Re-imagining MRO for Defence: Realistically Leveraging Technology

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Abstract

Maintenance, Repair, and Overhaul (MRO) set up in the Indian Defence Forces is responsible for rendering engineering support to the widest possible inventory of military weapon systems/platforms/ equipment with multidisciplinary state-of-the-art technologies, albeit on an individual Service basis. Over the years, there has been limited modernisation and automation while the systems and processes have largely remained static. In future, apart from the shortage of assemblies/ modules/spares for equipment of foreign origin, the system is likely to face even greater challenges with higher resource constraints on the horizon. In order to retain/enhance the existing levels of Equipment Readiness and Mission Reliability, it is felt that re-imagining/total restructuring of the MRO set up will be required.

Introduction

Over the last two decades, militaries the world over have been swept over by the Revolution in Military Affairs (RMA), predicated by the rapid advances in technology which have altered the Doctrines and Tactics of war fighting. The transformation has gathered further steam with the lessons learnt from more than a year-old Russia – Ukraine conflict. Technology has also led to 'Revolution in Logistics' involving supply chains and military inventories. However, a generation of technology has passed by (at least two decades or 'Techades') without touching the military Maintenance, Repair, and Overhaul (MRO), at least in the Indian context. The only change has been manpower optimisation (there have been several rounds) with an objective to improve the teeth

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to tail ratio. Even the Committee of Experts (Shekatkar Committee) has ended up only optimising manpower with its recommendations on Corporatisation yet to gain traction. The in-house initiatives for modernisation and technology insertion in repair/overhaul set up haven't found adequate support. Although, all appears well on the equipment availability front in defence, the professionals know that the problems of MRO are getting exacerbated and will now need to be tackled on a war footing if the defence forces have to achieve equipment readiness desired for operations. The urgency also stems from a couple of major triggers which have emerged over the last few years, which when analysed will make it clear that now is the time for transformative changes in MRO, incremental changes will not suffice.

Triggers for Transformative Changes in MRO for Defence

The first impulse for a transformative change in MRO is the Defence Budget itself. While in absolute figures, the Defence Budget keeps hitting new highs every year, yet as a percentage of GDP, it is in a secular decline over the last two decades or more. From a figure of 3.5 per cent of GDP, once upon a time in the eighties, it is down to almost 1.4 per cent of GDP (excluding pensions). Defence allocation in the latest Union Budget 2023-24 marks a paltry1.5 per cent increase from Revised Estimates (RE) 2022-23 figures.[1] It implies that in real terms, lower financial resources are available for defence and that the Capital Budget needs a fillip. The govt is now aptly focusing on modernisation of the Forces, increasing the Capital expenditure while limiting the Revenue Budget. The corollary of an increase in Capital Budget in a largely stagnant Defence Budget (real value after inflation) is a reducing Revenue Budget, which will compress the resources available for operational maintenance of the Forces. This is borne out by an increase of just 3.76 per cent[2] in Revenue head of Defence Budget 2023-24 over RE 2022-23, not sufficient to even cover inflation. The salaries component of Revenue Budget being rather inelastic and by itself contributing to almost 10 per cent annual increase, based on additional Dearness Allowance (DA) granted by the govt, the brunt will obviously be borne by the budget allocated for MRO (stores and repairs), impinging adversely on procurement of requisite spares, components, and assemblies. With likelihood of continuously declining availability of financial resources, foreseeable in future for MRO, a complete re-think on the MRO set up is

imperative now so that 'war like equipment readiness of forces' is not compromised.

The next trigger for requirement of a transformative change is the *Agnipath* scheme of recruitment introduced by the govt for the Defence Forces in June 2022. The number of *Agniveers* to be recruited in the balance six months of year 2022 was 46000.[3] Thus, on an annual basis, the intake of *Agniveers* for the three Services becomes 92000. After completion of four years of service, "Up to 25 per cent of each specific batch of *Agniveers* will be enrolled in regular cadre of the Armed Forces".[4] The held strength of the armed forces, uniformed personnel excluding officers, in year 2019 (pre Covid) was 13,72,666, while armed forces recruits under training were 74575.[5] With the *Agnipath* scheme likely to recruit 92,000 *Agniveers* annually, after four years, only 23000 will become regular Sepoys/equivalent on an annual basis. This is a much lower number than the annual intake number of regular Sepoys/equivalent hitherto fore and will have an impact on the overall strength of the defence forces. It is estimated, as per a quantitative model developed for *Agnipath* scheme, that unless there is an increase in annual intake of *Agniveers* in future (i.e., higher than 92000) or the retention percentage is enhanced from existing 25 per cent, there will be a gradual reduction in the overall strength of the Forces. As per the current intake and retention parameters, this force optimisation will stabilise after 20 years and the combined strength of defence forces in 2046 will be approximately 40 per cent of the existing strength (see Appendix at the end). Whatever be optimisation level of the Forces over next two decades, it is reasonable to infer that manpower engaged in MRO will also get pared proportionally. The moot question is that can the existing setup of MRO function effectively with drastically reduced manpower but an ever-increasing repertoire of weapon systems and equipment, or will it require a total rethink to be future ready?

Together, the significant cuts in MRO budget, foreseeable as of now, as well as reduction in MRO manpower present a challenge which appears insurmountable unless it is accompanied with transformative changes in the MRO domain. The existing set up has to be discarded/totally reengineered and a new construct, a new lean and mean structure, tailored to the needs of Defence 2050 has to be imagined and gradually implemented over next 20

years. Technology insertion in military MRO for ensuring a resource efficient system will be a *sine qua non*; however, it has to be planned realistically as cutting edge technology involves heavy upfront costs which the govt, unlike the private sector, cannot afford, given the budgetary limitations.

Reimagining the MRO System

The existing legacy MRO system in Defence is characterised by an echeloned system, manpower intensive nature, limited automation, little modernisation, inadequate overhaul capability with perennial shortages of requisite spares/assemblies/modules. With the fresh major constraints now getting placed on the system, it will have to be totally restructured, if the otherwise inevitable deterioration in overall Equipment Readiness of the Forces in future has to be checked. In such a scenario, where technical manpower resources availability in future may halve and MRO budget compressed, the Theory of Constraints makes it imperative that an altogether new MRO system is designed around the twin constraints as incremental changes are no longer adequate. Accordingly, ten tenets of the new system have been formulated, and are briefly enumerated below:

- **Separate Tri-Service MRO Computer Network.** Automation is the key when any organisation has to do more with less manpower. A pan India, secure, tri-Service MRO network is going to be the backbone of the new system. It is proposed for war like equipment only; civil end-use items like vehicles can be excluded so that the focus is firmly on readiness of war fighting assets. The tri-Services character will assist in pooling skills, infrastructure, and capacities for equipment used by more than one service, such as helicopters, small arms, air defence and communication equipment etc. The network can be suitably segmented into separate Services and further into equipment verticals, organised into Units/ Regiments on War Establishment. A secure system is of paramount importance and a distributed database with block chain technology with top-of-the-line crypto algorithms like RSA need to be employed.

- **War Like Equipment Centric System.** The MRO system will be centred around war like equipment; 'Equipment Readiness' will be the *mantra* and optimum 'Mission Reliability'

will be the objective. Each equipment will have a designated operator whose bounden duty it will be to key in the equipment status into the MRO network on a daily/status change basis. The formation repair echelons will also be hooked on the network. Thus, commanders at all levels will be able to monitor the 'Mission Capable' status of each of their war like equipment in their jurisdiction. At the central level, there will be an Analytics Module hooked on to MRO network and a specialist Analytics Team which will keep a tab on equipment readiness and mission reliability of various category of equipment. They will be responsible for pre-empting problem areas and tendering advise to senior commanders.

- **Collapsing the MRO Echelons.** The existing four echelons of repair, i.e., light, field, base, and Factory Repairs corresponding to 'O', 'I', 'D' and 'FR', have stood the test of time but in the drastically altered scenario of severely compressed availability of resources, the MRO echelons also need to be collapsed. Accordingly, the 'O' level will no longer be manned by equipment specialists; with more tech savvy soldiers being inducted and retained through the *Agnipath* scheme, it will be possible to finally implement the User Repair Concept. Thus, effectively, there will be only two echelons of repair 'I' and 'D'/'FR'. For any assistance required in repairs, the operator of the equipment will be able to reach out to the equipment specialists on a help line riding on the MRO network and utilise remote diagnostics. For training on any new modifications/technicalities, there will be provision for Extended Reality (Virtual and Augmented) modules, Artificial Intelligence (AI) based chat bots and digital twins for major equipment.

- **Minimal Move of Equipment for Field/'I' Level Repairs.**The new system will be designed to be 'Equipment Centric'. In a major departure from the existing system, it is envisaged that war like equipment does not move for 'I' level repairs, but in-situation 'Repair Teams'move for the job. It is anticipated that this system will be more cost effective, enable focused use of equipment specialists and have higher user satisfaction. The only exception is when the equipment requires special infrastructure (i.e., clean rooms, jigs and fixtures etc.), in which case the equipment is transported to the nearest

Equipment Specialist Workshop/Facility. For 'D' level repairs/ overhaul, the existing system continues.

- **Pool of Equipment Specialists.** The Formation Engineering Support Units will hold a pool of equipment specialists as per the formation equipment profile. They will be responsible for in-situ repairs as also repairs of equipment transported to the Engineering Support Unit. In case of shortfall of this manpower during peace time functioning, equipment specialists from neighbouring or higher echelons will be summoned. However, during operations, the formation affiliations of this manpower will be ensured.

- **Greenfield Private Sector Projects for Augmenting Capability of 'D' Level.** There is a need to ensure that there is no backlog of Recapitalisation of major war fighting equipment which has a direct bearing on combat potential of the Forces. In the simplest analysis, the national capability for 'D' level repair needs to be enhanced since the existing tri-Services set ups cannot liquidate the backlog with existing capacities, even if requisite assemblies/modules are made available. The defence Public Sector Undertakings (PSUs) also have their capacity and resource constraints. Financial crunch prevents expansion of capacities of this Defence Industrial Complex in the govt sector; thus, the only rational alternative is to encourage private industry to establish greenfield projects in order to augment national capacity of 'D' level repairs/Recapitalisation in various equipment domains. Although, the industry does not have any ready expertise in overhaul of complex weapon systems and platforms, yet, they have the flexibility of speedily entering into collaboration with foreign Original Equipment Manufacturers (OEMs) for training, technology transfer, and procurement of requisite spares. Ultimately, the aim should be to have a healthy mix of intrinsic in-house defence capability and private sector enterprise so that under no circumstances, war time requirements are compromised while ensuring most efficient utilisation of limited financial resources.

- **Manufacture/Indigenisation of Spares/Modules by Private Industry.** Availability of components of weapons/equipment of foreign origin is a major constraint in existing capacity

utilisation. The defence PSUs, responsible for supply of such spares, have developed a vendor eco-system, in addition to their intrinsic capacities, but are still unable to meet the demand. Still, many items have to be imported which causes outgo of foreign exchange as well as time penalty. In recent years, govt has encouraged private sector and Micro, Small and Medium Enterprises (MSMEs) to meet the shortfall. However, for giving a mega boost to indigenisation and manufacture of such assemblies/modules, much more needs to be done, including separate procedures in the Defence Acquisition System, especially for revenue procurements. This, by itself, merits separate detailed deliberations.

- **Modernisation of MRO Infrastructure.** Repeated attempts in the past to modernise the MRO infrastructure have met with limited success due to the resource crunch and the consequent lower priority being accorded. However, it needs to be realised that, beyond a point, antiquated set up has an adverse impact on output as well as quality and is counter-productive. The argument is only for outcome-based modernisation of MRO infrastructure in the initial phase and not straightaway aiming for the latest technology like ubiquitous IoT based sensors and AI for predictive maintenance, which has very high upfront costs for pan India deployment which the govt can ill afford. For the same reason, even introduction of Enterprise Resource Planning (ERP) based systems may be planned for subsequent phases while the MRO system is hooked on a tri-Service network with central analytics, as outlined earlier.

- **Inventory Support by Logisticians.** While the three Services have made progress in recent years in computerising the inventory control systems, the same need to be reconfigured in consonance with the tenets of the new MRO system. Primarily, there has to be a paradigm shift in three dimensions. Firstly, change to a Push System, shifting the onus of delivery, wherein, the requisite items, based on a demand originating from computerised network, are delivered directly to the Air Base/Ship/Unit or at least the Formation HQ in case of far-flung deployment. Secondly, the speed of delivery for at least the critical items, which are available, could be fixed, say 48 hours (except remote areas), using all available means of

conveyance (including private couriers) and drones.And, thirdly, the supply chains have to be configured for non-linear, non-hierarchical modes of operation based on the most economic model. Given these three terms of reference, the logisticians should be asked to propose a reorganised warehousing and inventory control system, which will feed the new MRO system. The implementation of this reorganised set-up can run concurrently with the execution of the transformed MRO system and planned to be completed within a decade.

- **Establishment of MRO Hubs for 'D' Level and Factory Repairs.** For all major weapon systems/equipment/rotables with state-of-the-art propriety technology, tri- Service MRO hubs for 'D' level/'FR' need to be established. The planning should be an integral part of Defence Acquisition Procedure, the objective being to eliminate need for sending the items to foreign OEM, reduce expenditure and turnaround time, fill the engineering voids, and give a fillip to technology transfer. The tri-Services nature, whenever applicable, will help economies of scale and efficient use of resources. These hubs can be established by foreign OEMs (propriety technology for major equipment), DPSUs, or private industry for respective equipment. They may even be established by DPSUs or private sector in collaboration with foreign OEM.

Way Forward

The significant impending compression of financial and manpower resources for the defence MRO vertical will be a double whammy for the 'equipment readiness' and 'mission reliability' of weapon systems/equipment. The prognosis is quite evident; if the present levels of equipment readiness have to be sustained, existing MRO system has to be totally revamped/transformed. The re-imagined system has to leverage technologyrealistically to reduce MRO operational costs significantly, while limiting the upfront financial outgo. Automation at all levels will enable frugal utilisation of human resources and the new collapsed echelon MRO system will be able to adapt to drastic reduction in available technical manpower. The system has to be 'Equipment Centric', emphasise minimal move of weapon systems and maximum in-situ repairs. The tri-Service nature will pool human and technical resources, while

private sector should augment the capacities of govt Defence Industrial Complex. The logisticians will have to simultaneously evolve an efficient warehousing and inventory supply system, conforming to the rigours of the new system.

There is a requirement of constituting a committee of MRO Subject Matter Experts in defence, which has to define the broad contours of this new MRO system re-imagined on the terms of reference of overall drastic reduction in resources over next two decades, while retaining/enhancing existing 'equipment readiness' and 'missionreliability' levels. The Committee could co-opt a suitable civili MRO automation expert while being tasked to formulate an implementation roadmap over next two decades. Almost simultaneously, there will be a requirement of constituting another committee of logisticians for designing a new Warehousing and Inventory Supply Chain, which will support this new MRO system. The Committee will have a MRO Subject Matter Expert and be tasked to evolve an automated system based on 'Push Model'and 48 hours spares delivery. It is envisaged that with the successful implementation of these transformative changes, archaic systems and procedures will be finally laid to rest and a new lean and mean organisation will emerge towards MRO Defence 2050.

Appendix

FORCES STRENGTH: *AGNIPATH* SCHEME (Simplified Quantitative Model)

75:25 Scheme

For modelling this scheme (strength excluding officers), the following assumptions are made:

- *Agniveers*, selected after 4 years, (25 per cent) will serve for another 20 years as NCOs/OtherRanks.
- Thereafter, they will retire if not already promoted to the rank of a JCO.
- The number of *Agniveers* recruited annually is '**A**'.

Year	Number of *Agniveers* (a) (b) (a) + (b)	Numbers Retained after 4 Years	Total
1	A	0	A
2	2A	0	2A
4	4A	0	4A

After initial 4 years of *Agnipath* Scheme

Year	Number of *Agniveers*	Numbers Retained after 4 Years	Total
1	4A	A/4	17A/4
2	4A	2A/4	18A/4
16	4A	16A/4	32A/4
20	4A	20A/4	36A/4
21	4A	20A/4	36A/4

It is evident that the scheme matures (numbers stabilise) after 4+20 years (year 2046 approx). The total strength of soldiers (NCOs/OR) can be computed by assigning different values to A.

A	Strength in 2042-43 (4+16)	Strength in 2046-47 (4+20)
92000	**32A/436A/4**	
	7.36 Lakh	8.28 Lakh* (remarks below)

*Strength includes all *Agniveers* till 4 years of service and JCOs/OR of *Agnipath* scheme, 20 years of service and below.

The soldier's strength (pre *Agnipath*) is in addition. But, by year 2046, overwhelming majority of them would have retired after rendering colour service and, hence, not added to the strength of 8.28 Lakh.

Endnotes

[1] Based on figures from Page 9, Serial 19-22, Demand for Grants 2023-24

[2] Analysis of figures from from Page 9, Serial 20, Demand for Grants 2023-24

[3] In a transformative reform, Cabinet clears 'AGNIPATH' scheme for recruitment of youth in the Armed Forces https://pib.gov.in/Press Release Page.aspx?PRID=1833747

[4] ibid

[5] Estimating India's Defence Manpowerhttps://idsa.in/issuebrief/estimating-indias-defence-manpower-040820