increasing availability and sustainability. Details of Life Cycle Logistics are available on the website of US Assistant Secretary of Defense for Sustainment (<https://www.acq.osd.mil/>).

3.10 Performance Based Logistics (PBL)

The essence of PBL is buying performance instead of spares for supporting equipment. This is accomplished through business relationships that are structured to meet Fleets operational needs and align support objectives with required performance outcomes and available resources. PBL transitions the support strategy to the vendor for purchase of capabilities such as systems availability instead of spares, repairs and tools etc. This is a significant change, in that it transitions the responsibility and corresponding risk to the vendor. This strategic shift is far more

result oriented when compared to the existing system, which is full of blame game and where there are only scapegoats to be found for delays in mission accomplishment. A case study on use of PBL by US DoD is available on the website of Centre for Public Impact which is a foundation of Boston Consulting Group (<https://www.centreforpublicimpact.org>). Other benefits of PBL are as follow:-

3.10.1 Buying a comprehensive performance package instead of individual spares.

3.10.2 Invests in reliability, consequently Mean Time Between Failures (MTBF) increases.

3.10.3 Obsolescence Management. Product life cycle management, including proactive approach by vendors to manage obsolescence.

3.10.4 Optimises Efficiency. Repair turn around time, awaiting parts during work in process decrease.

3.10.5 Vendor Managed Inventory. Improves spare parts support by increasing material availability and reducing logistics response time resulting in improved readiness.

3.10.6 This approach totally reverses vendor incentive as fixed price pay for performance now motivates vendors to reduce failures/spare parts consumption.

Performance measurement is based on operational reliability, operational availability, cost per unit usage, logistic footprint and logistics response time. It is implemented via agreements that specify a range of performance outcomes and corresponding metrics

sufficient to accommodate changes to resources or other usage requirements. It would be aligned across various tiers of support from peace time training to war time surge levels including over and above services. PBL strategies aim at following outcomes which are similar to Life Cycle Logistics:-

3.10.7 Increased reliability and reduced logistics footprints.

3.10.8 Continuing reviews of sustainment strategies, to include end-to-end materiel readiness value chain planning, assessment and execution.

3.10.9 Proactive consideration of DMSMS/obsolescence issues.

3.10.10 Demilitarization and final disposal of the equipment.

Effectiveness of PBL is evident when the existing method of material management is analysed. Material Organisation (Kochi) had an inventory of 1.72 lakh items out of which approximately 38% or 77,000 items pertained to the Equipment & Spare parts category. These are specific to equipment and get identified as per OEMs Part Identification List (PIL). Thereafter, the items continues to get replenished from the same source. Effectively, the inventory is being sourced from few hundred firms. Most of them will be well known OEMs like Bharat Electronics Limited, Kirloskar Oil Engines Ltd, Cummins India, MTU, MAN B&W, Anschutz and Paxman to name a few and other reputed engineering and electronic firms. The problems with this type of varied inventory are a plenty and typically as follows:-

3.10.11 Duplication of the same spare part due to its classification and fitment on two or more different models of the equipment manufactured and supplied by the same OEM.

3.10.12 Obsolescence due to introduction of newer models of similar equipment owing to advancements in technology, metallurgy, manufacturing process etc.

3.10.13 In the existing system of inventory management there is a tendency to over provision due to long procurement lead time. The provisioning formula used in the past generated upto four times the Annual Consumption Level (ACL) which leading to overstocking.

3.10.14 Improvement of product specification is a continuous process due to Research and Development or user feedback. This results in changes being made to Part Identification List (PIL). Under PBL inventory management is carried out by the vendor obviating the need for item introduction on ILMS and consequent delays in provisioning.

3.10.15 In the existing system of inventory management mismatches are found when the spare received in warehouse is compared to stock sample. This involves a cumbersome process of raising a discrepancy report and delays involved in replacement of the spare. Under PBL the warehousing process is managed by the vendor as the essence is buying performance instead of spares.

Para 2.6.1 of Report of the Comptroller and Auditor General of India for the year ended March 2016 brings out that non-moving inventory held in Material Organisations (MOs)

ranged between 54 and 98.29 per cent. Further, 30 per cent of the total inventory were in obsolete/ obsolescent condition. This indicated excess procurement made by MOs constraining the storage space and unhealthy inventory management. Apart from this, inventory worth Rs 7,359.37 crore was held by MOs above the upper stock level which resulted in avoidable liability of inventory carrying cost of Rs 588.75 crore per annum besides risk of deterioration and obsolescence of the store held. Large number of items in inventory were held at MOs below minimum stock level, thereby, increasing the risk of stock out situation. Several makes of equipment serving the same purpose and different items serving the same function existed in Naval inventory signifying that no efforts for standardisation of common equipment had been made by Indian Navy. This resulted in holding multiple inventories of similar types of equipment leading to issues relating to its provisioning and stocking.

In Feb 2021 an audit report was published by Inspector General, US Department of Defense (DoD) whether the Defense Logistics Agency's (DLA) sole source Captains of Industry (COI) strategic support contracts are delivering cost savings, value, and advantages to the DoD. The report is available on the website (<https://media.defense.gov/>). COI contracts leverage performance-based outcomes to improve the availability of spare parts and the response time for spare parts orders, resulting in greater warfighter support. DLA Aviation has 13 COI contracts totaling \$55.6 billion in projected value. Inventory investment and ownership, material management, forecasting, storage and transportation are all part of the Boeing COI contract's performance-based support. Under the Boeing COI contract, DLA officials anticipate to increase material availability and save money. Material availability improved for the

three performance based Contract Line Items (CLIN) reviewed and the DLA estimates a \$430.1 million cost savings over five years. The DLA computed these savings by comparing negotiated costs to a baseline estimate based on the DLA's management of the same items in a business case analysis (BCA). As a result of PBL the customer wait time for F-18 stores management is down to 7 days from 47. For tires they maintain zero inventory and have a compliance rate of 98%. Looking at the cost implication, it is claimed that would reduce the inventory carrying cost by atleast 20% with much higher level of customer satisfaction. A similar initiative in our Navy, with indigenous OEMs to begin with, will undoubtedly yield startling results. This inventory management philosophy can be extended to items of general naval stores as also the COTS items can be outsourced.

3.11 Life Time Maintenance Support – Maintenance, Repair and Overhaul

In this concept the OEM or preferred vendor is contracted for the complete maintenance during the life cycle of the equipment i.e. MRO of the equipment including testing, tuning and setting to work post repairs/overhaul, throughout its life cycle. In certain cases replacement of equipment on reaching obsolescence, is undertaken by OEM/PV. The objectives of this strategy are as follows:-

3.11.1 Exploiting commercial OEM support infrastructure.

3.11.2 Enable vendors to field high quality defence products quickly and support them responsibly.

3.11.3 Motivate vendors to invest for improvements and facilitate functional upgrades.

3.11.4 Under LTMS the OEM or preferred vendor is contracted for the complete maintenance during the life cycle of the equipment. This also includes spares support which reduces inventory carrying costs for the organization.

3.11.5 In certain cases replacement of equipment on reaching obsolescence, is undertaken by OEM/PV. This eliminates the need for obsolescence management as upgraded equipment is automatically provided for ensuring the desired level of performance.

3.11.6 Under LTMS equipment downtime is specified in the contract with penalties for not maintaining the desired performance level. This ensures guaranteed operational availability of equipment.

The LTMS or MRO can be implemented for all major indigenous equipment/system inducted in the Navy. However, to implement such a system / concept effectively, there is a requirement to build in reliable and advanced equipment health monitoring systems for remote diagnosis by the vendor. The monitoring system introduced at the customer end should be able to transfer data to the contractor's office/site on real time basis. While the OEM/PV will be required to create dedicated process for data collection, predictions, data management and analysis for carrying out diagnostics and implement solutions well before occurrence of actual breakdowns. However, in the event of unavoidable breakdowns at sea, exploitation and diagnostic data available with the vendor will help in fast track defect identification and provide requisite expertise and spares at next/nearest port of call by the ship thereby reduce down time of the equipment and ensure higher operational availability.

The LTMS/MRO is not only support but integration of planning, implementation and support process from design to disposal of equipment/systems. In such a scenario, the industry is deeply integrated into the life cycle process and involved with development, engineering, production, delivery, training, sustainment, disposal and support functions. Thus a total system support helps in inventory management, obsolescence management, product improvement, long term contracting and single focus accountability.

The international trend today is to move towards Life Cycle Support philosophy and MRO contracts. According to a Pentagon announcement available on (<https://www.janes.com/>), the US Air Force awarded Boeing a 3.5 BUSD performance-based logistics (PBL) contract for the C-17A Globemaster III transport aircraft sustainment programme on 27 September 21. The contract has a total potential value of 24 BUSD over a nine-year, eight-month performance term. Boeing, which designed the C-17A, will continue to maintain the global fleet of 275 aircraft, including engineering, field support and material management. Since 1998, Boeing has been contracted to provide PBL support for the C-17A fleet. The deal includes the United Kingdom, Australia, Canada, the NATO Airlift Management Program Office, India, Kuwait, the United Arab Emirates (UAE) and Qatar as worldwide C-17A operators.

3.12 Comprehensive Annual Maintenance Contracts

An alternate means to outsource equipment/machinery repairs is through Comprehensive Annual Maintenance Contracts (CAMC). This concept has been introduced to limited extent in the Navy in last decade. IT assets, photocopiers, portable welding machines,

GPS, hydrographic survey equipments etc are few examples of equipment presently being covered under CAMC. The objectives of this strategy are as follows:-

3.12.1 Exploiting OEM support infrastructure to conserve own repair infrastructure.

3.12.2 Reduce inventory carrying cost as the spares management is carried out by the firm.

3.12.3 High operational availability of equipment which is specified with equipment downtime and penalties for not maintaining desired performance level.

CAMC can be concluded for all COTS equipment. Under this concept, the contractor would be required to depute suitable expertise for routine repairs and breakdown maintenance on call from the customer. CAMC should also include planned preventive maintenance at periodic intervals. Therefore, for effective operation of such contracts, the contract document must cater for and dovetail following:-

3.12.4 **Routine Maintenance Visits.** The CAMC should include certain mandatory routine maintenance visits. The actual number of visits and detailed scope of work contracted would be based upon maintenance schedules promulgated by OEM and/or exploitation experience of customer.

3.12.5 **Breakdown Maintenance Visits.** The CAMC should include a requirement of fixed number of breakdown maintenance visits by the contractor, any additional visits above contracted number should be paid at actual. The number of breakdown maintenance visits to be contracted would be based upon

exploitation history of the equipment and its criticality, measured in acceptable down time of equipment.

3.12.6 On Call Visits. While the routine maintenance support should be contracted for home port, the breakdown maintenance support should necessarily be provided by contractor at the next/nearest port of call of the customer. Any expense by the contractor (transportation, freight etc) for providing such support at other than home port should be factored in the AMC charges by the contractor.

3.12.7 Maintenance Spares. The AMC can be contracted as comprehensive (with spares) or non-comprehensive. In all cases the consumable spares should be provided by the contractor. However, in case on non-comprehensive AMC , the customer should hold a minimum predetermined stock of critical spares on site.

3.12.8 Replacement Equipment. In case of delay in repairs beyond mutually acceptable periods, the contract should have a provision of temporary/permanent replacement to be provided by the contractor.

3.13 Contracting for Availability

Contracting for Availability (CfA) is a commercial method that aims to keep a system or capability at a certain level of readiness for a prolonged length of time by forming a partnership between the United Kingdom Ministry of Defense and industry. An Availability Contract will emerge as a result of this approach, which should include incentives for both sides to increase efficiency and effectiveness over the course of the

agreement. A comprehensive Contractor Logistics Support (CLS) structure, which employs availability as its primary metric, is similar to this. CfA can be deployed at multiple levels to new capabilities and old systems in any setting. It must fundamentally address what is available, when it is available and where it is available.

Given the complexities and uncertainties that surround Service settings, CfA is a deceptively simple concept that can be tremendously challenging to implement. The effectiveness of the resulting contract, as well as the degree of cooperation between the MoD and the Prime Contractor, will determine the success of individual arrangements. CfA should be considered as a chance to increase assistance for the User community rather than a convenient flag for budget savings, manpower cutbacks, or responsibility abrogation. Finally, the successful implementation of CfA necessitates a complete shift in mindset among all stakeholders, as it necessitates the replacement of traditional support operations with creative processes based on need.

Over the course of several years, several Project Teams have been involved in the CfA process, and each has taken a different approach. Uncertainty about the User's needs, limited knowledge of the system under consideration, complex contractual limits, personnel and time, affordability, and risk division are among the key challenges faced by projects. CfA's main goal is to provide equipment that stays working in the hands of the user. This could be entirely or partially Industry's obligation, depending on the circumstances and the type of the agreement. Although Contractors may be rewarded for meeting commercial obligations, penalties for systems that fail at key moments provide little compensation for missions that are cancelled or lives are lost. As a result, rather than punishing inconsistencies, CfA should concentrate on generating consistent results.

Details of CfA can be found in Applied Reliability & Maintainability Manual for Defence Systems available at (<https://sars.org.uk/>).

3.14 Inventory Models Practiced In Industry

3.14.1 Vendor Managed Inventory. VMI is a business model in which the buyer of the product provides certain information to a supplier of that product and the supplier takes full responsibility for maintaining an agreed inventory of the material, usually at the buyer's consumption location. A third party logistics provider is involved who makes sure that the buyer has the required level of inventory by adjusting the demand and supply gaps. One of the keys to making VMI work is shared risk also called "risk pooling". VMI helps foster a closer understanding between the supplier and manufacturer by using electronic data interchange formats, EDI software and statistical methodologies to forecast and maintain optimum inventory in the supply chain. VMI model has been discussed in detail at the website of North Carolina State University (<https://scm.ncsu.edu/>).

3.14.2 Strategic Partnership. A strategic partnership is a formal alliance between two commercial enterprises, usually formalized by one or more business contracts but falls short of forming a legal partnership or agency or corporate affiliate relation. Typically two companies form a strategic partnership when each possesses one or more business assets that will help the other but that it does not wish to develop internally. A common strategic partnership involves a supplier/manufacturer partnering with a distributor or wholesale consumer. Rather than approach the transactions between the companies as a simple link in the

product or service supply chain, the two companies form a closer relationship where they mutually participate in advertising, marketing, branding, product development and other business functions. The relationships are often complex as a result and can be subject to extensive negotiations. Strategic partnership exists in the Navy in limited form with companies like Indian Oil Corporation where they maintain Continued Guarantee Reserve (CGR) of petroleum products. A limited form of strategic partnership also exists in the form of award of Proprietary Article Certificate (PAC) to reputed manufacturers. Strategic Partnership has been discussed in detail at the website of International Institute of Management Development, Switzerland (<https://www.imd.org/>).

3.14.3 Just in Time Inventory Management. JIT inventory system is designed to ensure that materials or supplies arrive at a manufacturing facility just when they are needed so that shortage and holding costs are minimized. JIT requires considerable co-operation between the supplier and customer. The customer must specify what will be needed, when and in what amounts. The supplier must be sure that the right supplies arrive at the agreed on time and location. However, JIT inventory management model is not considered suitable for implementation in the present context as it is predominantly a manufacturing based model. For implementation of a JIT model the list of spares has to be small and standardized. In a typical car manufacturing assembly line approximately 2500 parts go into a finished product and parts are often interchangeable between models. JIT has been explained in detail on the website of Oracle (<https://www.netsuite.com/>).

To illustrate this point, there are around 2,700 pumps in the IN inventory, with 210 different models manufactured by various vendors. This is in stark contrast to the Russian Navy's strategy, which uses only the most basic types of pumps across all ship classes. According to research into the design of Russian pumps, only a few different types can replace the complete spectrum of water pumps in IN's inventory. According to an analysis of the current IN inventory, previous induction techniques resulted in a vast inventory of pumps on IN platforms with several duty points sourced from diverse sources. There have been numerous instances where pumps of various designs from various manufacturers have been accepted for the same duty point applications. There have also been instances where different types of pumps have been fitted for ostensibly slight duty point differences. Some design aspects of these pumps have exacerbated their maintenance issues in some circumstances. The demand variation is also very high and unpredictable making JIT impractical to implement.

3.15 Conclusion

To offset the effects of some of the problems plaguing the Naval logistics chain we can adopt some of the best industry practices embraced by Navies worldwide. Globally, the Armed Forces have imbibed the outsourcing initiatives in their support systems, mainly in the area of military logistics. The US and Royal Navy have outsourced significant proportion of their logistics requirements through Maintenance, Repair and Overhaul (MRO) contracts, Performance Based Logistics (PBL) and Total Life Cycle Support System initiatives.

CHAPTER – IV
REVIEW OF PROCUREMENT SYSTEM

4.0 Introduction

A sizeable chunk of the Equipment and Spare parts inventory fitted onboard our ships are sourced from foreign OEMs, as the indigenous sources are not well developed. As per the Indian Naval Indigenisation Plan (2015-30) 70% of equipment/systems in the fight category and 40% in the move category are imported. An overview of our procurement system would reveal that it is not technologically advanced in scope and function. It is not keeping pace with the rapid advancement in the use of technology for procurement methodology being followed worldwide and is causing avoidable delays at each stage. Although, it has been modified from time to time, it is compartmentalized and disjointed growth has been able to meet, at best, the short time requirements. This chapter will aim at studying the deficiencies in the existing procurement system in the Navy and recommend remedial measures. The chapter will cover the following aspects:-

4.0.1 Drawbacks in the existing procurement system in the Indian Navy.

4.0.2 Scope for incorporation of e-procurement system for procurement from foreign sources.

4.0.3 Proposed model for e-procurement for procurement from foreign sources.

Procurement forms an integral part of the chain of inventory management in the logistics field. Sourcing of inventories for creating and sustaining the organizational operations, whether civil or military, is the nodal point for all activities. The procurement part of

logistical performance provides time and place utility. Such utility represents an important aspect of business and governmental operations. Value, in the form of timely availability, is added to either materials or products as a result of procurement process. It is a fact that no amount of change in strategy will help if the procurement process does not keep pace with the improvements in other fields of material management. Our existing procurement system suffers from a surfeit of rules, regulations and restrictive business practices. The reality, however, is that if orders are not placed the bins will be empty and there will be a shortage of spares to support the fleet.

Procurement management, in a nutshell, involves everything that moves to, from between the operating facilities of an organization to maintain an orderly flow of materials and resources to their final destination. The hallmark of defence procurement, therefore, is integration of varied dimensions and demands for strategic movement and storage. The study of procurement in integrated logistics received an impetus due to more dynamic tools of analysis like high speed computers, the need for cost reduction, the realization that procurement as an integrated part of logistical performance could, in fact stimulate revenue generation and finally awareness of the importance of timing, risk and commitment of logistical resources in overall distribution channel.

4.1 New Management Strategy

4.1.1 De-centralisation

With implementation of New Management Strategy (NMS) in the three services, the Government has de-centralised decision making process so as to enhance efficiency and expedite decision making. The procurement function has also been

de-centralised and most defence departments undertake bulk of the central procurement and local purchase themselves. With the establishment of Government e-Marketplace (GeM) most general purpose products can be sourced from there by the procurement agencies of the services concerned.

4.1.2 Delegation of Financial Powers

With the objective of de-centralising powers to enable effective use of resources by the actual operators, financial powers have been delegated to various authorities in the defence establishments. These powers are used within the framework of laid down procedures, financial canons and amplificatory instructions. The powers so delegated also imply accountability and the Competent Financial Authority (CFA) has to ensure that financial propriety and probity are observed in all cases.

4.2 Types of Procurement

4.2.1 Capital Procurement

As per rule 84 of General Financial Rules (GFR) 2017, significant expenditure incurred with the object of acquiring tangible assets of a permanent nature (for use in the organisation and not for sale in the ordinary course of business) or enhancing the utility of existing assets, shall broadly be defined as Capital expenditure.

4.2.2 Revenue Procurement

Subsequent charges on maintenance, repair, upkeep and working expenses, which are required to maintain the assets in a running order as also all other expenses incurred for the day to day running of the organisation, including establishment and administrative expenses shall be classified as Revenue expenditure. The revenue procurement, therefore, is for products and equipment including replacement equipment, assemblies/sub-assemblies and components to maintain and operate already established. For revenue procurement, Ministry of Defence has delegated financial powers to CFAs from Naval Headquarters down to the Ships and units. The latest Delegation of Financial Powers to Defence Services (DFPDS) issued in Sep 2021 has adequate delegation for cases to be culminated at Service Head Quarters level without any need for referring to MoD.

4.2.3 Central Procurement

It is undertaken against Indents resulting from the planned provisioning process like the annual review of demands, refit planning, obsolescence planning and planned repair routines. Central procurement indents are normally beyond local purchase powers of the provisioning authority and such procurement is undertaken by the designated central procurement agencies.

4.2.4 Local Procurement

Local purchase is undertaken within the LP powers of the provisioning authority to meet ad-hoc and urgent requirement of the department. Such procurement may

be done through the central procurement agency or other CFAs including units and formations.

4.2.5 Foreign Procurement

For such defence equipment and assets, which are of foreign origin, spares required to maintain and operate these equipment also need to be procured from suppliers abroad. In such procurement international trade practices are followed and our standard terms and conditions are not acceptable to certain Russian firms. Payment against foreign procurement is made in foreign currency through a Letter of Credit (LC) or Direct Bank Transfer (DBT). A number of restrictions are imposed by the foreign governments, in respect to supply of defence related products in general and military good in particular.

4.3 Purchase from CIS and EE Countries

The procurement environment in Commonwealth of Independent States (erstwhile Soviet Union) and Eastern European countries has substantially changed in the recent years and is still changing. In Russia, RosoboronExport (RoE) is the agency to deal with in case of products where military export controls are in force. But in case of other products, it is possible to buy from factories which manufacture the products or from other trading agencies. In case of other CIS and EE countries such as Ukraine and Poland, there are designated State Trading Agencies and certain private players. However, control over few factories is still exercised by various Ministries and Government agencies. The degree of such control varies considerable from country to country. In all these countries, there are

several trading agencies, both government and private, who are involved in international marketing of defence products.

4.4 Problems Faced in Russian Procurement

The specific problems faced in Russian procurement will be highlighted in the succeeding paragraphs. The peculiarity of procurement from Russia is that it is predominantly a seller's market. There is a standard list of 11 firms which are approached for spares support. Most of these firms are state enterprises and the Indian Navy as a buyer has no choice but to go to these firms for spares. Some of the issues which are glaringly evident are being highlighted:-

4.4.1 Erratic Pricing Policy. Post breakup of the erstwhile Soviet Union, the dependency for Equipment and Spare parts has increased manifold. In order to meet the perennial requirements of refits of ships and submarines and the constant demands of units, there is no choice but to procure these Equipment and Spare parts from Russia at the quoted price. Failure to do so would result only in rendering the ship/submarine non-operational. The main hurdle is the highly erratic pricing of the quoted rates. Escalation of prices is very high and sometimes the range is unjustifiable, making the procurement decision difficult.

4.4.2 Non- Participation of OEMs. View excessive control by the Federal Service for Military Technical Co-operation (FSMTC) of Russia, no OEM is permitted to submit an offer for the Request for Quote (RFQ). Amongst the 20 firms cleared by FSMTC, only two firms namely Rosobornexport and Admiralty Shipyard are authorized for exporting these Russian spares. Other

firms such as Sudoexport and Promeselectronica are exporting items under commercial purpose.

4.4.3 Standard of Quotes. Firms are not quoting for all the spares included in an indent leading to problems in procurement of Russian equipment and spares. Rates in many cases are exorbitant compared to Last Purchase Price available. In a competitive tender some firms submit their offer late leading to rejection. The response to tender enquiries by Russian firms has been poor and this results in gross delays in procurement. As a standard practice firms are given four months to respond to a tender enquiry, however, in spite of the adequate notice their response is not up to the mark.

4.4.4 Withdrawal of Offer Post-Order Placement. Russian firms withdraw their offers post-order placement citing low order values. This leads to re-tendering which causes undue delays in the procurement process and further lack of response due to the un-attractive volume of spares.

4.4.5 Non-submission of Shipping Documents. Original shipping documents are not being received in time resulting in problems during clearance of consignment by the consignee. Not supplying the shipping documents in original in time results in demurrage/warehousing charges being levied.

4.4.6 Variation in Part Numbers. Part numbers of items being supplied are in variation to the part number being sought. There is very poor response to forwarding interchangeability certificate, when demanded, for such varied part number.

4.4.7 Delays in Dispatch and Discrepancies. After conclusion of contracts/ establishment of Letter of Credit, inordinate delays in the dispatch of spares results in inability to meet operational/refit requirement of the ships/submarines. In certain cases, items being delivered are found discrepant in nature which leads to delays in accounting of spares.

4.4.8 Extension of Tender Opening Dates. The Russian firms repeatedly request for extension of Tender Opening Dates (TOD). Extension of TOD leads to undue delay in the procurement process. Despite the four months given for submission of offer, request for extension of TOD at the fag end is common.

4.5 Purchase from Other Countries

The major non CIS/EE western countries from which Navy makes purchases are UK, Germany, France, Italy and Sweden. However, purchases are also made from several other countries such as United States, Canada, Netherlands, Spain, Switzerland, Israel, Japan, Republic of Korea and Singapore. The export control rule in each country are different.

4.6 Sequence of Activities for Purchase from Abroad

The normal sequence of action in the case of purchase from abroad is as follows:-

4.6.1 Directorate of Indigenisation (DoI) import clearance.

4.6.2 Obtaining budgetary quote.

4.6.3 Expenditure clearance for import.

- 4.6.4 Raising of Indent.
- 4.6.5 Forwarding of tender enquiry.
- 4.6.6 Receipt of quote.
- 4.6.7 Purchase decision.
- 4.6.8 Foreign Exchange release and noting.
- 4.6.9 Placement of purchase order.
- 4.6.10 Opening of Letter of Credit/Bank Transfer.
- 4.6.11 Receipt of spares.
- 4.6.12 Settlement of bills.

4.7 DOI Import Clearance

The objective of DoI import clearance is to ensure that the spare being indented is not available within the country. In some cases DoI may feel that, while the spare is not immediately available within the country, it cost effectively indegenised over a period of time. A decision of this nature would depend upon following:-

- 4.7.1 The period for which the main equipment is likely to be in service.
- 4.7.2 The annual requirement of the product and its value.
- 4.7.3 Technologies involved.

4.8 Expenditure Clearance for Import

After getting import clearance for DoI, it is necessary to get the approval of Competent Financial Authority with concurrence of Financial Advisor from the expenditure angle before an Indent can be raised. For this, the indenter should get a budgetary quote, through the procurement agency, from atleast one supplier.

4.9 Purchase Decision

Quotes are examined to determine the fairness of price. If the price is considered high, negotiations are conducted either in person or virtual mode. Bundling of tender enquiries is carried out to make order quantities attractive in order to obtain high volume of discount.

4.10 Export Control

Firms abroad have to obtain export license especially for military grade equipment and spares. For this they have to be issued with a end user certificate by the purchasing agency.

4.11 INCOTERMS 2000

Standard terms of delivery defining the obligations of the purchaser and supplier have been promulgated by the International Chamber of Commerce, Paris and are known as INCOTERMS 2000. This convention is invariably insisted on by all foreign suppliers.

4.12 Letter of Credit

The sequence of actions for operating a letter of credit are as follows:-

4.12.1 Requisition to Controller of Defence Accounts (CDA) to open LC, specifying period, accompanied by a copy of contract and FE noting.

4.12.2 Application from CDA to bank, to open LC.

4.12.3 The purchaser's bank notifies the firm's bank of opening LC.

4.12.4 Firm hands over the consignment to forwarding agent.

4.12.5 Firm delivers Bill of Lading (BOL)/ Air Way Bill (AWB), certificate of quality, certificate of country of origin and invoice to the firm's bank.

4.12.6 Firms bank forwards documents to purchaser's bank.

4.12.7 After checking the documents, the purchasers bank makes the payment to firms bank.

4.12.8 The purchasers bank forwards the documents to purchaser.

4.12.9 The purchaser uses shipping documents to collect the consignment.

4.13 Direct Bank Transfer

The sequence of actions for making payment by bank transfer is as follows:-

4.13.1 Firm delivers consignment to the forwarding agent and obtains AWB/BOL.

4.13.2 Firm forwards AWB/BOL, with certificate of quality and ink signed invoice, to the procurement agency.

4.13.3 After checking the documents, the procurement agency forwards to CDA, AWB/BOL and invoice along with purchase order, indent and FE release noting.

4.13.4 CDA authorizes the bank to make remittance to the firm's bank account abroad.

4.14 Use of ILMS in Procurement

The procurement module of ILMS facilitates generation of Tender Enquiry, receipt of quotes, preparation of Comparative Statement of Tenders (CST) for deciding L1, purchase order generation and payment clearance. However, the module is passive in the sense that it does not auto generate the list of steps and alternative options that a procurement officer would like to have at their disposal and thereby, it leads to delays at every step. Some of the drawbacks are explained in following paragraphs:-

4.14.1 Tender Enquiry. The item-vendor link is not auto linked. Hence, finding which vendor supplied what in the past is a tedious task. Tender enquiries are generated on a hard copy and a print is forwarded to the suppliers. Option also exists to retrieve the data in relevant table from back end and attach the list to e-mail. With e-procure and now GeM the process has been automated to certain extent, however, the process has to be replicated on ILMS.

4.14.2 Quotation. On the similar pattern of tender enquiries, quotations are received from the suppliers, in hard copy and manually fed in for each supplier. In

the case of big tender enquiries, which invariably is the case in Equipment & Spare parts purchases, the list runs into hundreds of line item, manual feeding of quotes is a tedious process.

4.14.3 Purchase Order Generation. Purchase decisions are made online, but purchase orders, in print copy are dispatched by post. In case of Russian procurement the orders are sent as an e-mail attachment as the order is just an intimation and actual shipment is against the contract signed by the State Foreign Trade Enterprise of Russia and Naval Attaché.

4.15 Scope for E-procurement

The present system of procurement through ILMS is limited in its functionality in that it is primarily designed to perform in-house function of the procurement organization. The application does not cater for interaction with external environment. The information obtained from external sources is fed manually to complete the sequence of activities in procurement setup and is thereafter disseminated manually to the external sources for information and action. This limitation becomes a handicap in more ways than one. An analysis of the system reveals severe drawbacks of this system, which limits its scope and range of services expected and therefore, needs complete revamp to expedite the procurement process. An analysis of the existing system, lacking information required for the purchaser, is highlighted below.

4.16 Procurement Lead Time Analysis

In Para 2.4.2.2 of CAG report 20 of 2017 it is mentioned that 60.03 per cent of the indents were converted into purchase orders after the prescribed time limit of 23 weeks,

which indicates that indents raised with definite purposes were unable to meet the indented objective due to weakness in procurement system. Lead time analysis of the time taken between indent approval and tender enquiry and between tender enquiry and order placement must be carried out regularly. This is a tedious process at present which requires information to be extracted from the database using Structured Query Language (SQL) queries. The time taken between the receipt of an indent and the placement of purchase order is very high and ranges from a few months to occasionally upto three years as brought out in the report. The delays are caused by dysfunctional procedures, non-availability of specifications and difficulty in identifying suitable suppliers.

4.17 Supply Lead Time Analysis

Lead time analysis of the actual time taken between order placement and delivery should be undertaken in respect of each section. This is essential for monitoring the performance of vendors for the purpose of vendor rating. This is a neglected field due to the complexities involved in carrying out the task manually. A similar analysis should be undertaken with regards to extension of Delivery Period (DP) of each section. Due to the prevalence of manual DP extensions this information is not available on system for analysis. In case of DP expiry the manual file has to be invariably opened to determine the cause and extension granted.

4.18 Delivery Acceptance Analysis

Lead time analysis should be carried out in respect of the time taken between physical delivery from the manufacturer's premises and receipt of stores. This information is available in incomplete detail on system. A manual report is often used to track the

packages received in Depot and pending for accounting on system. Items remain pending for accounting due to various discrepancies like, lack of documents, consignee's right of rejection, not meeting stock sample, supplier not deputing rep for Joint Receipt Inspection (JRI) and non-availability of inspection notes. This leads to various issues like delay in payment, which erodes the confidence of vendors on the Naval logistics chain.

4.19 Multitude of Sources

The Navy's requirement of materials are extremely diverse as we have equipment manufactured by a large cross section of foreign manufacturers. Because of inadequate standardization, both at the time of construction and during equipment replacement, there are variations in equipment fit even within the same class of ships. Many of the equipment required have become obsolete abroad and many production lines have closed down for equipment still in use in Indian Navy.

4.20 Long Procurement Lead Time. The lead time from the placement of purchase order to delivery is much longer than it need to be. This is largely because of our tendency to treat each procurement decision as a "one-off" case and the consequent failure to develop advantageous long term relationships with good suppliers.

Many of the products supplied to Navy are not part of the regular production run of a supplier and therefore they need time for preparatory work such as buying raw materials, sub-contracting to parts suppliers, design work, scheduling and tooling. Dovetailing our procurement in to the production schedules of suppliers through prior discussion and buying in larger quantities would, besides saving costs, help to reduce lead time significantly.

Proprietary Article Certificate (PAC) sourcing is generally not difficult provided the product is in regular production by the manufacturer. However, regular production lines are often terminated much before the equipment goes out of use in the Navy. Often production has to be re-started each time the Navy places an order, leading to high start-up costs and delays. Sometimes, firms are unable or unwilling to re-start production and Life Time Buy (LTB) of spares becomes necessary in such cases. This problem can be easily remedied using the concept of LCL and TLCSM covered under chapter on Global Best Practices.

4.21 Features of Foreign Procurement

In a technology intensive service like the Navy, the quality of material is a factor of great importance. All products needed by the Navy have to meet stringent standards of quality. Ensuring high quality of products brought by the Navy is a complex process where the purchase officer has a critical role to play. Quality does not come free and has to be paid for. The higher price paid for quality is related to the concept of value of money. A higher priced product must obviously give superior performance or reliability that makes up for the higher cost. Purchases from abroad have certain features which distinguish them from buying within India. They include:-

4.21.1 Finding the right source abroad is generally more difficult than finding it in India. This is largely because of communication difficulties including language barriers.

4.21.2 Foreign exchange availability, though not as serious problem as in the past, is still a major limiting factor. Therefore, each indent needs to be accorded expenditure clearance for import by CFA with concurrence of FA.

4.21.3 It is not feasible to carry out pre-dispatch inspection of imported products in most cases.

4.21.4 Payment is based on LC or DBT before the receipt of spares. In case of Indian firms the bulk of payment is made after receipt and accounting of spares.

4.21.5 Transportation is a major aspect to be considered, as it can add substantially to time or cost.

4.21.6 In some cases, export clearance from sellers government is essential.

4.21.7 Face to face negotiations can add considerably to cost.

4.21.8 Lack of Standardisation and Codification. A vast range of assorted equipment, both imported and indigenous, has complicated the problem of providing effective logistics support.

4.22 Proposed Model For E-Procurement

In order to bring in an efficient procurement system in place, there is an inescapable need to introduce the systems approach to all our procurement activities towards the overall fulfillment of integrated approach to the logistics management in the navy. The convergence of money, market, computing and networks has laid the foundation of a global market place. The open marketplace offers a wide variety of shopping platforms to the consumers, but defence related equipment are subject to respective governmental

regulations. However, common nature equipment, used by our Navy is available in plenty from the world market and we as consumers have the option to choose over the internet and place order on it after scrutiny and subject to governmental regulations.

In this world of electronic age, where the global market is shrunk to our desktop through World Wide Web, it is difficult for almost every major manufacturer/supplier of defence equipment not to have their own website offering multitude of marine equipment to the ever growing list of buyers. Using a computer connected to the internet, one can virtually go through unending list of catalogues offered by the vendors on internet. Some of the necessary information needed for decision making, such as third party ratings, can be located on commercial archive services. The on-line shopping system is a virtual shopping mall in which one can browse through unlimited list of shopping options.

In the electronic market, not only can we buy products or services, but also compare notes on who has the best products and prices. There are always shrewd impartial sources whose opinions and endorsements are sought by many. The ability to openly evaluate the wares offered is a fundamental principle of a viable marketplace. No marketplace is complete if it does not support negotiations. The electronic marketplace allows us to negotiate over conditions of mutual satisfaction including price, terms and conditions, delivery dates and evaluation criteria.

Merchandising or trading on the internet is through electronic means and is termed as electronic procurement or e-procurement. This process defines interaction models between customer and supplier for on-line procurement. This model is necessary because to buy and sell goods, a buyer, seller and other parties must interact in ways that represent

some standard business processes. The establishment of a common business transaction process has increased convenience for customers who do not have to figure out a new business process for every single vendor. The absence of a common process for managing and completing transactions will result in e-procurement being entangled in a mesh of bilateral ad-hoc mechanism that are specific to every company doing business online.

4.23 Procurement Model from Customers Perspective

The on-line consumer expects quality, convenience, value, low price and control. To meet these expectations and understand the behavior of the on-line purchaser, there is a need for a business process model that provides a standard product/services purchasing process from an interactive services and merchandising point of view. The business process model from a consumers perspective can be grouped into three phases:-

4.23.1 Pre-purchase Preparation Phase. This phase includes search and discovery for a set of products in the larger information phase capable of meeting customer requirements and product selection from the smaller set of products based on attribute comparison. From the purchasers perspective, any major purchase can be assumed to involve some amount of pre-purchase deliberations, the extent of which is likely to vary across individuals, products and purchase situations. Purchase deliberation is the elapsed time between a purchaser's first thinking about buying and the actual purchase itself. Information search constitutes the major part of the duration, but comparison of alternatives and price negotiation is included in the information search and deliberation process.

4.23.2 Purchase Consummation Phase. This phase includes procurement protocols that specify the flow of information and documents associated with purchasing and negotiations with suppliers for suitable terms, such as price, availability, delivery dates and electronic payment mechanisms that integrate payment into the purchasing process. After identifying the products to be purchased, the purchaser and supplier interact in some way to actually carry out the transaction. A transaction is defined as the exchange of information between the purchaser and the followed by the necessary payment. Depending upon the payment model mutually agreed upon, they may interact by exchanging currency that is backed by transferring authorization for billing.

4.23.3 Post Purchase Interaction Phase. This phase includes customer service and support to address customer complaints, product returns and defects.

The e-procurement has the following characteristics in the overall supply chain management:-

4.23.4 An ability to source raw material and finished goods from anywhere in the world.

4.23.5 A centralized, global business and management strategy with flawless local execution.

4.23.6 On-line, realtime distributed information processing providing total in-transit visibility.

4.23.7 The seamless integration of all supply chain processes and metrics, including of third party suppliers, information systems and cost accounting standards.

4.23.8 The development and implementation of accounting models such as activity based costing that link cost to performance are used as tools for cost reduction.

4.24 Conclusion

A sizeable chunk of the Equipment and Spare parts inventory fitted onboard our ships are sourced from foreign OEMs, as the indigenous sources are not well developed. Procurement forms an integral part of the chain of inventory management in the logistics field. The procurement part of logistical performance provides time and place utility. Value, in the form of timely availability, is added to either materials or products as a result of procurement process. Our existing procurement system suffers from a surfeit of rules, regulations and restrictive business practices. The hallmark of defence procurement, therefore, is integration of varied dimensions and demands for strategic movement and storage. The study of procurement in integrated logistics received an impetus due to more dynamic tools of analysis like high speed computers, the need for cost reduction, the realization that procurement as an integrated part of logistical performance could, in fact stimulate revenue generation and finally awareness of the importance of timing, risk and commitment of logistical resources in overall distribution channel.

CHAPTER – V

RESEARCH METHODOLOGY AND ANALYSIS

5.0 Introduction

In this chapter research methodology and analysis of primary data will be discussed in detail. Primary data was generated through a survey questionnaire administered to 100 officers working in the field of inventory management in the Indian Navy. The questionnaire was targeted at specific officers to obviate biased views. Responses were received from 53 officers and analysis of profile indicated that majority of responses were received from officers with adequate seniority and experience in the field of inventory management.

5.1 Research Objectives

The objectives of the paper are to study the existing naval logistics management system, evaluate the present issues and challenges in the system and to provide some suggestions to improve the responsiveness of the system. The objectives of the study are as follows:-

- 1.** To examine the challenges of existing inventory management system with special emphasis on refit logistics management.
- 2.** To analyze the problems of key processes in the fields of inventory management including initial induction, provisioning, procurement, IT interface available etc.
- 3.** To study best practices in inventory management prevalent in industry.

4. To suggest solutions for greater efficiency in inventory management, improve customer satisfaction and reduce inventory holdings.

Research question related to objectives mentioned at Sl. No. (a) and Sl. No. (b) are to be addressed on the basis of primary data generated through survey questionnaire. Whereas research questions that emanates from objective at Sl. No. (c) and (d) entailed to be addressed on secondary data.

5.2 Research Strategy and Research Design

The research strategy used will be quantitative with descriptive and exploratory design. Review of documents and case studies of best practices in the field of inventory management will also be used.

5.3 Research Questions

Following are the research questions for the dissertation:-

1. What are the challenges of existing inventory management system with special emphasis on refit logistics management?
2. What are the problems with key processes in the fields of inventory management including initial induction, provisioning, procurement, IT interface available etc.?
3. Which best practices prevalent in industry can be imbibed?
4. What changes can be suggested for greater efficiency in inventory management, improve customer satisfaction and reduce inventory holdings?

5.4 Methods to be Applied and Data Sources

The research method applied will be quantitative and primary data was generated through survey questionnaire issued to 100 personnel involved in inventory management. Appropriate statistical analysis was conducted on the primary data. Review of documents and case studies of best practices in the field of inventory management prevalent in industry was also undertaken.

5.5 Research Gaps

Existing literature shows lack of studies on the theme of Inventory Management in the Indian Navy. The existing literature shows studies on the subject of Logistics in defence forces, however, they deal with outsourcing of logistics, joint logistics and performance based logistics. Inadequate availability of research material is a research gap.

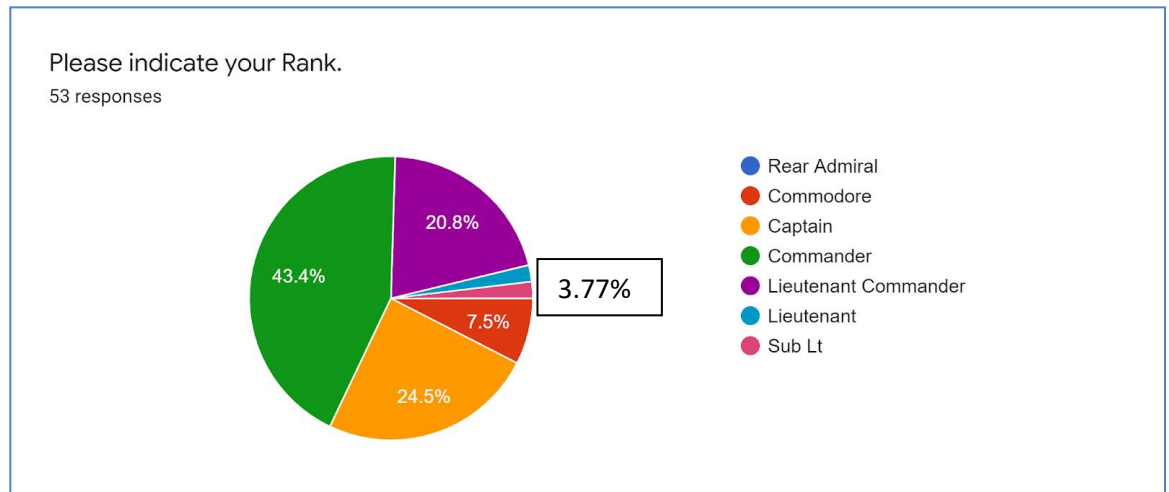
5.6 Analysis and Discussions

A survey questionnaire placed at **Appendix “A”** was administered to a population of 100 officers working in the field of logistics. The questionnaire was targeted at specific audience as the subject was service specific and inputs were sought from officers actually working on inventory management in the Navy. The questionnaire included both structured and unstructured questions. Responses were received from 53 participants and analysis of the response is as follows:-

Profile Analysis

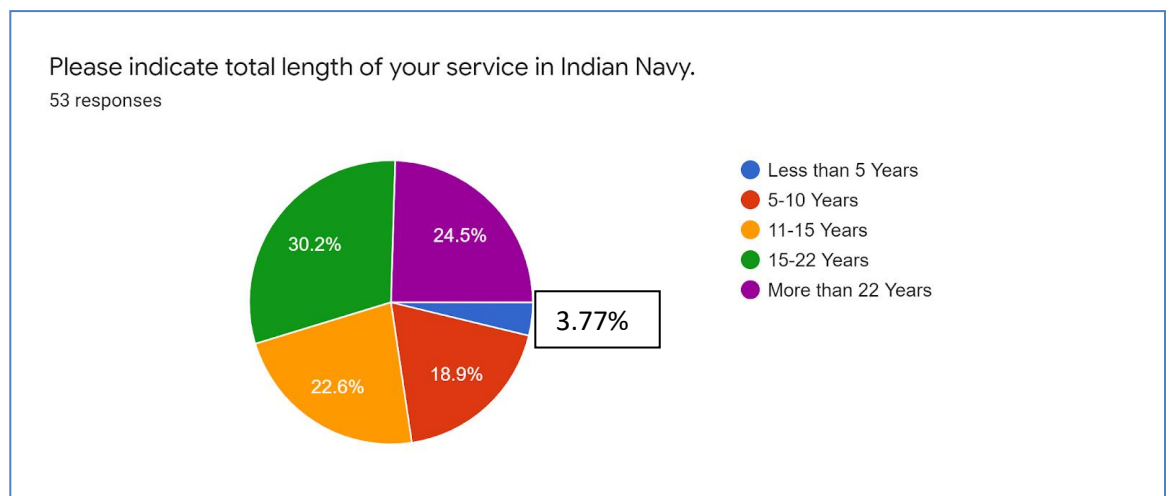
5.6.1 75% of respondents are in the rank of Commander to Commodore who will have good experience in the field of inventory management. 77% of the

respondents have length of service above 11 years during which they would have done atleast one tenure in Material Organisations during which they are exposed to the various facets of inventory management. This is indicative of lack of bias in their responses and correct inputs to the survey questionnaire.



Note : One each response was received from Sub Lieutenant and Lieutenant which is an insignificant 3.77 % percentage of population

Figure 1 : Profile analysis of Rank



Note : Two response was received from officers with less than five year service which is an insignificant 3.77 % percentage of population

Figure 2 : Profile analysis of length of service

5.6.2 Research Question 1-What are the challenges of existing inventory management system with special emphasis on refit logistics management?

5.6.2.1 66% of respondents **disagree** that Equipment & Spare Parts inventory management in Indian Navy fully meets its Operational & Equipment Maintenance requirements. 77% of respondents **disagree** that critical spares for Refits & Running Hour based routines are always available within required timelines. This clearly brings out that there are challenges in existing inventory management system which effects refit logistics management.

5.6.2.2 85% of respondents **disagree** that Spares forecast by stakeholders (Ship Staff & Repair Yards) are close to precise.

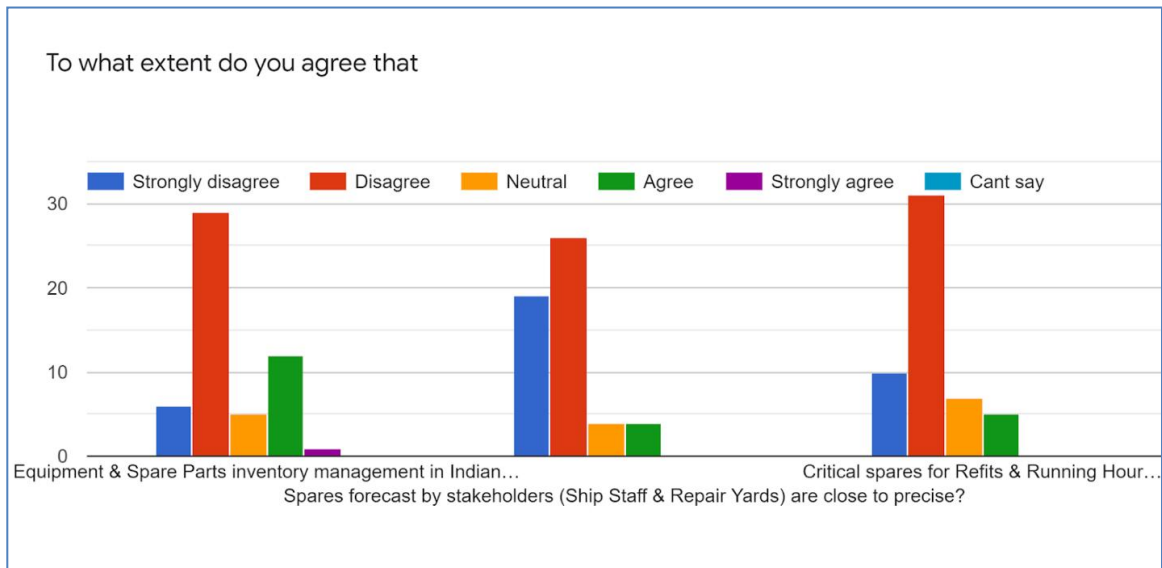


Figure 3 : Challenges of existing inventory management system

5.6.3 Research Question 2- What are the problems with key processes in the fields of inventory management including initial induction, provisioning, procurement, IT interface available etc.?

5.6.3.1 75% of respondents **agree** that the present Integrated Logistics Management System has outlived its utility and needs upgrade.

5.6.3.2 74% of respondents **disagree** that Logistics Management System of Indian Navy is integrated in the real sense.

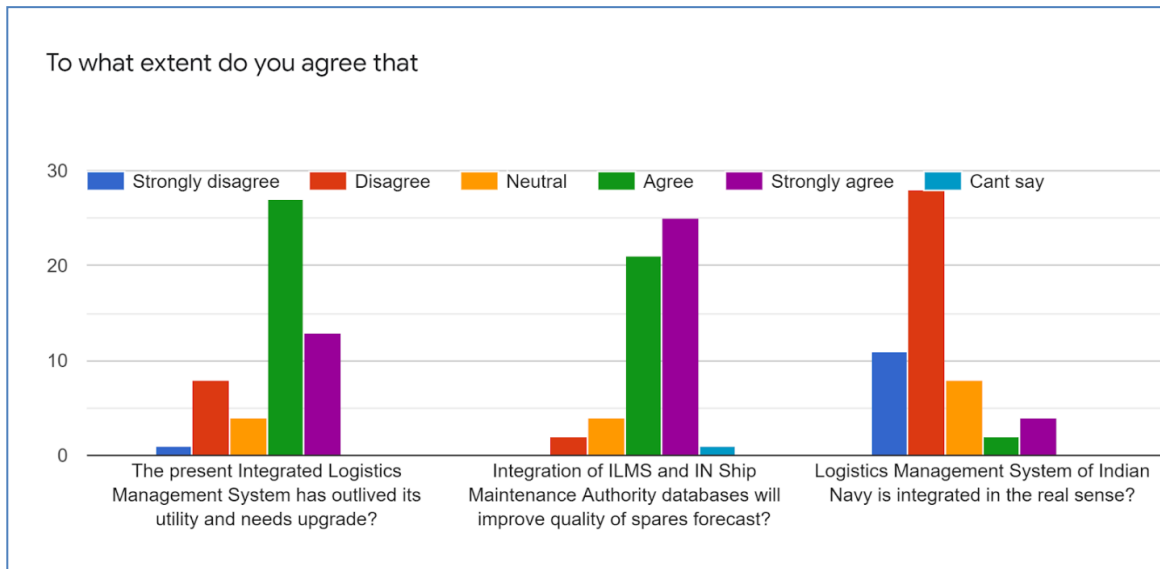


Figure 4 : Issues with key processes in the field of inventory management

5.6.3.3 77% of respondents **agree** that there is a requirement to make Stocktaking more 'Accurate' and 'Effective' to avoid embarrassment due to non-availability of spares in the Storehouse even though ILMS records indicate availability.

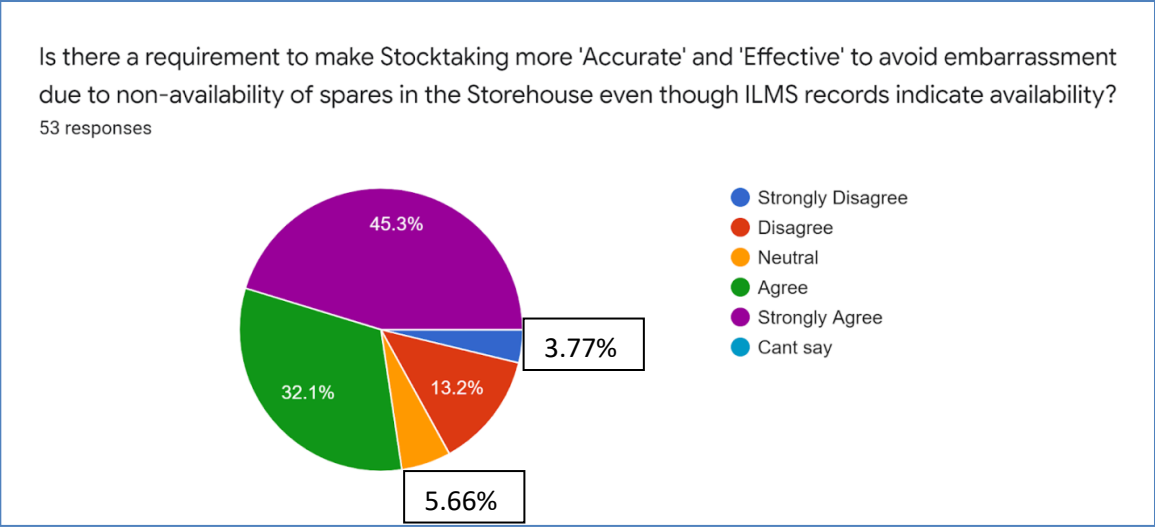


Figure 5 : Accuracy of Stocktaking

5.6.3.4 87% of respondents **disagree** that there is Total Asset Visibility in the present Equipment & Spare Parts inventory management methodology.

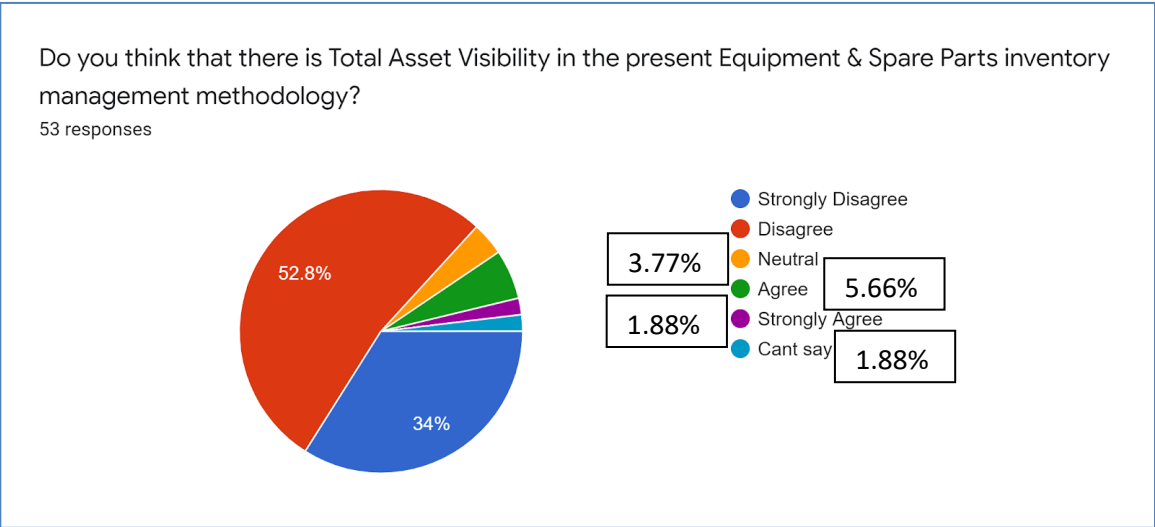


Figure 6 : Total Asset Visibility of Equipment and Spare Parts

5.6.3.5 77% of respondents **disagree** that the review formula used for forecasting inventory requirement fits all types of spares.

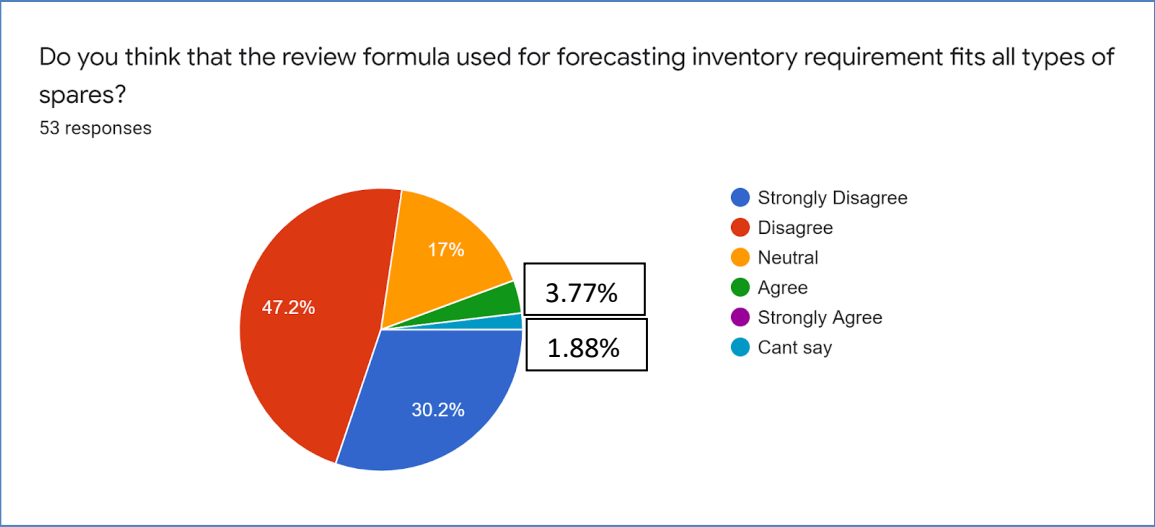


Figure 7 : Efficacy of Review Formula

5.6.3.6 An overwhelming 94% of respondents **disagree** that the initial Ranging and Scaling of equipment and spares adequately caters for lifecycle management.

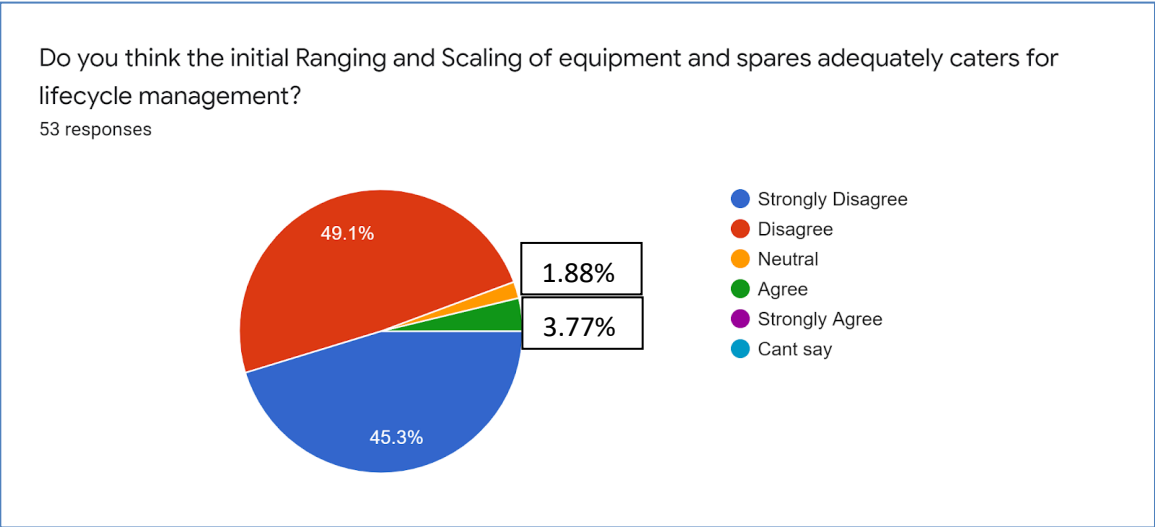


Figure 8 : Adequacy of Ranging and Scaling

5.6.3.7 85% of respondents **disagree** that if the provisioning of On Board Spares (OBS) and Base & Depot (B&D) spares should cater for one

and five years requirement respectively, do you think the OBS and B&D lists are being correctly formulated?

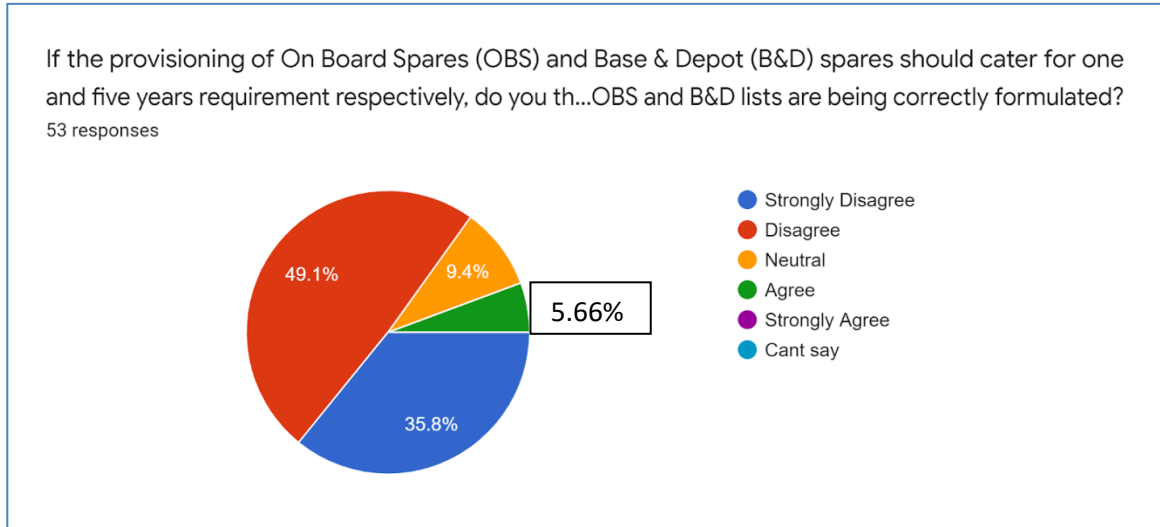


Figure 9 : Formulation of OBS and B&D Spare lists

5.6.3.8 The survey respondents were asked to rank the factors which lead to generation of Serviceable Surplus Inventory (1 being the least affecting and 5 being the most affecting).

5.6.3.8.1 36% respondents ranked Base & Depot spares provisioning as the leading cause for accumulation of Serviceable Surplus Inventory.

5.6.3.8.2 32% respondents ranked over projection by users as the second leading cause for accumulation of Serviceable Surplus Inventory.

5.6.3.8.3 On an average 11% respondents ranked the other factors like obsolete spares, serviceable spares from de-

commissioned ships and Provisioning Quantity formula leading to accumulation of Serviceable Surplus Inventory.

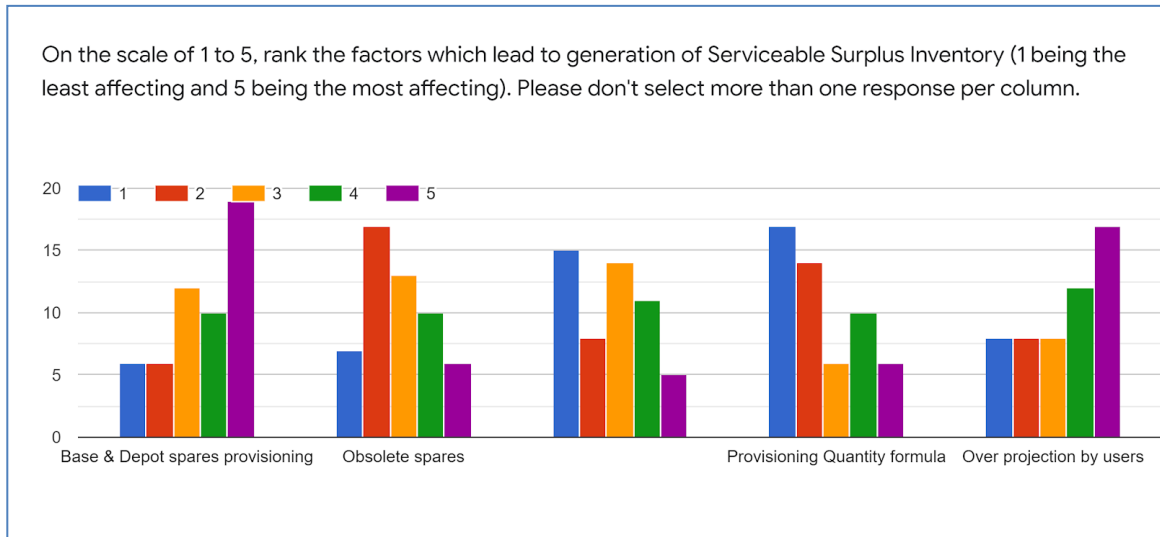


Figure 10 : Factors generating Serviceable Surplus Inventory

5.6.4 Research Question 3 - Which best practices prevalent in industry can be imbibed?

5.6.4.1 The survey respondents were asked to rank the best practices that can be imbibed to improve the responsiveness of Logistics Supply chain (1 being the least affecting and 5 being the most affecting).

The responses are as follows:-

5.6.4.1.1 42% of respondents ranked procurement procedures in vogue as the highest factor that effects the responsiveness of logistics supply chain.

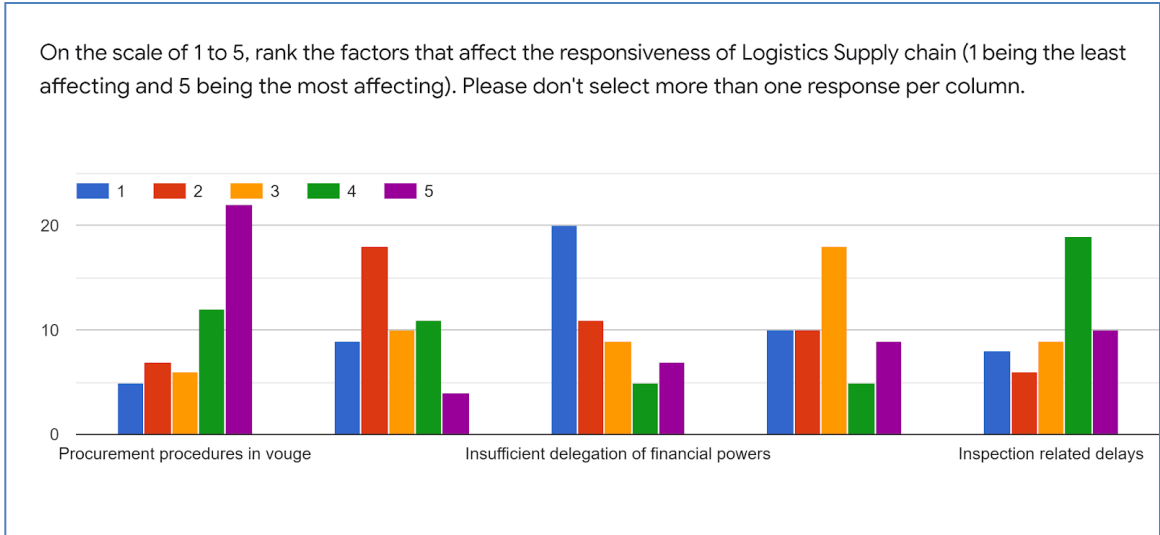


Figure 11 : Factors affecting responsiveness of logistics supply chain

5.6.4.1.2 32% of respondents ranked using a Commercial ERP with customization the second highest. This can be corroborated by the response to whether the present Integrated Logistics Management System has outlived its utility and needs upgrade.

5.6.4.1.3 30% of respondents ranked procurement of Running Hour based kits as the third highest factor that can improve responsiveness of logistics supply chain.

5.6.4.1.4 On an average only 13% of respondents feel that adopting technologies like BARCODING, RFID tagging and Store House Automation will improve the responsiveness of logistics supply chain.

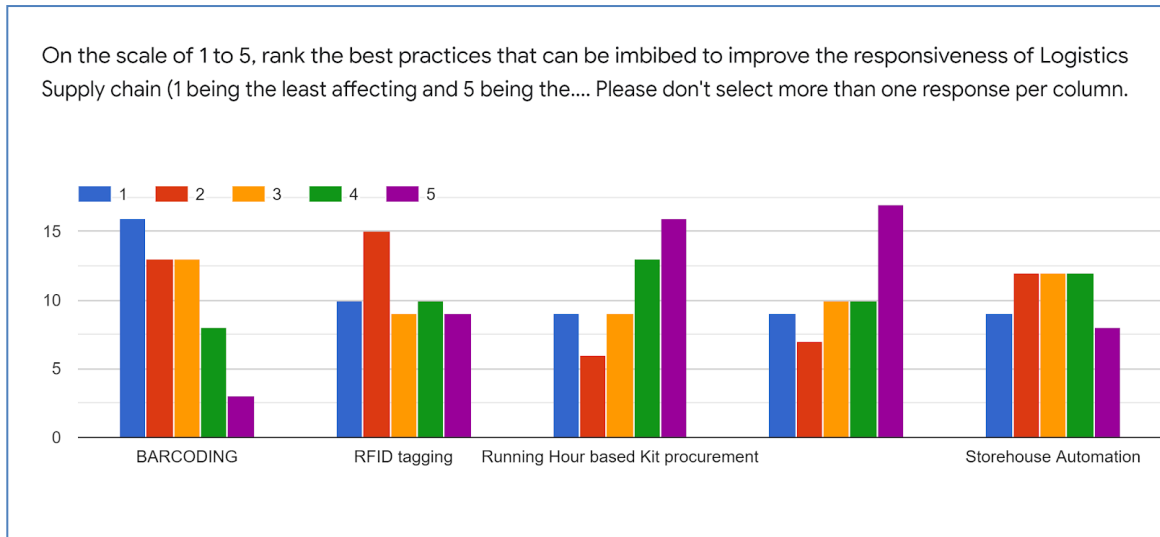


Figure 12 : Industry best practices

5.6.5 Research Question-4 What changes can be suggested for greater efficiency in inventory management, improve customer satisfaction and reduce inventory holdings?

5.6.5.1 87% of the respondents agree that integration of ILMS and IN Ship Maintenance Authority databases will improve quality of spares forecast.

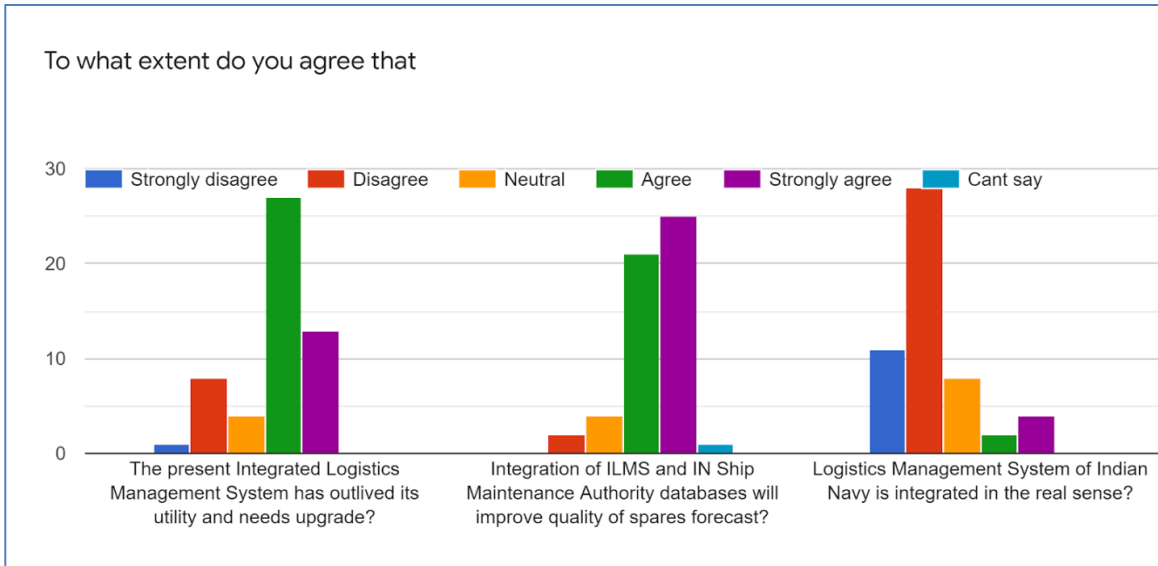


Figure 13 : Suggestions for improving efficiency

5.6.5.2 The other recommendations in response to the unstructured question in questionnaire have been covered in detail in Chapter VI.

5.7 Conclusion

Primary data and secondary data were used to answer research questions linked to the objectives. Analyses of responses to survey questionnaire are indicated in preceding paragraphs. The response to survey questionnaire clearly brings out that there are issues and challenges which affect the logistics supply chain. Majority of respondents agree that inventory management of Equipment and Spare Parts needs greater emphasis to meet the desired aim to providing spares in time for critical activities like refit. The logistics management system is not integrated in true sense and there is an urgent need to upgrade the Integrated Logistics Management System by using a customizable commercial ERP. The survey has brought out that provisioning of Base and Depot spares is the leading cause for generation of Serviceable Surplus Inventory. Provisioning of Running Hour

based kits has been recommended to ensure that spares required for periodic maintenance routines are available obviating the need of using refurbished spares. Procurement procedures in vogue which need complete revamp for making the logistics supply chain more responsive. Initial induction of equipment and ranging and scaling of spares needs more attention to ensure that spares last for the intended period and do not contribute to building up Serviceable Surplus inventory.

CHAPTER-VI

RECOMMENDATIONS FOR ENHANCING RESPONSIVENESS OF LOGISTICS CHAIN

6.0 Introduction

This chapter provides certain in-house recommendations that can be implemented for making the Naval Logistics system more responsive to customer needs. These recommendations will aim at opportunities to improve the existing management of equipment and spares parts with respect to rationalization, cost effectiveness and distribution system. The existing outdated and inefficient business practices that create unnecessary inventory levels, provide poor customer satisfaction, generate excess and obsolete inventory that requires huge costs to manage and distribute, can be fine tuned to yield better results in terms of demand to delivery lead times, which is a key result area for Material Organisations.

6.1 Material Provisioning Process

Current provisioning process is based on calendar year review instead of re-order point triggered provisioning. The existing provisioning formula in ILMS is only suitable for fast moving spares. Most of the fields are constant, due to lack of better data and MSL is system dependent and constant. Procurement lead times are not conducive to allow Material Organisations to provide spares in time base on FCL for most of the items.

6.1.1 Recommendation

MSL should be defined for all moving spares by Professional Directorates, as a onetime measure. MSL to take into account nearly one year of internal lead time,

plus the vendor lead time and should not be re-calculated by system based on fixed co-efficient. Material Organisation to add internal lead time computed by system as well as vendor lead time in the system. The system should automatically adjust MSL for above factors.

Current annual review process does not optimally leverage the time available to Planning officers. Annual review policy leads to few months of high number of Indents per officer, while a low level of activity for other months for same officer. The recommended changes in review policy should provide significant efficiency improvement. Each officer will be fully responsible for a set of items from planning to procurement cutting down on many levels of permission and approvals. Each officer will have his own review calendar so that he reviews nearly equal number of items each month and reviews each item at least four times a year. In addition, each officer will review items whose stocks fall below MSL every month.

6.2 Material Procurement Process

Procurement process for a large number of Commercially Off The Shelf (COTS) items needs to be simplified and should be different from the other items of inventory. It is also essential to enter into Annual Maintenance Contracts (AMC) with large OEMs during purchase of equipment for life cycle support.

At Material Organisations indenting and procurement process has very long lead times. Indenting and procurement process typically requires six to seven stages of concurrence by Integrated Financial Advisor (IFA). Significant delays in the process due to second

guessing by Controllerate of Material Planning on “necessity of demand” and evaluation by IFA of “acceptance of necessity” exists in the present system.

6.2.1 Recommendations

Integration of e-procurement into logistics system is an evolutionary process and cannot be implemented overnight. Implementation of Government e-Marketplace (GeM) is a welcome step in this direction. Presently waiver has been obtained from Standing Committee on GeM (SCOGeM) in MoD for procurement of Equipment and Spare Parts through GeM. This waiver is conditional to development of functionalities on GeM for procurement of Equipment and Spare Parts. Due to the inherent advantages of GeM, like fast track procurement and payments, procurement lead time can be considerably reduced, resulting in timely availability of critically required spares.

6.3 Quality Assurance Process

Significant delays are also encountered in the Quality Assurance Process which add to the procurement lead time. Self certification should be allowed and firms having ISO or other globally recognized quality certifications should not be subjected to full inspection. The firms should be willing to provide acceptable warranty and guarantee of equipment and spares, including full replacement and penalty cost in case of quality failures for the warranted life of spares.

6.3.1 Recommendations

Quality certified vendors should automatically be assumed to be self certified on providing quality certificate and then allowed to supply on bank guarantees and

user acceptance of quality. Vendors who can play the role of aggregators of a set of equipment or spares should be developed for a mutually beneficial, long term business relationships. Identification of acceptable suppliers capable of matching product specifications is critical to assuring quality products procurement.

The Government of India has decided to institute a mechanism for awarding green channel status to firms with pre-defined financial and quality credentials for broad categories of items with continuous requirement/mass consumption in the Defence Forces in order to promote ease of doing business and achieve the national vision of 'Make in India.' As a result, the Department of Defense has developed a Green Channel Policy with the assent of Honorable Raksha Mantri. All procurement agencies under the Ministry of Defense will honour a corporation awarded Green Channel status by any department of the Ministry of Defense. This is a progressive step which will significantly remove inspection related delays affecting procurement lead time. The present eligibility criteria is annual average turnover of Rs 1000 Crores (Rupees One Thousand Crores) during last three years. Till date five firms have been granted green channel certificate by Directorate of Quality Assurance (Naval). These include four business units of Bharat Electronics Limited (BEL) and M/s Larsen & Toubro Defence, Talegaon. Due to the high annual turnover criteria most MSMEs will not qualify for the green channel status.

6.4 Visibility of Repair Yard and On Board Spares

Repair yards stock large quantity of spares and critical material issued for refits and day to day running. The extent of such stocks is not known to Material Organisations as only

issue data gets captured on ILMS. Presently the consumption data is not recorded on ILMS at repair yards and ships.

6.4.1 Recommendation

ILMS needs to be extended to repair yards, where production centers should be marked as additional stocking locations. For certain items, repair yards may even specify MSL. Stock availability onboard ships should also be visible on system. This will aid in revising OBS regularly based on actual consumption. It will also ensure that where possible excess stocks will get used up to service other demands.

6.5 System Integration and Collaboration

There is no transparency regarding stock levels on ships and repair yards and no knowledge base on actual items consumed in a refit. There is no knowledge base on spare requirements/consumption for a system, so as to aid in formulation and revision of On Board and Base & Depot spares. Indian Naval Ship Maintenance Authority (INSMA) has lot of useful data collated from Defect and Repair Transaction (DART) returns received from ships, but its contribution to refit is minimal. That data is not being efficiently used for FCL generation or forecasting as there is no integration between INSMA and Integrated Logistics Management System.

6.5.1 Recommendation

All stocks in repair yards as well as OBS on ships should be transparently visible and available on system. It is recommended that actual consumption of spares for

a refit be recorded in a software system by extending ILMS to repair yards, which will record issues to a production center against a work order. It is also recommended that buffer stocks levels at repair yards, driven by perceived poor reliability of Material Organisations should be formalized and recorded on ILMS. Repair yards should define items required to be stocked at production centers and define MSL to be maintained. Physical verification and validation of ILMS system inventory and actual inventory in stores of moving items should be carried out with a view to eliminate duplicates.

6.6 Recommendations from Survey Respondents

6.6.1 Tri-services Joint Logistics is the Way Forward. The Standard Operating Procedure (SOP) for Joint Logistics Node, Mumbai has been covered in the literature review section. It may be seen that the services are moving towards joint logistics with setting up of the JLN, Mumbai. Presently, only three type of common use stores and two type of services are covered under JLN. Complete integration of logistics will never be possible, because the services operate different type of equipment. For example the Generators used on Ships are marinised versions having higher cost implication. A generator for land based use need not be marinised and therefore of lower cost. The spares may be common, however, procuring and stocking by a central agency will have its own drawback and long lead time.

6.6.2 Ranging and Scaling

Ranging and Scaling of On Board and Base & Depot Spares. A syndicate of officers undergoing Long Logistics & Management Course (LL&MC) at INS Hamla has undertaken a major research paper titled “Management of Onboard Spares and B&D for Newly Commissioned Ships and Review of Procedures for Introduction of Items in ILMS”. The syndicate has studied the procedure in great detail and come out with pertinent observations. The second area of concern as observed and studied by the syndicate was the present mechanism of Ranging and Scaling of OBS and B&D spares. Ranging and Scaling needs to be scientific as per parameters of INBR 622 Rev and facilitated by ILMS. B&D must be procured after studying worldwide sales pattern of the equipment and spares and must include a buy back offer by firm after certain period of review. The provisioning of OBS and B&D spares does not factor equipment maintenance hygiene and exploitation patterns. Exploitation patterns can be broadly arrived-at with commensurate Ops Costing. The biggest contributor is a disconnect between acquisition by Professional Directorates who do not cater for operation and maintenance requirements diligently. Ranging and Scaling and fixing of allowances to be integrated with ILMS by Professional Directorate. Initial OBS and B&D promulgation as well as the First Outfit Allowance List (FOAL) promulgated to be accurate and needs to be ratified. OBS and B&D spares, even if formulated correctly are not being provisioned adequately view adjustments made to cater for additional fitments/ weaponry etc. Accurate and diligent initial ranging and scaling for new inductions must be a priority area.

Using Artificial Intelligence (AI) based tools to predict range and scale of OBS and B&D spares for equipment already inducted in IN is also recommended.

6.6.2.1 Legacy Equipment. R&S in terms of legacy equipment is mainly being done on the basis of following:-

6.6.2.1.1 Technical manual considering scheduled routines.

6.6.2.1.2 Professional experience of Officers.

6.6.2.1.3 Consideration of Manufacturers Recommended List of Spares (MRLS).

6.6.2.3 Non-Legacy / New Equipment. The analysis of Project-15A has indicated ineffective R&S of OBS and B&D spares which is primarily because of heavy dependence on MRLS by professional directorates.

The syndicate has recommended that process of R&S be undertaken iaw INBR 622. The salient points to be adhered are as follows:-

6.6.2.4 Legacy Equipment. The R&S for an equipment which has been already procured by *IN*, is recommended to be undertaken as per data available from following sources:-

6.6.2.4.1 Ensure grouping of similar nature of equipment to ensure similar spares are not bought multiple times as OBS and B&D.

6.6.2.4.2 Demand & Consumption Pattern along with OPDEM/ STOREDEM data from ILMS to be considered for better forecasting of spares.

6.6.2.4.3 Inputs from INSMA wrt previous defects and routines on similar equipment to be considered at time of R&S.

6.6.2.5 **Non-Legacy/ New Equipment**. The R&S for new equipment is recommended to be undertaken as per data available from following sources:

6.6.2.5.1 Manufacturers Recommended List of Spares which are required to sustain the equipment for a specified period of time.

6.6.2.5.2 The quantity of B&D spares should be kept bare minimum. A provision to conclude RC/ RA to be explored.

6.6.2.5.3 Professional judgment of the individual officer should be utilised.

6.6.3 **Time Bound Inspections**

One of major factor contributing to procurement lead time in inspection related delays. Quality inspections should be made tighter and time bound with specifications, drawings and clarity on all other aspects available upfront at RFP stage for the bidders to prevent time loss / excuses later on. Self certification, with much longer guarantee period (say 03 yrs) to cut down on inspection delays. We can analyse cost benefit of increasing warranty guarantee of spares against the need of inspection. For example guarantee of 5 years and the firm bearing charges in case of damage of equipment if caused by the spare.

6.6.4 **Rate Contracts**

RCs can be concluded with OEMs for easy / time bound availability of required spares with price escalation formula. This is a practically implementable

suggestion and will significantly reduce procurement lead time. In case of rate contract there is no need for tendering and case can be straightaway processed for Acceptance of Necessity (AoN) and financial sanction. RC should be concluded by the central procurement agency. With the enhanced delegation of financial powers to Commands and lower formations it is anticipated that not many cases will be referred to IHQ. The focus can be shifted to concluding RC with all OEMs similarly to the RC with M/s ROCHEM for RO plant spares.

6.6.5 Vendor Managed Inventory

VMI has been adopted in almost all Material Organisations in some form or the other. Material Organization Extension Centre (MOXEN), Consumer Operated Lube Depot (COLD) and Bearing Bank are some examples of practical implementation of VMI. There is a need to bring more and more items under the ambit of VMI to reduce inventory holding and risk pooling. OEM managed inventory by having long term vision and focus on other aspects of inventory management e.g ICC + optimum utilisation of Store House Space.

6.6.6 Development of Sub-Vendors

As per the Deloitte 2021 Global Chief Procurement Officer (CPO) survey, around 70% of CPOs said they had good visibility into the risks that their direct (tier 1) suppliers posed. Only 26% of respondents could correctly identify risk inside their supply chains. Only 15% of respondents have access to tier 2 or higher. The COVID-19 pandemic underlined the need for a greater understanding of the end-to-end supply chain, as well as the dangers that exist outside of direct suppliers.

6.6.7 Total Asset Visibility

Total Assets Visibility is the need of the hour, also defects and rectification data must be considered as part of provisioning qty which is most important but not catered in present setup in ILMS. We must have one complete Enterprise Resource Package (ERP) system for all at par with IMMOLS of Air Force. The major reason for the non-availability of timely spares is the non-integration between Material Organisations, IN Ship Maintenance Authority, repair yards and Ship. Navy requires a common ERP integrating all these inputs. Having ERP linked to all stakeholders and catering for each event affecting allowance and urgent upgrade of ILMS is to be done. Equipment has to be the focus for E & SP Inventory management at MOs. Asset visibility onboard and with repair yards and utilisation/consumption of spares is the weakest link. There is a large quantity of spares lying unutilised in Dockyard that need to be brought into the system to get Total Asset Visibility. Pan-navy integrated system for all stakeholders for material and inventory management using a good contemporary ERP, coupled with strong VMI are the basic requirements to proceed ahead. Visibility of spares held at repair yards too needs to be catered and utilization of spares by Dockyards in refits/ ops ships should be linked to ILMS. Obtaining a new customised system with logistics supply chain practices of the commercial world are need of the hour. All SCM stakeholders should be in one ERP system. Towards this integration of all the different database management system being followed should be integrated to get TAV.

6.6.8 Standardisation of Equipment

The other means include standardisation of equipment's to increase redundancy within MOs, repair yards and ships. Rationalisation and standardisation of inventory should be given more impetus with an aim of achieving a lean mean inventory. For example PLA Navy introduced same type of ships in large numbers, which helped them in standardization, spare availability, reduce MSL of spares and much more. Similar thing was done by Maruti company with same common spares in multiple models.

6.6.9 Provisioning Quantity Formula

The existing PQ formula needs a relook and deliberation. Indian Air Force works on simple formula based on demands raised in last five years +/- POEV. In this context it is clarified that a syndicate of Officers undergoing Long Logistics & Management Course (LL&MC) has undertaken a major research paper titled "Data Analytics for Effective Material Management". The syndicate after detailed deliberations has suggested a new PQ formula, which is under staff evaluation at IHQ MoD (Navy). The review provisioning formula needs to be different for various types of inventory.

6.6.10 Role of Integrated Finance

The individual dependant response and efficiency of the office of IFA is one of the major causes of delays in the system. The IFA system, though effective has its own limitations like staff shortages and sheer volume of work. While Material Organisations at Mumbai and Vizag has co-located IFAs, Material Organisation (Kochi) does not have a co-located IFA leading to delays in

procurement do to physical movements of purchase files to IFA office at various stages of procurement.

6.6.11 Uniqueness of Inventory

Inventory management in Navy is dynamic due to the uniqueness of spares and opportunity cost. So the normal methodology of inventory management which corporate follows never fits Naval Inventory and we end up with SSS. A more intelligent version of managing Inventory with unique techniques incorporating data analytics is a need of the day. Provisioning also need a revamp, which cannot be executed in isolation rather need to be thought holistically with the induction of ship. Despite peculiar requirements and dynamics, the Navy logistics has more to learn from the best practices and latest technology in the relevant field available commercially as well as other sister government institutions.

6.6.12 Running Hour Based Kits

Running hour based routine and spare parts for the same to be accurately predicted by respective agencies. Running Hour Based Kit provisioning is strongly recommended.

6.6.13 Forecasting of Spares

What is lacking is efficient and accurate forecasting and inability to ensure delivery of the item to our depots within the injected Lead Time into the forecasting model. The inability of the procurer has to be factored by the planner by increasing quantities and pushing the indent ahead of time. The procurer needs to ensure delivery within the planners timelines.

6.7 Conclusion

In this dissertation, an effort has been made to analyze the existing inventory management system of the Indian Navy with a view to highlight the various lacunae and recommend steps for making the system more responsive. The various activities connected with material logistics have been discussed to determine the weaknesses of the system and to suggest remedial measures. Some of these measures are in house and can be adapted to fine tune the existing system. The practices followed by extraneous organizations especially the United States Defense Logistics Agency have been studied in depth and recommended for implementation.

All operations these days involve gigantic effort than ever before. The existing logistic support system in the Navy is a fragmented approach and leads to sub-optimal utilization of resources and duplication of effort. In order to utilize the logistics resources in a more rational and optimum manner, it is desirable to integrate all logistics elements on a functional basis. A study of logistic support systems of the major world military powers reveals that they have gone in for total integration of their logistics support systems. An analysis of the Gulf war indicates that the operation of this magnitude could not have been successful without an integrated logistics system being in place that did sourcing of phenomenal volumes of war material from the world over. The magnitude of future war effort, the cost of modern equipment and its maintenance all through its life cycle, are all increasing day by day.

Total ownership cost today is replacing acquisition costs as the main parameter in induction decisions. Acquisition costs are only a tip of the iceberg in the life cycle of the

equipment. Whole life costs also include operations cost, maintenance costs, training costs, supply support costs, retirement and disposal costs. In the traditional method of logistics support practiced in the Indian Navy today we are concerned with only the acquisition and maintenance costs, which is a small element of the life cycle cost of equipment inducted into the services.

All the trends in providing effective logistics support in the advanced Navies are moving towards integration of all aspects of system acquisitions and operations. The emphasis is on reducing the total ownership costs, adopting the best business practices, using information technology for better results and last but not the least making all elements of the system including the use of civil industry work towards the common objective of achieving the designated purpose. Going by the evident success of these methods when compared to the level of customer satisfaction provided by existing system, it is time we changed over to the system of Life Cycle Logistics and Performance Based Logistics.

6.8 Scope / Limitations / De-limitations

A limitation in information due to topic being specific to inventory management in Indian Navy was a major impediment towards completion of the study. However, because of the limited time available, the study has mainly been limited to primary data generated through survey questionnaire and secondary data in the form of case studies on global best practices. Despite its small size, the sample can be regarded representational of the population. As a result, research findings can be generalized and research recommendations can be adopted in the field of research. The restrictions on travel and interactions imposed by COVID 19 must also be taken into account.

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INVENTORY MANAGEMENT OF EQUIPMENT & SPARES PARTS IN
INDIAN NAVY- ISSUES AND SUGGESTIONS

Dear Sir/Madam,

As part of the 47th Advanced Professional Programme in Public Administration conducted by Indian Institute of Public Administration, New Delhi a dissertation on the subject "Inventory Management of Equipment & Spare Parts in Indian Navy - Issues and Suggestions" is being undertaken by me. This survey questionnaire is being forwarded for collection of responses for the dissertation. The survey will be confidential and data collected will only be used for research purpose. Your valuable responses will be useful for completion of the dissertation.

Captain Hari K Nair

47th APPPA

Mobile : 8304070056

1. Please indicate your Rank. *

Rear Admiral

Cmde

Capt

Cdr

Lt Cdr

Lt

Others

2. Please indicate total length of your Service. *

Less than 5 Years

5-10 Years

11-15 Years

15-22 Years

More than 22 Years

3. Please indicate your Branch.

Executive

Technical

Logistics

Others

4. To what extent do you agree that the Equipment & Spare Parts inventory management methodology of Indian Navy fully meets its Operational & Equipment Maintenance requirements? *

Strongly Disagree

Disagree

Neutral

Agree

Strongly Agree

Cant say

5. To what extent do you agree that Spares forecast by stakeholders (Ship Staff & Repair Yards) are close to precise? *

Strongly Disagree

Disagree

Neutral

Agree

Strongly Agree

Cant say

6. To what extent do you agree that critical Spares for Refits & Running Hour based Routines are always available within required timelines? *

Strongly disagree

Disagree

Neutral

Agree

Strongly Agree

Cant say

7. The present Integrated Logistics Management System has outlived its utility and needs upgrade?

Strongly disagree

Disagree

Neutral

Agree

Strongly Agree

Cant say

8. To what extent do you agree that integration of ILMS and IN Ship Maintenance Authority databases will improve quality of spares forecast?

Strongly disagree

Disagree

Neutral

Agree

Strongly Agree

Cant say

9. To what extent do you agree that Logistics Management System of Indian Navy is integrated in the real sense?

Strongly disagree

Disagree

Neutral

Agree

Strongly Agree

Cant say

10. On the scale of 1 to 5, rank the factors which lead to generation of Serviceable Surplus Inventory (1 being the least affecting and 5 being the most affecting). Please don't select more than one response per column.

	1	2	3	4	5
Base & Depot spares provisioning					
Obsolete spares					
Serviceable spares from de-commissioned ship					
Provisioning Quantity formula					
Over projection by users					

11. On the scale of 1 to 5, rank the best practices that can be imbibed to improve the responsiveness of Logistics Supply chain (1 being the least affecting and 5 being the most affecting). Please don't select more than one response per column.

	1	2	3	4	5
BARCODING					
RFID tagging					
Running Hour based Kit procurement					
Commercial ERP with customisation					
Storehouse Automation					

12. On the scale of 1 to 5, rank the factors that affect the responsiveness of Logistics Supply chain (1 being the least affecting and 5 being the most affecting). Please don't select more than one response per column.

	1	2	3	4	5
Procurement procedures in vogue					
Non-availability of Integrated Financial Advisor					
Insufficient delegation of financial powers					
Insufficient budget vis a vis expectations					
Inspection related delays					

13. Is there a requirement to make Stocktaking Process more 'Accurate' and 'Effective' to avoid last minute embarrassment of non availability in the warehouse even though the system records indicate availability?

Strongly Disagree

Disagree

Neutral

Agree

Strongly Agree

Cant say

14. Do you think that there is Total Asset Visibility in the present Equipment & Spare Parts inventory management methodology?

Strongly Disagree

Disagree

Neutral

Agree

Strongly Agree

Cant say

15. Do you think that the review formula used for forecasting inventory requirement fits all types of spares?

Strongly Disagree

Disagree

Neutral

Agree

Strongly Agree

Cant say

16. Do you think the initial ranging and scaling of equipment and spares adequately caters for lifecycle management?

Strongly Disagree

Disagree

Neutral

Agree

Strongly Agree

Cant say

17. If the provisioning of On Board Spares (OBS) and Base & Depot (B&D) spares should cater for one and five years requirement respectively, do you think the OBS and B&D lists are being correctly formulated?

Strongly Disagree

Disagree

Neutral

Agree

Strongly Agree

Cant say

18. Any other suggestions?
